A STUDY OF CERTAIN FACTORS WHICH AFFECT THE OPINIONS OF ELEMENTARY SCHOOL TEACHERS IN THE TEACHING OF SCIENCE

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Figure Page

Figure Page

CHAPTER I

NATURE OF THE PROBLEM

Introduction

The teaching of science in the elementary school began more than one hundred years ago. Yet it is within the past decade only that the method and the quality of the teaching of science in the elementary school have become a major concern. Elementary school science today is entering a nationwide movement of reappraisal and change. The basic cause of this movement is the fantastic growth of scientific knowledge and its impact on human life.

Since the early 1940's scientists and science educators have been aware of the need for a reorientation of science teaching at all levels of our educational system. There was little evidence of modification until recent technological advances acted as a powerful catalyst in arousing interest in the present and future needs for highly trained scientists and citizens who are scientifically literate. As a result, the federal government and various types of foundation grants have provided financial support to develop modern courses in science at all levels of our educational system.

In the earlier years, science in the elementary school emphasized nature study. Objects were collected, identified, displayed, observed and talked about. Incidental activities made up the larger part of science learning experiences. Little or no curricular design prevailed,

and few schools made sufficient effort to teach science.

Modern science is concerned with more than just the new knowledge that has been acquired in science. The content of the curricular materials has been broadened and more emphasis is being placed on the physical and earth sciences. New methods of problem solving and scientific inquiry are being stressed. Modern teaching equipment and materials are being developed. Providing first hand experiences to the young children through the laboratory is being emphasized.

The development and implementation of such programs must be carefully planned, energetically implemented and adequately supported financially. Time, facilities and equipment must be provided. But the most essential factor in such programs is the need for teachers who have adequate preparation for teaching science in elementary schools. No program can be successful unless teachers are competent and willing to carry the program through.

Hopman reported her view of the teacher's effect on the curriculum as follows:

> One of the premises set forth earlier was that curriculum change is primarily change in people. The teacher is the key curriculum planner and the key agent for change. The attitudes, perceptions, understandings, and skills of teachers influence quality of teaching more than any other factor.[1]

General Background and Need for the Study

The responsibilities of the elementary teacher are unique in the

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[1]Ann B. Hopman, "Effecting Changes in the Elementary Science Curriculum of a School System," Science Education, Vol. 48, No. 2, (March, 1964), p. 104.

teaching profession. Elementary teachers are required to be specialists in all areas of the curriculum, in the problems and the nature of the learning processes of the young child, and in the development of social behavior and citizenship. There is no other level in the teaching profession that requires an individual to specialize in so many areas. The requirements for elementary teachers necessitate such a broad preparation that many teachers believe they are not adequately prepared for teaching science.

This inadequacy of preparation is also borne out in the literature related to the teaching of science in the elementary school. Smith and Anderson[2] and Bryant[3] have stated that the science preparation of elementary teachers in general is not adequate to do the kind of teaching that they desire and need to do.

The literature also indicates that elementary teachers feel insecure in teaching science, have fears of teaching science, or that they are reluctant to teach science, feelings which apparently are caused by inadequate preparation.

Simmons, in a report of the growing responsibility of teacher education institutions for preparing elementary teachers, states:

> ...while most teachers have sufficient certification for teaching in the elementary schools, too few have had the kind of training that would give them security in teaching science.[4]

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[2]Herbert A. Smith and Kenneth E. Anderson, Encyclopedia of Educational Research, 3rd Ed., New York: The Macmillan Company, 1960. p. 1228.

[3]Paul Payne Bryant, "Science Understandings Considered Important for Children and the Science Required of Elementary Teachers," (unpub. doctoral dissertation, George Peabody College for Teachers, 1959), pp. 270-9.

[4]R. H. Simmons, "Elementary Science a New Discipline and Growing Responsibility of the Teacher Training College," Science Education, Vol. 43, No. 4, (October, 1959), p. 338.

Washton reported that of 100 teachers taking a graduate course of science in the elementary school, sixty-three had less than the equivalent knowledge of science possessed by ninth-graders. He concluded that most elementary school teachers dislike science and are afraid to teach it to their pupils since they have little confidence in handling and manipulating science materials. He further stated:

> Previous studies and current interviews with elementary school teachers indicate that there is a need for these teachers to overcome the fear of learning science and to develop positive attitudes that will help them master the teaching of scientific knowledge, skills, and attitudes to children.[5]

Mallison in a report of the research in the elementary school science program remarked:

> The vast majority of the studies in this field point to the discouraging fact that most elementary-school teachers have had little or no training in science; the training that they do possess is of little value in their work with elementary school children; and, as a result of their lack of training, they "shy away" from teaching science.[6]

She further indicated that since the facts mentioned above are now well established, future studies should focus attention on the things that can be done to alleviate the existing situation.

Wytiaz emphasized that little has been done in the area of teacher attitudes or their feelings of competency in science. She commented:

> Since the teacher plays a vital role in the lives of the children in her classroom, it is important that she have a favorable attitude toward science. The future of science lies in the hands of those

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[5]Nathan S. Washton, "Improving Elementary Teacher Education In Science," Science Education, Vol. 45, No. 1, (February, 1961), p. 33.

[6]Jacqueline Buck Mallinson, "What Research in Science Education is Needed to Strengthen the Elementary-School Science Program?" Science Education, Vol. 40, No. 5, (December, 1956), p. 371.

> children in the schools today. As a result, it is imperative that the classrooms have teachers that will develop in these children an enthusiasm for science. Needless to say, enthusiasm for science does not come from a person that feels inadequate.[7]

Many other studies have shown similar results. If such research is correct, then a need for improvement in teacher preparation is indicated. First, some investigation should be made to determine and describe the opinions that the elementary teachers themselves have concerning certain factors about science and science teaching at the elementary school level. Second, some investigation should be made to determine the opinions that the elementary teachers have concerning the contributions that their preparation has made and should make toward teacher competency. Thirdly, some investigation should be made to determine if there are differences in the opinions expressed by elementary teachers in different teaching situations.

This information then could be used to provide a basis for determining what could be done to alleviate existing situations.

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[7] Patricia Lorraine Wytiaz, "A Study of the Attitudes of Fifth-Grade Teachers of Cumberland County New Jersey Toward Science and Their Preparation for Teaching it in the Elementary School," Science Education, Vol. 46, No. 2, (March, 1962), p. 151.

CHAPTER II

SELECTED REVIEW OF THE LITERATURE

If the assumption is valid that classroom teachers can arouse interest in and influence students on the importance of certain subject matter areas, then the personalities and opinions of teachers are important in plans to encourage the study of science. MacCurdy, in a study in 1960, reports that teachers today are exerting a stronger influence on the interest of elementary school children than ever before.[8]

Zafforoni, in a study of pupil-teacher interaction, strengthens the conviction that the role assumed by the teacher is the important determinant in the general procedures developed and evolved in a classroom. He reports that the potentiality of the group and the pattern of interaction are curcially dependent on the capability and, in a sense, the sensitivity of the teacher.[9]

The role of the teacher then becomes paramount when considering the present and the future programs of science in the elementary school. However, in attending professional meetings and reading the reports from professional meetings, one is confronted with the statement that elementary teachers are reluctant to teach science.

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[8] Robert D. MacCurdy, "Science Interest Grows," Science Education, Vol. 44, No. 5, (December, 1960), pp. 401-7.

[9] Joe Zafforoni, "A Study of Pupil-Teacher Interaction in Planning Science Experiences," (unpub. doctoral dissertation, Columbia University, 1960), p. 279.

Evidence of Reluctance to Teach Science

In the preceding chapter, reports by Simmons, Washton, Mallinson, and Wytiaz indicate that many elementary teachers feel insecure in teaching science, have fears of teaching science, or that they are reluctant to teach science. These reports alone would indicate cause for concern, but the literature is filled with such reports.

The feelings that many elementary teachers have concerning the teaching of science may result in their not teaching science or in their teaching science in ways that are not consistent with modern views of science teaching.

Dubins tended to confirm this in making the following comments:

> Many localities do not teach science in the elementary school. ...activity towards improving science instruction in the elementary school is now in motion. The action is proportionate to the size of the school district. Many localities reported that they were starting to teach science in the elementary school. Other localities reported the holding of workshops and conferences in order to properly initiate a program. It is true that the activity is not on a large scale, but elementary science is not dormant either.[10]

Eiss emphasized the actual methods employed in the teaching of science in the elementary school in contrast with modern theories in science methodology in the following statement:

> Many elementary teachers are poorly prepared and afraid to teach science. This has resulted in a textbook centered curriculum, at its worst only a course in reading.[11]

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[10] M. Ira Dubins, "A Geographical View of What is Being Done to Improve Elementary Science Instruction in the United States," Science Education, Vol. 43, No. 4, (October, 1959), p. 327.

[11] Albert F. Eiss, "New Techniques in Science Instruction in the Elementary Schools," Science Education, Vol. 46, No. 2, (March, 1962), p. 172.

The reluctance of elementary teachers was stated another way by Gemmill:

> Among the pressing needs of elementary education today is one for a functional course in science. Some states have such a program but many teachers are afraid to attempt it.[12]

Maddux tended to confirm the reluctance when she reported that in visitations to 114 elementary schools in Ohio she sensed a feeling of insecurity among the teachers concerning the teaching of science.[13]

Victor indicated that there is a reluctance of many elementary teachers to teach science. He implies that the reluctance is not new as its existence has been acknowledged by the literature for some time.[14]

These studies indicate that there is indeed cause for concern if many elementary teachers are reluctant to teach science. However, the investigator has found through personal contacts with many elementary teachers that they have expressed the opinion that they were not reluctant to teach science and they were teaching science. This seems to indicate that additional research might provide more recent information concerning this problem.

If there is a reluctance of many elementary teachers to teach science, what then are the basic factors which would cause this reluctance? Victor reported the following:

The most common reason offered for this reluctance to teach science

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[12]Anna M. Gemmill, "Elementary Science Education," Science Education, Vol. 33, No. 4 (October, 1949), p. 282.

[13]Grace Maddux, "Helping the Elementary School Teachers," School Science and Mathematics, Vol. 49, No. 433, (October, 1949), pp. 534-7.

[14]Edward Victor, "Why Are Our Elementary School Teachers Reluctant to Teach Science?" Science Education, Vol. 46, No. 2, (March, 1962), pp. 185-92.

> is the inadequate science background of elementary teachers. This reason seems to be so logical and so widely accepted, that comparatively little research has been done to confirm it as a definite and valid factor.[15]

Evidence of Inadequate Pre-Service Education

As early as 1931, a Committee on the Teaching of Science, appointed by the National Society for the Study of Education, conducted a study in order to establish a plan for the reorganization of science teaching. The report of their findings and a plan for reorganization of science teaching was presented in the Committee's report, the Thirty-First Yearbook, A Program for Teaching Science. The findings of the study indicate that there were relatively few courses provided by the colleges that would prepare elementary teachers for teaching science. The courses that were provided gave little or no sequence between courses. The committee recommended that elementary teachers should take eight hours of a course that would be organized around generalizations and principles of science that relate to the needs and interest of liberally educated people. In addition they should take an introductory course in one special science, a professional course in elementary science and take electives in science to total twenty-eight hours.[16]

In 1946, the Committee on Science, reporting in the Forty-Sixth Yearbook of the National Society for the Study of Education, made specific recommendations for preparing elementary teachers to teach science. They recommended that three six-semester-hour courses be provided. One of

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[15] Victor, p. 186.

[16] National Society for the Study of Education, Thirty-First Yearbook, A Program for Teaching Science, Part I, Chicago: Distributed by the University of Chicago Press, 1932, pp. 1-37.

these courses was recommended to provide for laboratory and field work. It was also recommended that a special methods course for the teaching of elementary school science should be provided which should follow the basic content of the science courses.[17]

These two major research studies served as standards for comparison of what was being done to prepare elementary teachers for the teaching of science. As a result of the recommendations from these two committees, countless surveys and studies have been conducted in an effort to improve the science preparation of elementary school teachers.

In 1949, Maddux investigated the preparation of elementary teachers to teach science in Ohio. Of 145 respondents to a questionnaire, thirty-two had no science courses, and the remaining had from one to eight courses in science. The greater number of respondents had courses on the lower end of the scale.[18]

Snyder collected information from sixty state colleges whose primary function was teacher education. He found the average number of hours required to be 13.6 quarter hours. He suggested that prospective elementary school teachers be required to take thirty quarter hours composed of biological and physical science and be required to take a science methods course.[19]

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[17]National Society for the Study of Education, Forty-Sixth Yearbook, Science Education in American Schools, Part I, Chicago: Distributed by the University of Chicago Press, 1947. pp. 1-46.

[18]Maddux, p. 537.

[19]Ernest E. Snyder, "College Degree Requirements for Teachers of Elementary Science," Science Education, Vol. 34, No. 1, (February, 1950), pp. 30-1.

In 1955, Chamberlain also sought to determine the status of teacher education in elementary science. He sent a questionnaire to teachers in which he asked the teachers to evaluate their college science courses. These teachers felt that science courses were helpful, but they could not indicate a qualified faculty in the colleges. They emphasized a lack of sympathy between the education department and the science departments. Of 765 accredited colleges which educate elementary teachers, 442 listed courses in elementary science in their catalogs. The median of semester hours was three for such courses, and approximately nine hours of science background were required. He concluded that the trend is toward inclusion of more academic science and also more professionalized science in educating elementary school teachers.[20]

Gega investigated the relationship between reported problems in teaching science in the elementary school and elementary school science courses in California teacher education institutions. The teacher education institutions showed considerable differences in their offerings, requirements and approaches used in the teaching of the elementary science courses. Of twenty courses, nine offered an integrated content and method approach, seven emphasized method and four were organized for content mastery of subject matter.[21]

The record of teacher education institutions of this time indicate that they were not providing the standards set up by the National Society

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[20]William D. Chamberlain, "The Development and Status of Teacher Education in the Field of Science for the Elementary School," (unpub. doctoral dissertation, Wayne University, 1955). pp. 189-195.

[21]Peter C. Gega, "College Courses in Elementary School Science and Their Relation to Teaching Problems," Science Education, Vol. 42, No. 4, (October, 1958), pp. 338-41.

for the Study of Education. Smith emphasized this by stating:

> The plight of the prospective elementary teacher is desperate in many cases. She is faced with the unhappy prospect of choosing 6 to 10 hours in any one of a dozen or more highly specialized sciences which makes only the slightest contribution to improving her ability to teach science in the elementary school.[22]

More recent investigations also indicate that there is an obvious need to stress a fuller, more effective utilization of the semester hours that are available for the development of science at the collegiate level. Esget suggests that combined courses which deal with content-method lead to more significant gains in science knowledge and understanding than courses which deal strictly and exclusively with method or content.[23]

In 1957, Watson in a study of science courses required for the preparation of elementary teachers suggested that teachers be required to take full year courses in biology, chemistry, physics and mathematics totaling approximately 32 semester hours. He also implied that gains in science knowledge may result from instruction designed specifically for prospective elementary teachers.[24]

Verrill conducted a combined historical research with a questionnaire survey to determine changes and trends in science and science education aspects of elementary teacher education from 1870-1959. He found

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[22]Herbert A. Smith, "Panel Statement Presented for a Symposium on Needed Research in Science Education," Science Education, Vol. 40, No. 5, (December, 1956), p. 365.

[23]Miles Esget, "Developing and Using an Objective Instrument to Measure Student Growth in Elementary School Science Courses," (unpub. doctoral dissertation, University of Colorado, 1958). pp. 197-210.

[24]Fletcher G. Watson, "Course Requirements for Future Science Teachers," The Scientific Monthly, Vol. 32, No. 11, (December, 1957), pp. 323-5.

that:

> (a) Elementary teachers, as a group, were poorly trained during the entire period of investigation. (b) Preparation in science courses did not increase in proportion to the over-all time increase in teacher preparation over this period. (c) Neither the objectives, scope, and sequence of elementary science nor, therefore, the programs for preparing teachers were clear and directed over the period. (d) Most prospective teachers acquired their science subject matter through general education courses or from basic courses for science majors rather than from courses specifically designed for the unique needs of elementary school teachers.[25]

Richardson also found that many teachers were poorly trained for teaching science. His observations led him to believe that all elementary school personnel should complete introductory laboratory-type courses in biology, chemistry, physics, and earth sciences, and a course in methods of elementary school science. He further stated that these courses should include experience in problem solving.[26]

A comprehensive study was conducted by Wytiaz to determine the attitudes of fifth-grade teachers of Cumberland County, New Jersey, toward their preparation for teaching science in the elementary school. She found that over one-half of the respondents had taken a biology course in college while two-fifths had taken a chemistry course. A methods course for teaching science in the elementary school had been taken by slightly less than three-fourths of the teachers. She felt that the colleges should offer a science program that would provide more practical experiences for preparing teachers of the elementary grades. She also

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[25] John Earl Verrill, "The Preparation of General Elementary Teachers to Teach Science: 1870 to the Present," (unpub. doctoral dissertation, University of Wisconsin, 1961). p. 189.

[26] Evan C. Richardson, "Proposals for the Improvement of Science Teaching in New Jersey Elementary Schools," Science Education, Vol. 47, No. 3, (April, 1963), 299-303.

felt that a methods course should include learning in experimentation and construction of simple scientific equipment.[27]

Raksaboldej, in 1961, selected 25 state teachers colleges from five U. S. accrediting regions, the number from each region being in proportion to its population. Using data from college catalogs and questionnaire returns, he determined the curricular requirements in science for prospective teachers. He found that the science programs varied widely, with the mean requirement of eleven semester hours.[28]

In a similar investigation, Kisner, in 1963, studied the science content preparation of prospective elementary school teachers in eight Oklahoma institutions of higher education. He found that these eight schools were including instruction comparable with the preparation that had been established by authorities. He indicated that the emphasis placed on areas of science varied from institution to institution and from teacher to teacher. The greatest area of strength in science preparation was in the area of the earth sciences and the weakest area was in knowledge, understanding and appreciation of living things. He recommended that more standard procedures be used by schools and instructors in the emphasis placed upon areas of science, that overlap be eliminated, and that more consideration should be given to the ideas of specialized science courses for elementary school teachers and the

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[27]Wytiaz, pp. 151-2.

[28]Bitak Raksaboldej, "A Survey of Science Programs in Selected State Teachers Colleges," (unpub. doctoral dissertation, New York University, 1961). pp. 206-221.

provision of special elementary school methods course.[29]

Lepp reported findings compatible with those of Kisner. He studied the science programs of the five state colleges of New Jersey. He found wide variations in the science programs. More than 90% of the respondents rated their pre-service education in science as only fair or poor. From a consideration of his data he recommended that 21 semester hours, including a course in the teaching of elementary school science, be allotted to science courses adapted to the needs of elementary school teachers.[30]

Uselton, Bledsoe and Koelsche conducted a study to analyze the relation of selected factors to measure competence in science of prospective elementary teachers. They found that the knowledge of science concepts possessed by elementary teacher candidates was generally inadequate to enable them to teach science to elementary school pupils.

They felt that the formal course work in science provided by the teacher institutions may not be sufficient or perhaps another type of science course more specifically directed toward the needs of elementary teacher candidates might be more fruitful. They noted:

> It appears that the elementary teacher needs competencies in science that are different from those appropriate for scientists, technicians and cultured persons in the American social order.[31]

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[29]Andrew Jackson Kisner, "Science Content Preparation of Prospective Elementary School Teachers in Eight Oklahoma Institutions of Higher Education," (unpub. doctoral dissertation, Oklahoma State University, 1963). pp. 121-23.

[30]Herman Irwin Lepp, "A Program of Science for Elementary School Teachers in New Jersey," (unpub. doctoral dissertation, Rutgers University, 1960). pp. 130-145.

[31]Horace W. Uselton, Joseph C. Bledsoe and Charles L. Koelsche, "Factors Related to Competence in Science of Prospective Elementary Teachers," Science Education, Vol. 47, No. 5, (December, 1963), p. 508.

They pointed out that general education courses in science do not provide an adequate background for teachers. They stated:

> General education science programs should serve to correct misconceptions, prejudices, and superstitions, and to develop a scientific attitude so that a person can make sound judgments between facts and unsupported claims and opinions. The cultured person should be able to appreciate the applications of science and technology as these affect his everyday life. The elementary teacher needs a broader range of competencies than those mentioned plus a knowledge of the methods of teaching science concepts.[32]

They reported the following concerning the regular courses provided for science specialists:

> Scientists and technicians must be specialists in their chosen branch of science and they must also have a basic knowledge of related fields. They must know the methods of research applicable to the problems in their particular field. A few hours of science credit earned in courses designed specifically for the person who majors in science fail to prepare properly the elementary teacher.[33]

They indicated that the teachers of science courses should be carefully selected:

> It is generally assumed that the way in which teacher candidates have been taught has an important bearing on the way they themselves teach. It is very important, therefore, that college personnel who have the responsibility of planning and supervising the programs of study and of preparing prospective teachers be themselves competent teachers.[34]

Considering the kind of job that the elementary science teacher has to perform, these studies indicate that both course and hour requirements need upgrading. The few hours of survey courses, and assorted methods courses may not give the elementary teacher the kind of background in science necessary for effective teaching nor give the foundation essential in overcoming fear and insecurity in the classroom.

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[32] Ibid, p. 508.

[33] Ibid.

[34] Ibid.

A further inadequacy from the point of certification is pointed out in an investigation made by Mallinson. He found in thirty-two states the possibility for a teacher to be certified to teach in the elementary grades without having any courses in science. He also reported that in those states that do require science of elementary school teachers, the number of semester hours required ranges from three to twelve hours.[35] This falls short of the recommendation of the Committee on Science of the National Society for the Study of Education.

Pruitt made a similar investigation relating to minimum requirements for certification for new or beginning teachers in various states. He found that twenty-one states require teachers in the elementary school to have had courses in elementary science.[36] This is indicative of some degree of improvement; there is, however, great flexibility within the stipulated courses needed to make the minimum requirements.

Since the teacher is the basic factor in all school instruction, most of the research seems to have been done in the area of teacher preparation. As indicated by this review of the research, much has been of a negative nature. The vast majority of the studies in this field point to the discouraging fact that most elementary school teachers have had little or no preparation in science; the science they do possess may be of little value in their work with elementary school children; and as a result of their lack of training with science they may be reluctant to

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[35] George G. Mallinson, "State Requirements for Certification of Teachers of Elementary Science," Science Education, Vol. 33, No. 4, (October, 1949), pp. 289-91.

[36] Clarence M. Pruitt, "Certification Requirements for Teachers in Elementary and Secondary Schools," Science Education, Vol. 36, No. 2, (April, 1952), pp. 182-93.

teach science.

The review of the pre-service preparation of elementary teachers in science implies that there is much need for additional preparation or assistance in some type of in-service program. The attention of the writer was then turned to the research to determine the status of in-service programs for elementary teachers in the area of science.

In-Service Science Programs for Elementary Teachers

The need for in-service training of many elementary teachers in science is conclusively demonstrated by the previously cited studies. Support for both summer and year-round institutes in science provided by that National Defense Education Act, the National Science Foundation and various foundations has provided increased resources for in-service programs. Now that funds have been provided, both public school and teacher education institutions now face the problem of designing workshops and institutes which will meet the continuing educational needs of the teachers in the field.

In a study of the extent and status of in-service education to one hundred schools in Indiana, Taylor found that the wealth of a school district was a principal factor in the amount of in-service education provided by a school system. The larger, wealthier city school districts provided more in-service education than the smaller, poorer districts.[37]

Dubins reported similar results in a different way:

From an analysis of the inquiry forms, it is the small cities and

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[37]Bob L. Taylor, "Factors Influencing In-Service Teacher Education Programs," Journal of Educational Research, Vol. 52, No. 9, (May, 1959), pp. 336-38.

> towns which need the science educators, which need science workshops and conferences, which have fewer courses of study in elementary science. It seems evident that the elementary teachers in the larger cities have more opportunities for improving their instruction.[38]

Dubins also indicated that most of the states have colleges which are providing workshops in science for the elementary school teacher. He said that this may be a trend towards providing opportunities for improving elementary science instruction.

Challand, studying practices and conditions of science teaching in elementary schools in Illinois, found that only one-third of the schools offered an in-service program which provided opportunity for professional growth in science content.[39]

Kuslan, in a study designed to elicit information for the purpose of bettering the education of prospective elementary school teachers, surveyed the science programs in four schools utilized by New Haven State Teachers College. He reported that teachers believe in-service programs utilizing members of the college science staff were the most helpful method of improving elementary science instruction.[40] This indicates that there are possibilities here for assisting elementary teachers.

Yet, Mallinson reported that, as a group, the elementary teachers have taken little graduate work in science. She questioned the fact that colleges were offering science courses that are designed to bring

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[38]Dubins, pp. 324-8.

[39]Helen Jean Challand, "An Appraisal of Elementary School Science Instruction in the State of Illinois," (unpub. doctoral dissertation, Northwestern University, 1956). pp. 250-65.

[40]Louis I. Kuslan, "Science In The Training Schools," Science Education, Vol. 43, No. 4, (October, 1959), p. 355.

elementary teachers up-to-date in science.[41] This should be an additional suggestion to colleges in providing for the elementary teachers.

Wytiaz found that although over one-half of the respondents in her study did feel that their background was inadequate, 68.9% had not taken any in-service courses in science.[42]

Bingham questioned teachers regarding the kind of workshop in elementary science they considered valuable. The teachers expressed a desire for working space and a wealth of laboratory and library facilities, an atmosphere which promotes a free exchange of ideas, opportunity to plan much of the work, a chance to develop materials for their own classrooms, and wide provision for experiments. They preferred a sufficiently structured organization to guide the inexperienced person, and sufficient time to carry out the activities undertaken.[43]

Sims conducted an experimental study concerning an in-service program for elementary teachers. He held eleven sessions during the school year. He gave a pre-test and a post-test in science to fourth and fifth grade teachers. The test results were compared with a control class whose teachers did not participate in the program. Statistical analysis which held intelligence and pre-test scores constant, showed that the

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[41]Jacqueline Buck Mallinson, "The Grand Rapids Study," Science Education, Vol. 45, No. 1, (February, 1961), pp. 35-9.

[42]Wytiaz, pp. 151-2.

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

experimental classes achieved more on the post-test than the control classes.[44]

Fowler described an NSF-supported summer institute for the preparation of forty-five elementary school science resource teachers. He indicated that in a pre-test and post-test situation the results following the program were considered to be highly significant.[45]

Another type of in-service program for the improvement of elementary science education is the consultant or science supervisor. Kerr attempted to determine more clearly the qualification, functions and responsibilities of the consultant in the elementary school science program. She concluded that consultants should have qualities of leadership, ability to further school-community relationships, ability to build rapport among teachers within a school and within a school system, and that they should have the responsibility for an in-service program. Specifically the elementary science consultant needs a good background in science, needs to see the science experiences of children in relation to educational values and behaviors, and to see science in relationship to the total curriculum. The consultant also needs to be cognizant of the many instructional materials and equipment plus a knowledge of types, sources, use, care, storage of these materials, and a knowledge of community resources.[46]

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[44] Ward L. Sims, "The Development and Evaluation of an In-Service Program in Elementary School Science," Science Education, Vol. 42, No. 5, (December, 1958), pp. 391-8.

[45] H. Seymour Fowler, "Evaluation of an Institution for the Training of Elementary School Science Resource Teachers," Journal of Educational Research, Vol. 53, No. 9, (May, 1960), pp. 358-9.

[46] Elizabeth Feeney Kerr, "The Role of the Consultant in Elementary Science," (unpub. doctoral dissertation, Teacher's College, Columbia University, 1956), pp. 200-213.

These studies appear to emphasize the lack of information concerning in-service education for elementary teachers. Mallinson pointed this out in the following statement:

> Attention needs to be given to the problems of in-service training for teachers now in the field. For example, what types of workshops are most helpful to in-service teachers? ...Future research here needs to be designed to help the teachers, rather than condemning them.[47]

One realizes the importance of in-service education in science when he considers the fact that science is now playing a more vital role in our daily lives and will probably continue to do so. Elementary school teachers feel a greater need today for learning science than ever before. Many children ask their teachers for answers to scientific problems. Modern means of communication report on scientific developments and raise questions for children in the elementary school. Therefore, the teachers are compelled to teach science in order to keep up with the interest and needs of children. How can teachers be expected to accomplish this without an understanding of new approaches to teaching science?

Modern Science Makes New Demands of Elementary Teachers

A comprehensive study undertaken by a steering committee of the American Association for the Advancement of Science was reported by Hall and others. The study was designed to review the status of elementary school science and to formulate an extensive plan for improvement. The committee recommended:

> (a) Science should be a basic part of general education, starting in the primary grades for all students; (b) there must be clear progression from grade to grade; (c) science teaching should stress

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[47] J. Mallinson, Science Education, Vol. 40, No. 5, p. 371 ff.

> the "spirit of discovery characteristic of science itself"; (d) preparation of new instructional materials requires the combined efforts of scientists, classroom teachers, and specialists in learning and teacher preparation.[48]

The report advocated major attention to the teaching of cognitive processes that are integral to science. The committee recommended a massive, coordinated attack on the improvement of science teaching.

Several new curriculum projects, each receiving support from the National Science Foundation, began to issue reports of initial activities and findings during the past three years. Most of these efforts were initiated for the purpose of developing specific types of curricular materials.

The development of new curriculum projects has indicated that it is no longer adequate to relegate science in the elementary school exclusively to incidental or chance happening study of teaching even though both have a place in the elementary school program. The hit-or-miss approach is inadequate today. There is a need for continuity in the program in order to minimize boredom and repetition, and in turn to provide for the early introduction of the methods and systematic characteristics of scientific inquiry.

Carin and Sund asserted that science education today should emphasize the development of scientific principles and methodology instead of the memorization of facts. They further said that teachers should employ the experimental or discovery approach to science with emphasis upon

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[48]Thomas S. Hall and others, "Science Teaching in Elementary and Junior High Schools," Science, Vol. 133, No. 23, (June, 1961), p. 2019.

inductive learning, problem solving, and critical thinking.[49]

The Commission on Science Education has reported the philosophy underlying the new program as being quite different. Here the assumption was made that science is much more than a simple encyclopedic collection of facts, and that children in the elementary school will derive much benefit from experiences which will enable them to acquire certain basic skills and competencies essential for the learning of science. Many terms have been identified in relation to these competencies. Observation, classification, recognition and use of space-time relations, measurement, communication, analysis, inferences, interpretation, and prediction are a few of the skills that have been emphasized as necessary to develop the process approach to science.[50]

Piltz stated this in another way:

> Modern science is more than new knowledge. It is also a way of thinking and working. Modern science demands that students learn to identify problems and to seek their solution. This means gaining an understanding of basic principles, the habit of curiosity, the skill of observation, the attitude of questioning and exploring, the knowledge of experimentation, the ability to work out relationships, the patience to test and retest, the persistence to try again and again when efforts fail.[51]

Hurd contends that science should be taught as an intellectual achievement of man stemming from his desire to understand the forces which control and give meaning to the physical and biological world, the aim of instruction being depth and quality of understanding. The

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[49]Arthur Carin and Robert B. Sund, Teaching Science Through Discovery, Columbus, Ohio: Charles E. Merril Books, Inc., 1964. pp 1-15.

[50]Commission on Science Education Newsletter, Vol. 1, No. 1, (December, 1964), pp. 2-11.

[51]Albert Piltz, "Promising Trends for Effecting Needed Changes in Curriculums in Elementary School Science," Science Education, Vol. 48, No. 1, (February, 1964), p. 8.

usual descriptive cataloging of information in a taxonomic classification is unsuited to achievement of objectives compatible with a real understanding of the scientific endeavor.[52]

When one realizes the purposes of modern science education in the elementary school, the teacher becomes of considerable importance as an interpreter and mediator.

This is illustrated by Butts when he concluded that teacher direction is needed for the discovery of relationships to take place and that the schools should furnish a rich opportunity for exposure to science experiences.[53] The teacher, in the case of the scientific understandings studied by Butts, must furnish a conceptual framework for learning.

Atkin and Karplus reported findings similar to Butts'. They reported that children did not discover concepts of science solely by self-generated and autonomous activity. The teacher had to furnish the intellectual framework within which autonomous learning occurred profitably.[54]

Ausubel argued that discovery is often an unrealistic expectation, that available procedures and methods of handling data must be skillfully arranged and simplified for children in such a way as to make ultimate discovery almost inevitable.[55]

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[52]Paul De H. Hurd, "Science Teachers for the New Era in Science," California Journal of Secondary Education, Vol. 33, No. 8, (December, 1958), pp. 486-91.

[53]David P. Butts, "The Degree to Which Children Conceptualize from Science Experience," Journal of Research in Science Teaching, Vol. 1, Issue 2, (1963), p. 138.

[54]J. Myron Atkin and Robert Karplus, "Discovery or Invention?" Science Teacher, Vol 29, No. 5, (September, 1962), pp. 45-51.

[55]David P. Ausubel, "Some Psychological Considerations in the Objectives and Design of an Elementary School Science Program," Science Education, Vol. 47, No. 3, (April, 1963), pp.278-84

These reports emphasize the important role that the teacher must play in modern science teaching. Yet, teachers cannot be expected to teach children how to develop the process of inquiry, discovern, and problem solving if nowhere in the curriculum have they had a functional opportunity to learn how to develop the necessary skills.

This fact has been realized by the National Science Foundation which has established institutes and in-service programs for preparing teachers to work with the modern science programs. It has been reemphasized by the various programs in developing materials and providing consultants to help orient the teachers in working with the new materials. For example, Livermore reported: "Some scientific help for the teachers is provided by science consultants at biweekly meetings..."[56]

Karplus further stated:

> The new curricular materials have to be communicated to teachers in such a way that they can use them. The information must go beyond the minimum required for the classroom presentation so that the teachers will have a reserve on which to draw in discussions, a reserve that is a basis for self-confidence in front of the class. Teachers must also acquire a many-sided view of the subject so that they can link it to the pupils' diverse ways. All of this in addition to their other teaching obligations.[57]

The Science Curriculum Improvement Study considered the problem of the teacher by providing films that summarize explicit procedures for teaching the basic concepts to the teachers.[58]

The Commission on Science Education Newsletter also pointed this

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[56]Arthur H. Livermore, "Science A Process Approach," Science and Children, Vol. 1, No. 8, (May, 1964), pp. 24-5.

[57]Robert Karplus, "The Science Curriculum-One Approach," The Elementary School Journal, Vol. 62, No. 5, (February, 1962), pp. 243-52.

[58]Science Curriculum Improvement Study, "Beginning A Study in Elementary School Science," American Journal of Physics, Vol. 30, No. 1, (1962), p.1.

out in another way:

> Many teachers in the elementary grades have had limited training in science. Recognizing this, the summer writers prepared a teachers' commentary to help these teachers fill in their science backgrounds. The commentary answers questions about the philosophy of the program, makes clear the motive of the process approach, and fills in gaps in content knowledge with ten science background papers. The teachers' commentary is being used in an in-service training program which is being conducted this year in each of the tryout centers by the science consultant for the center.[59]

Hurd also considered this problem when he stated:

> Teachers in the future will require training which considers conditions that influence scientific discovery, the nature of the creative process, and the tools employed.[60]

The fact that teachers of the future will be required to teach more science and that this science will be a different kind of science making new demands upon them re-emphasizes the probability of their increased reluctance to teach science in the elementary school.

Moreover, the importance of understanding the objectives of elementary science is emphasized. This fact led the writer to investigate the research in the objectives of teaching elementary science.

Understanding of the Objectives of Elementary Science

In 1961, Johnston undertook to determine how well the stated objectives of elementary school science were achieved. She found that classroom activity emphasized textbook reading and discussion. Only limited use was made of experimental and laboratory activities, directed observation and research reading. She stated: "It would appear that the

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[59] Commission on Science Education Newsletter, p.3.

[60] Hurd, p. 491.

objectives ordinarily accepted for elementary science were not being attained."[61]

Piltz also indicated the teachers' lack of understanding and implementation of science objectives.[62] Tyndall reported that teachers generally did not perceive the importance of laboratory-like classrooms in teaching elementary school science.[63] Richardson stated that limited use was made of activities designed to develop understanding, and problem-solving abilities, and that the least-used teaching tool was the experiment.[64]

Challand reported that teachers, in general, were concerned with appropriate objectives but failed to provide adequate opportunities for achieving them. They made insufficient use of materials and methods suited to the instruction of science.[65]

Wytiaz found that two-ninths of the teachers in her study felt that science should help students seek generalizations which they can use in solving problems of their environment.[66]

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[61] Jane Johnston, "Achievement in Elementary School Science in a Representative Sampling of Minnesota Schools," Science Education, Vol. 45, No. 1, (February, 1961), pp. 58-61.

[62] Albert Piltz, "An Investigation of Teacher-Recognized Difficulties Encountered in Teaching Science In the Elementary Schools of Florida," Science Education, Vol. 42, No. 5, (December, 1958), pp. 440-3.

[63] Jesse Parker Tyndall, "The Teaching of Science in Elementary Schools by Recent Graduates of Atlantic Christian College as Related to Their Science Preparation," Science Education, Vol. 44, No. 2, (March, 1960), pp. 118-21.

[64] Richardson, pp. 299-303.

[65] Challand, pp. 189-95.

[66] Wytiaz, pp. 151-2.

In interviews with both students and teachers, he found that the majority of the students and teachers expressed preference for the problem solving method of teaching.[69]

Hubbell, in a study similar to that of Carpenter's, compared experimentally the achievement of three groups of eighth graders using (1) the textbook method, (2) an audio-visual method with filmstrips, and (3) a pupil-activity approach. The pupil activity approach (or the project method) ranked significantly highest, with the audio-visual method ranking second, and the textbook method lowest.[70]

Jones conducted a study in 1958 at the first grade level. Through the use of anecdotal records taken over a year's period of children's questions, responses, and resulting decisions regarding solutions to problems, she concluded that experimentation at the first grade level did produce the beginning of concepts, skills, and attitudes. She also concluded that some of the concepts concerning the child's environment, as developed by her first graders, were more advanced than those presented in most modern first grade science books.[71]

The review of the research to this point appears to indicate that inadequacy of preparation and failure to understand or implement the

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[69]Regan Carpenter, "A Study of the Effectiveness of the Problem Solving Method and the Textbook-Discussion Method in Elementary School Science Instruction," (unpub. doctoral dissertation, University of Colorado, 1958). pp.194-209.

[70]Lawrence Hubbell, "An Investigation in the Use of the Filmstrip Method, the Pupil Activity Method, and the Textbook Method in Presenting Science Concepts to Eighth Grade Pupils," (unpub. doctoral dissertation, Northwestern University, 1957). pp.215-19.

[71]Mary Elliott Jones, "A Study of the Possible Learnings Resulting from Science Experimentation by a Class of First Grade Children," Science Education, Vol. 43, No. 4, (October, 1959), pp. 355-74.

objectives of modern science teaching could be factors in the reluctance of elementary teachers to teach science.

But are these the primary factors? Victor suggested:

> Other reasons have also been offered. However, little has been done to determine whether these reasons are independent factors in themselves, or whether they have developed either as logical consequences of an inadequate science background or as substitutes for an understandable reluctance to admit to an inadequate preparation in a teaching field.[72]

Evidence of Other Factors Related to Teaching Science

Two comprehensive studies were made to investigate relationships between aspirations of teachers and difficulties that they think they face in the teaching of elementary school science. Piltz found that in order of frequency, the areas are physical facilities; methods and techniques of teaching; resources, materials and equipment; field trips, content, subject matter and areas of experience; and library facilities.[73]

Gega found that the most frequently reported teaching problems were, in order of magnitude: (1) materials and resources, (2) teacher skills, techniques, and security, (3) organization of instruction, (4) human relations, administration, and supervision, (5) objectives and evaluation.[74]

These two reports concur that the availability and use of materials and equipment might be factors influencing the teaching of science at the elementary level.

A number of additional studies also indicate that there is a lack

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[72] Victor, p. 186.

[73] Piltz, Science Education, Vol. 42, No. 5, pp. 440-43.

[74] Gega, Science Education, Vol. 47, No. 2, pp. 197-200.

of materials and equipment. Kuslan pointed out that one of the major lacks hindering science instruction was materials, audio-visual aids, books, special advisory services, and community resources.[75]

Hedges and MacDougall stated:

> The majority of elementary schools do not have any equipment. Where some equipment is available, it has been acquired for the 6th and 7th grades, and its use is commonly confined to those grade levels.[76]

Chamberlain said that the teachers he surveyed reported difficulty in obtaining equipment and books and in finding storage space.[77]

Other studies pointed out that equipment was available but this equipment often was not widely used.

Mallinson indicated that standard materials were available in most cases and that they were accessible to teachers. In most cases, much of the equipment was kept in a central storage area in the building, rather than being available in each classroom.[78] This may have caused some teachers to be hesitant about using the equipment.

Victor pointed out that most of the teachers involved in his study reported adequate equipment, although some responses indicated infrequent use of it. He further indicated that unfamiliarity with the materials and equipment was a definite factor in the reluctance of the elementary

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[75] Kuslan, p. 355.

[76] William D. Hedges and Mary Ann MacDougall, "An Investigation of the Status of Science Education In Selected Public Elementary Schools of Virginia," Science Education, Vol 48, No. 1, (February, 1964), p.62.

[77] Chamberlain, p. 107.

[78] J. Mallinson, Science Education, Vol. 45, No. 1, pp. 35-39.

school teacher to teach science.[79]

Simmons reported this in another way when he stated:

> The answer may not stem alone from lack of equipment or its availability, but lack of operational "know how" on the part of the teachers.[80]

Washton stated:

> Elementary school teachers need confidence in handling and manipulating materials that are used in scientific experiments and demonstrations. When the teachers were given such opportunities to develop these skills in the course, they acquired confidence and improved techniques.[81]

Again this would emphasize the necessity of finding whether teachers feel that they need more assistance in handling and preparing materials and equipment for use in elementary science teaching. In view of the vast sums of money being granted through the National Defense Education Act to assist in the purchase of equipment and materials necessary for remodeling science instruction, the issue becomes even more critical.

This is indicated by Navarra's discussion of the question:

> In my opinion, more information is needed with respect to the classroom setting including the availability and utilization of materials by teachers. The specific competency of teachers with respect to materials should be investigated to assess the way such competencies unleash or restrict the potential of a group of children studying science in the elementary school.[82]

Another area of concern is the provision of a special teacher to teach science in the elementary school. Fitzpatrick has maintained that

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[79] Victor, p. 187.

[80] Simmons, p. 340.

[81] Washton, p. 34.

[82] John Gabriel Navarra, "Issues Raised in a Review of Research in Elementary Science," Science Education, Vol. 47, No. 3, (April, 1963), p.239.

a specialist is essential to an effective science program in the elementary school.[83]

The problem of utilizing either classroom teachers or science specialists in elementary school science programs is receiving a great deal of attention today. This is not a new idea and is actually a problem that has confronted educators for a number of years. In fact several facets of this problem have been investigated by researchers for over a quarter of century. Studies such as that reported in 1938 by Russell indicated that while more educators favored special science teachers rather than classroom teachers instructing in science, the differences were not statistically significant.[84]

Later research in this area has led to conflicting results. Gibb and Matala reported the results of a comprehensive study conducted under the auspices of the American Association for the Advancement of Science that was designed to compare science instruction by special teachers with teachers in self-contained classrooms. Data were drawn from four school systems wherein fifth and sixth grade children were matched on the basis of intelligence and achievement. They found that children, regardless of their intellectual ability, learned science more effectively when taught by special teachers.[85]

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[83]Frederick L. Fitzpatrick, Policies for Science Education, New York: Bureau of Publications, Teachers College, Columbia University, 1960. p. 15.

[84]D. W. Russell, "How 51 Well Known Educators Answered A Questionnaire Concerning the Teaching of Science in the Elementary Grades," School Science and Mathematics, Vol. 38, No. 341, (November, 1938), p. 907.

[85]Glenadine E. Gibb, and Dorothy C. Matala, "A Study of the Use of Special Teachers of Science and Mathematics in Grades 5 and 6," School Science and Mathematics, Vol. 62, No. 550, (November, 1962), pp. 565-85.

DiLorenzo conducted a similar study comparing science instruction by special teachers with that by teachers in self-contained classrooms. The study was conducted in four elementary schools in suburban Long Island. The students were matched on the basis of intelligence and achievement. The same text was used to teach both groups of students. He did not find a significant difference in the outcomes.[86]

There is also some conflict of opinion among elementary teachers as to whether special teachers should or should not be used. Victor reported that, in general, the teachers felt that science teaching, even in the elementary school, should be a function of an expert.[87] Richardson also reported that teachers felt that in the upper elementary grades science should be taught by science majors.[88] Wytiaz found that teachers felt that special teachers were needed in other areas of the curriculum more than in science.[89]

Other factors have also been given as possible reasons for the reluctance of elementary school teachers to teach science as indicated in the research. For example, Victor mentioned that teachers feel that insufficient time and the pressure of teaching other areas in the elementary curriculum are significant causes. He also stated that the teachers expressed the belief that they were embarrassed because they were

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[86]Louis T. DiLorenzo and Joseph W. Halliwell, "A Comparison of the Science Achievement of Sixth Grade Pupils Instructed by Regular Classroom and Special Science Teachers," Science Education, Vol. 47, No. 2, (March, 1963), pp. 202-5.

[87]Victor, p. 192.

[88]Richardson, p. 303.

[89]Wytiaz, pp. 151-2.

repeatedly being placed in the position of not being able to answer the pupils' questions. He further indicated that the teachers felt that science teaching is a man's job.[90]

Hill on the other hand felt that individual experience rather than sex was the dominant operative factor in understanding the concepts of science.[91]

Johnston did concur with Victor on the point of competition of science with other subject matter areas. She found emphasis on science in elementary classrooms less than that given to social studies and reading and more than that given to music or art.[92]

Uselton, Bledsoe and Koelsche found a significant relationship between the levels of teaching chosen by teaching candidates. Those who chose to teach at the upper elementary level scored significantly higher on the average on the Sequential Test of Educational Progress than those who preferred to teach at the primary level.[93]

Washton found that regardless of age the teachers were capable of learning science under suitable conditions.[94]

Practically all of these studies that have been reviewed recognized the fact that the teachers are concerned about their adequacies for teaching science and that they recognize their difficulties in organizing an effective program of instruction.

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[90]Victor, p. 191.

[91]Katherine E. Hill, "Varying Perceptions of Science Phenomena," Science Education, Vol. 45, No. 1, (February, 1961), pp. 29-32.

[92]Johnston, p. 61.

[93]Uselton, Bledsoe, and Koelsche, pp. 506-8.

[94]Washton, p. 34.

The future of science lies in the hands of those children in the schools today. As a result it is imperative that the classrooms have teachers that will develop in these children an enthusiasm for science. Needless to say, enthusiasm for science does not come from a person that feels inadequate and recognizes that they have difficulties in organizing an effective program of instruction.

CHAPTER III

METHODS AND PROCEDURES

The present study is an exploratory one designed to gather data to determine the opinions of elementary school teachers concerning science and science teaching at the elementary school level in an attempt to provide insight into their reported reluctance to teach science.

Statement of the Problem

A great quantity of evidence has been accumulated to substantiate the opinion that elementary teachers are reluctant to teach science. This raises questions as to the factors that might account for such feeling. Considerable evidence, as reported in the previous chapter, points to inadequate preparation in science either as a direct or indirect source of this reluctance. Also, evidence has been presented to indicate that there are other factors which might influence the teaching of science in the elementary school. On the other hand, there is some ambiguity in the results, considerable apparent contradiction among the findings of the various studies, and a tendency for different research methods to produce different results. The writer felt that after a review of the literature there was evidence to justify a more recent and perhaps more conclusive investigation of certain factors which could influence the teaching of science at the elementary school level.

The review furnished some ideas of what factors might be included.

The review also furnished something disturbing about the current emphasis on the lack of security and confidence of the classroom teacher in teaching science. Various proposals imply that something must be done to teachers instead of with them, with little or no attention to providing teachers with an opportunity to make some contribution in doing something for themselves. Few of the investigators consulted the teacher in their studies. Most had pre-determined standards which were used to measure the teachers.

The review of the research indicated that teachers of elementary science were concerned about any inadequacies that they might have and were concerned with improved science teaching. The investigator felt that the authorities in elementary science teaching should be those teachers involved in teaching elementary school science. The writer felt too that the approach to make in the investigation was to go to the teachers and find the areas that they felt might influence science teaching in the elementary grades and to find what improvements these teachers thought possible.

The investigator realized that to attempt to cover all factors which might be affecting science teaching at the elementary level would be impossible. Consequently, certain factors were selected for analysis in this study from interviews with elementary teachers, interviews with those responsible for the pre-service and in-service teacher education programs, and from a review of the literature which stressed the importance of needed research.

The factors given consideration in the study are:

1. The amount of time that is devoted to science teaching.
2. The number of hours of academic course credit in science.

3. The belief that science is a man's field.
4. The nature of the understanding of the modern goals of science teaching.
5. The belief that the major responsibility of elementary teachers should be in the areas of the basic communication skills.
6. The belief that there is a loss of classroom prestige in teaching science.
7. The belief that science demands too much time, creates a cluttered classroom, or disrupts normal classroom routine.
8. The belief concerning the availability and use of science teaching equipment and materials.
9. The belief concerning the responsibility for designing and controlling the elementary school science program.

In addition to these factors, the investigator felt that valuable information might be provided by consideration of the opinions of the elementary school teachers concerning the contributions that have been made and that should be made by their science courses, by science workshops or institutes, by science supervisors, and by science methods courses in preparing them for science teaching.

It is not the intention of the investigator to suggest that the factors being considered are the only factors that influence the teaching of science or that the factors are equal in value or importance.

Although the writer realizes that controlling all factors which might affect the results of the study would make the study more meaningful, it would not be possible to consider all of the factors which would influence the opinions of elementary teachers in a study of this type.

Definition of Terms

The following terms are defined as they are used throughout this study:

Elementary school teachers: individuals who teach in any one or a combination of more than one of the grades, kindergarten through sixth.

Primary grades: kindergarten through third grade of the elementary school.

Intermediate grades: fourth through sixth grade of the elementary school.

Opinions of elementary teachers concerning science: a belief or judgment of an individual concerning science and the teaching of science which has not been conclusively proved. As used in this study the belief is stronger than an impression but less strong than positive knowledge.

Science workshop or institute: an in-service teacher improvement activity in science subject-matter disciplines or science teaching methodology.

Science supervisor: any school officer charged with the responsibility of assisting, guiding, and directing the improvement of instruction and instructional materials in the teaching of science.

Science methods course: a type of course in education emphasizing methods or techniques of instruction as well as content and related problems for science.

Self-contained classroom organization: an organized class usually under the direction of one teacher who provides instruction in all subject-matter disciplines.

Departmentalized classroom organization: an organization of classes in which a teacher provides instruction in selected subject-matter

disciplines usually to several grades. In this study the teacher provided instruction in science and geography to several grades (in some instances grades one and two, grades three through six, and grades one through six).

Modern goals of science teaching: teaching science as a process of discovery and inquiry by providing elementary school students with experiences that will help them arrive at some of the concepts of science through observation, analysis, recording and interpreting data, solving problems, and through the study of cause-and-effect relationships. Thus, science becomes a process of thinking and solving problems rather than a memorization of factual information.

Development of the Instrument

The nature of this study indicated that the most suitable type of instrument for securing the desired information from a large sample would be the opinionnaire.

The check list, as an opinion-gathering technique, has been used frequently to inquire into the opinions and attitudes of a group. It is particularly useful when the researcher cannot readily see personally all the people from whom he desires responses. It is also useful in determining opinions and attitudes important to defining the function of the group. The check list is an accepted technique in educational research. It provides for uniformity of response which in turn facilitates the collection and statistical treatment of large quantities of data.[95]

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[95] Carter V. Good and Douglas E. Scates, Methods of Research, New York: Appleton-Century-Crofts, 1954.

As has been previously stated, the investigator selected factors concerned with modern views of science and science teaching which might influence the opinions of elementary teachers in the teaching of science. No attempt was made to evaluate these factors other than interviews with elementary teachers and those involved in pre-service and in-service preparation of teachers as the investigator was concerned only with the expressed opinions of the teachers concerning the teaching of science in the elementary school.

A check list of eighty statements was prepared in the form of an opinionnaire which required the respondent to select an appropriate response and to indicate his answer as directed by instructions included on the opinionnaire.

The opinionnaire also provided for obtaining pertinent information such as the teacher's age, sex, science background, teaching experience, teaching grade-level, type of classroom teaching situation (self-contained or departmentalized), time devoted to the teaching of science, frequency of performance of science demonstrations, availability of equipment and reference materials, and functions of workshops, supervisors, and methods courses.

A preliminary form of the opinionnaire was administered to a group of sixteen elementary teachers enrolled in an extension class (Education 542, Teaching and Supervision of Science) conducted by the staff of the College of Education at Oklahoma State University. These individuals were asked to answer the opinionnaire and to indicate areas of possible need for revision. A careful analysis was made of the responses and a revised opinionnaire was developed which contained seventy statements.

Certain limitations in the method used for gathering data in the

study are acknowledged. The opinionnaire, as an instrument for collecting data, may be limited by the biased judgments of the respondents. All respondents may not react from a common frame of reference. Statements may not be understood by the respondents. These limitations are significant. Consequently, the investigator made an attempt in the construction and revision of the instrument to state the questions in such a way as to keep the limitations to a minimum. The revised opinionnaire is available in Appendix A.

Selection of the Sample

A careful analysis was made in selecting the population that would attempt to furnish a random sampling and still provide the comparisons that were present in the problem. The population from which the data were collected was chosen from a stratified sampling in Oklahoma defined as town and city. The definition employed by the 1960 United States census population was the major criterion used for determining the classification of schools. Schools were classified as town-schools if their districts had a population of 2,500 to 10,000 and city-schools if their districts had a population of 10,000 or more. This was an attempt by the writer to have representation of the teacher in the small school system as well as in the larger school system as the research indicated that these teachers might differ in their responses. A breakdown of the schools and respondents is found in Appendix B.

In a further attempt to furnish a more random sampling, opinionnaires were also sent to selected extension classes provided by Oklahoma State University during the spring of 1965 and to a group enrolled in a graduate science methods course for elementary school teachers at

Oklahoma State University during the summer of 1965.

Since the investigator was also interested in comparing the opinions of experienced teachers and inexperienced teachers, the instrument was given to a group of student teachers enrolled in an elementary science methods course at Oklahoma State University during the spring semester of 1965.

Because the review of the literature indicated a conflict in the results when using special teachers and self-contained classroom teachers in the teaching of science, the investigator chose representative town-school and city-school populations involved in both departmentalized and self-contained teaching situations for inclusion in the study.

The sample for the study thus consisted of those teachers who responded to the opinionnaire.

The selection of the population is indeed limited. However, a universal sampling would not appear feasible for a study of this type. A study which has been made in selected schools in the state of Oklahoma might limit generalizations that could be made concerning the opinions of elementary teachers in other locations. The findings of such a study would not necessarily be applicable to other teachers in different locations. The investigator is of the opinion that this limitation is not significant in view of the fact that the literature reveals that there is no indication of geographical significance to the commonality of the problems that confront elementary teachers in the teaching of science. This would seem to indicate that there would be little geographical significance to the opinions expressed by elementary teachers concerning science and science teaching.

Procedures for Distribution of the Instrument

Letters describing the study and requesting permission to sample teachers were sent to selected schools in Oklahoma during the spring semester of 1965. The investigator made personal visits to two schools to secure permission to distribute the instrument. On receipt of a favorable reply, a letter and a specified number of the opinionnaires were sent to the designated person for distribution to the elementary teachers.

Each teacher was furnished a cover letter explaining the purpose of the study. This letter also explained that there was no attempt being made to identify individuals. The teachers were asked not to sign their names as the study was not concerned with the identification of individual opinions but with the opinions of the group. Each teacher was provided with a stamped addressed envelope and instructed to return the instrument to the investigator. This was an attempt on the part of the investigator to assure teachers that no one in their school system (in fact, no unauthorized person) would be able to see their responses. The investigator felt that this would provide more freedom of expression of true opinions of the elementary teacher concerning science and science teaching.

The instruments were marked by the investigator so that distinctions could be made in the type of school system from which the instruments came. Further distinctions were made for individuals engaged in departmentalized classroom teaching and for the extension classes. (For the teachers enrolled in Oklahoma State University extension classes, the investigator presented the opinionnaires to the instructors of the

classes who distributed the opinionnaires to their students with stamped, addressed envelopes and instructions for returning them directly to the investigator.)

Treatment of the Data

Data from the returns were tabulated by the investigator and recorded on computer data cards. The cards were machine processed to determine the responses to each statement of the opinions expressed on the pre-determined factors established by the investigator. The opinionnaire items were tabulated for each statement in frequencies and percent of response in relation to all of the respondents. The types of analysis to be made in this investigation appeared to indicate the use of a nonparametric statistic. (Siegel suggests that the behavioral sciences rarely achieve the sort of measurement which permits the meaningful use of parametric tests so that the nonparametric statistical tests are finding an increasingly prominent role in research in the behavioral sciences. He indicates that the power of any nonparametric test may be increased by simply increasing the size of N.)[96]

The investigator felt that the use of percent to compare the opinions expressed by the sample would provide the clearest insight into the factors that might influence science teaching. (Siegel reports that nonparametric statistical tests are available to treat data which are inherently in ranks or in instances where the researcher may be able only to say of his subjects that some have more or less of a characteristic

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[96]Sidney Siegel, Nonparametric Statistics For The Behavioral Sciences, New York: McGraw-Hill Book Company, Inc., 1956, p. 31.

than others.)[97]

The investigator also felt that additional insight might be provided in the analysis of the responses if comparisons were made among selected groups for each statement or question. The groups were chosen to provide insight into differences that might occur among the comparative groups that would not be indicated by the total responses. The opinionnaire items were tabulated for each statement in frequencies and percent of response in the divisions of each comparative group. The groups selected for analysis were: (1) type of classroom teaching situation, (2) number of years teaching experience, (3) grade that the respondents are now teaching, (4) participation in a science methods course, and (5) the number of hours of science coursework. The selection of the types of comparisons under each of the groups which would provide information of value was a difficult task. Judgments had to be made, and the investigator could find no established precedent to assist in the divisions. The investigator consulted elementary teachers, those involved with teacher education, and the published research. The final decisions were made by the writer.

The type of classroom teaching situation was divided into two groups, (1) departmentalized classroom teachers and (2) self-contained classroom teachers. The literature indicated that there might be differences in the opinions expressed by those teachers who teach science as their primary responsibility and those teachers who teach science as part of the total elementary program.

The number of years of teaching experience was divided into two

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[97] Ibid, p. 33.

groups, (1) those teachers with zero to three years of teaching experience (inexperienced teachers) and (2) those teacher with four or more years of teaching experience (experienced teachers). The literature indicated that there might be a difference in the opinions expressed by experienced teachers and inexperienced teachers. However, there was no indication as to the number of years teaching experience that distinguished the experienced teacher from the inexperienced teacher. Through interviews with teachers and those involved with teacher education, the writer classified the experienced teacher as one with more than three years of teaching experience and the inexperienced teacher as one with three or fewer years of teaching experience.

The grade level at which the respondents are now teaching was divided into five groups, (1) respondents teaching in kintergarten, grade one, grade two, or grade three (primary grade teacher); (2) respondents teaching grade four, grade five, or grade six (intermediate grade teacher); (3) respondents teaching grade three through grade six; (4) respondents teaching grades one and two; and (5) respondents teaching grades one through six. The research indicated that there might be a difference in the opinions expressed by teachers of the primary grades and teachers of the intermediate grades. Groups (1) and (2) were to provide a distinction for these teachers. Because of the special situation of teachers teaching several grades in the departmentalized classroom situation, it did not appear wise to place the teachers of grades one through six with either group. Groups (3), (4), and (5) were selected to provide for the special teaching situations of the departmentalized classroom teachers.

The participation of the respondents in a science methods course

was divided into two groups, (1) those teachers who had a science methods course and (2) those teachers who did not have a science methods course. These groups were chosen due to special interest of the writer and because of an indication by those concerned with teacher education that this was an area of needed research.

The number of hours of science course work was divided into six groups: (1) those teachers with 1 to 6 hours of science course work; (2) those teachers with 7 to 12 hours; (3) those teachers with 13 to 18 hours; (4) those teachers with 19 to 24 hours; (5) those teachers with 25 to 30 hours; and (6) those teachers with more than 30 hours of science course work. The investigator felt that the research had emphasized the course preparation as a definite cause for the reluctance of teachers to teach science. Also, the writer further felt that a breakdown into several groups might indicate more readily any differences that might occur among the groups. After interviews with teachers and those involved in teacher education, the above groups were chosen in order to provide insight into any differences that might occur.

The writer felt that the insights gained through identification of the expressed opinions of the elementary teachers could be of assistance to three primary groups: (1) people who are responsible for the preparation of elementary teachers in the teaching of science, (2) resource teachers and science supervisors, and (3) administrators in developing a modern science program that would be successful in their school systems.

CHAPTER IV

RESULTS OF THE STUDY

The purpose of this study is to determine if certain selected factors affect the opinions of elementary school teachers in the teaching of science. Considerable evidence has been presented to indicate that elementary teachers are reluctant to teach science. Evidence has also been presented to indicate that there are certain factors which influence the teaching of science in the elementary school.

Chapter IV reports the responses made by the respondents to an opinionnaire designed to elicit the opinions of the sample concerning various aspects that might affect science teaching. The report includes: (1) a description of the sample, (2) the expressed opinions of the sample towards the selected factors concerning science teaching in the elementary grades, and (3) the expressed opinions of the sample towards practices as they occurred and as they should have occurred in science subject-matter courses, science methods courses, in-service workshops or institutes, and in the assistance provided by science supervisors.

The Sample

The population from which data were collected was chosen from a stratified sampling in Oklahoma and groups which might provide special conditions inherent in the problem as has been indicated in Chapter III. A description of the participating groups is found in Appendix B. A

breakdown of the respondents by groups is found in Table I.

Opinionnaires were sent to 523 elementary teachers. Returns were received from 335 respondents. This represents a 64.05% return on the instrument. Since an attempt was made to minimize external factors which might influence the opinions of the respondents by having them omit their names and to return the instrument directly to the investigator, there could be no follow up for those who failed to respond. The investigator felt that under these conditions the response was sufficient for completing the analysis. The sample for the study thus consisted of those teachers who responded to the opinionnaire.

Description of the Sample

The first section of the opinionnaire was designed to provide pertinent general information about the respondents. The data in section one are presented in Tables II through VIII. The data are analyzed by: the number of years of teaching experience, the type of classroom teaching situation (departmentalized teaching or self-contained classroom teaching) the grade level at which the teachers were then teaching, the teacher's sex, the teacher's age, the number of hours of science course work indicated by the teachers, participation by the teacher in a science methods course, participation by the teacher in a science workshop or institute, and the extent of the teacher's college preparation. Analysis of the sample by these factors is provided in Table II which shows the total number of teachers in each group and the percent response based upon the total number of respondents to each group. (The number of teachers responding is of interest because the actual number of teachers involved is not shown on the graphs used to illustrate the responses. The percent of

TABLE I

BREAKDOWN OF RESPONDENTS BY GROUPS

Participating Groups	Community Population	Number of Opinionnaires Distributed	Number of Opinionnaires Returned	Percent of Opinionnaires Returned	Percent of Opinionnaires in Each Group of Total Returns
A	9,588	45	38	84.44	11.31
B	261,658	80	49	61.25	14.98
C	5,210	22	14	63.64	3.98
D	*a	62	37	59.68	11.01
E	*b	16	16	100.00	4.89
F	*c	83	83	100.00	25.38
G	38,859	207	90	43.51	25.99
H	*d	8	8	100.00	2.46
Totals		523	335	64.05	100.00

*a Participating group from selected extension classes provided by Oklahoma State University during the spring of 1965.
*b Participating group from the pilot study during the fall of 1964.
*c Participating group from student teachers in an elementary science methods course at Oklahoma State University during the spring of 1965.
*d Participating group from students enrolled in a graduate science methods course for elementary school teachers at Oklahoma State University during the summer of 1965.

TABLE II

BACKGROUND OF THE SAMPLE

Types of Information	Number	Percent
Classroom Teaching Situation		
Departmentalized Classroom Teachers	50	15.29
Self-Contained Classroom Teachers	277	84.71
Totals	327	100.00
Number of Years Teaching Experience		
0 to 3 Years	131	40.31
4 or More Years	194	59.69
Totals	325	100.00
Grade Teaching		
K, 1,2, or 3	152	46.63
4, 5, or 6	130	39.88
3 thru 6	24	7.36
1 and 2	4	1.23
1 thru 6	16	4.90
Totals	326	100.00
Sex		
Male	39	11.96
Female	287	88.04
Totals	326	100.00
Age		
Below 20	4	1.22
20 to 29	118	36.09
30 to 39	33	10.09
40 to 49	65	19.88
50 to 59	79	24.16
60 or above	28	8.56
Totals	327	100.00

TABLE II (Continued)

Types of Information		Number	Percent
Hours of Course Work			
1 to 6 Hours		46	14.94
7 to 12 Hours		147	47.73
13 to 18 Hours		50	16.23
19 to 24 Hours		32	10.39
25 to 30 Hours		10	3.25
Above 30 Hours		23	7.46
	Totals	308	100.00
Science Methods Course			
Yes		234	72.00
No		91	28.00
	Totals	325	100.00
Science Supervisor			
Yes		122	37.31
No		205	62.69
	Totals	327	100.00
Science Workshop or Institute			
Yes		140	43.08
No		185	56.92
	Totals	325	100.00
Level or Degree of Education			
Bachelors		255	78.95
Masters		34	10.53
Above a Masters		34	10.52
	Totals	323	100.00

teachers rather than the number is used.)

It will be evident that not all teachers responded to each item of the opinionnaire. Since the investigator could make no follow-up due to the method of return for the instrument, there could be no effort made to determine why teachers might fail to respond to any part of the instrument. Upon investigation of the responses, it was found that those who failed to respond to all of the items were few in number and that in all cases they failed to respond to only one or two items. The investigator then decided to ignore those few instances of no response. The percents were based upon the total response to each item.

This information provides a general description of the sample as follows: a majority of the teachers had four or more years teaching experience; were involved in self-contained classroom teaching situations; were teaching kintergarten, grade one, grade two or grade three; were females; were in the age bracket from 20 to 29 years of age; had 7 to 12 hours of science course work; had taken a science methods course; did not have the services of a science supervisor available; had not participated in a science workshop or institute; and had a bachelor's degree.

The investigator also felt that additional insight might be provided in the analysis of the responses if comparisons were made between selected groups for each statement or question. The groups that were selected were discussed in Chapter III. The groups selected were: (1) the type of classroom teaching situation (departmentalized teachers or self-contained classroom teachers), (2) the number of years teaching experience, (3) the grade that the teachers were then teaching, (4) participation by the teacher in a science methods course, and (5) the number of hours of science course work indicated by the teachers.

The type of classroom teaching situation was divided into two groups, (1) departmentalized classroom teachers and (2) self-contained classroom teachers. This information is reported in Table III. Table III indicates that the departmentalized classroom teachers differ from the sample in the grade that they are teaching (this would be expected from their teaching assignment and the categories that were selected). This group is also older than the sample, has more hours of science course work, have science supervisors, and have a science workshop or institute experience. While this group shows that it agrees with the sample in having a science methods course, the agreement is not as positivie as is indicated by the total response.

Table III would indicate also that the self-contained classroom teachers are in general agreement with the sample. This would be expected as these teachers make up the larger part of the sample. It should be noted, however, that the distinctions in both the number of years teaching experience and the grade teaching are not great.

The number of years teaching experience was divided into two groups, (1) teachers with 0 to 3 years teaching experience (inexperienced teachers) and (2) teachers with four or more years teaching experience (experienced teachers). This information is reported in Table IV.

Table IV indicates that the inexperienced teachers are in general agreement with the sample. This table also indicates that the experienced teachers differ from the sample in the grade teaching (intermediate grades), in being older, and in having a science workshop or institute experience. It should be noted that the distinction in having a science methods course and in not having a science supervisor is not great.

The grade that the respondents are now teaching was divided into

TABLE III

CLASSROOM TEACHING SITUATION

Types of Information	Departmentalized		Self-Contained	
	#	%	#	%
Number of Years Teaching Experience				
0 to 3 Years	11	22.00	120	43.64
4 or More Years	39	78.00	155	56.36
Totals	50	100.00	275	100.00
Grade Teaching				
K, 1, 2, or 3	3	6.00	149	53.99
4, 5, or 6	4	8.00	126	45.65
3 thru 6	24	48.00	0	0.00
1 and 2	4	8.00	0	0.00
1 thru 6	15	30.00	1	0.36
Totals	50	100.00	276	100.00
Sex				
Male	17	34.00	22	7.97
Female	33	66.00	254	92.03
Totals	50	100.00	276	100.00
Age				
Below 20	0	0.00	4	1.44
20 to 29	8	16.00	110	39.71
30 to 39	8	16.00	25	9.03
40 to 49	16	32.00	49	17.69
50 to 59	14	28.00	65	23.47
60 or Above	4	8.00	24	8.66
Totals	50	100.00	277	100.00

TABLE III (Continued)

Types of Information	Departmentalized		Self-Contained	
	#	%	#	%
Science Methods Course				
Yes	28	58.33	206	74.37
No	20	41.67	71	25.63
Totals	48	100.00	277	100.00
Science Supervisor				
Yes	49	98.00	73	26.35
No	1	2.00	204	73.65
Totals	50	100.00	277	100.00
Science Workshop or Institute				
Yes	45	90.00	95	34.55
No	5	10.00	180	65.45
Totals	50	100.00	275	100.00
Hours of Science Course Work				
1 to 6 Hours	1	2.13	45	17.24
7 to 12 Hours	10	21.28	137	52.49
13 to 18 Hours	10	21.28	40	15.33
19 to 24 Hours	8	17.02	24	9.20
25 to 30 Hours	5	10.64	5	1.92
Above 30 Hours	13	27.65	10	3.82
Totals	47	100.00	261	100.00

TABLE IV

NUMBER OF YEARS OF TEACHING EXPERIENCE

Types of Information	0 to 3 Years		4 or More Years	
	#	%	#	%
Classroom Teaching Situation				
Departmentalized	11	8.40	39	20.10
Self-Contained	120	91.60	155	79.90
Totals	131	100.00	194	100.00
Grade Teaching				
K, 1, 2 or 3	79	60.31	72	37.31
4, 5 or 6	42	32.06	87	45.08
3 thru 6	6	4.58	18	9.33
1 and 2	0	0.00	4	2.07
1 thru 6	4	3.05	12	6.21
Totals	131	100.00	193	100.00
Sex				
Male	10	7.63	29	15.03
Female	121	92.37	164	84.97
Totals	131	100.00	193	100.00
Age				
Below 20	3	2.29	1	0.52
20 to 29	111	84.73	7	3.61
30 to 39	11	8.40	22	11.34
40 to 49	5	3.82	60	30.93
50 to 59	1	0.76	77	39.69
60 or Above	0	0.00	27	13.91
Totals	131	100.00	194	100.00

TABLE IV (Continued)

Types of Information	0 to 3 Years		4 or More Years	
	#	%	#	%
Hours of Course Work				
1 to 6 Hours	7	5.34	38	21.71
7 to 12 Hours	80	61.07	66	37.71
13 to 18 Hours	27	20.61	23	13.14
19 to 24 Hours	11	8.40	21	12.00
25 to 30 Hours	3	2.29	7	4.00
Above 30 Hours	3	2.29	20	11.44
Totals	131	100.00	175	100.00
Science Methods Course				
Yes	120	91.60	113	58.85
No	11	8.40	79	41.15
Totals	131	100.00	192	100.00
Science Supervisor				
Yes	27	20.61	95	48.97
No	104	79.39	99	51.03
Totals	131	100.00	194	100.00
Science Workshop or Institute				
Yes	18	13.85	122	63.21
No	112	86.15	71	36.79
Totals	130	100.00	193	100.00

five groups: (1) respondents teaching in kintergarten, grade one, grade two, or grade three (primary grade teachers); (2) respondents teaching grade four, grade five, or grade six (intermediate grade teachers); (3) respondents teaching grade three through grade six; (4) respondents teaching grades one and two; and (5) respondents teaching grade one thru grade six. Groups (1) and (2) were established for the self-contained classroom teachers; and groups (3), (4), and (5) for the departmentalized classroom teachers. All discussions of grade teaching will introduce the differences that might occur between primary grade teachers and intermediate grade teachers and the differences that would occur in the groups established for the departmentalized teaching situation. A breakdown by groups is provided in Table V.

Table V indicates that those teachers of the primary grades differ from the sample in having less teaching experience (there is not a great difference indicated). Teachers of the intermediate grades are in general agreement with the sample. Teachers of grades three through six differ from the sample in being departmentalized classroom teachers, in being older than the sample, in having more course work in science, in having a science supervisor, and in having a science workshop or institute experience. This group also indicates an equal division of those who have and those who do not have a science methods course. Teachers of grades one and two differ from the sample in being departmentalized classroom teachers, in being older than the sample, in having more course work, in having a science supervisor, and in having a science workshop or institute experience. Teachers of grades one through six differ from the sample in being departmenatlized classroom teachers, in being older than the sample, in having more science course work, in having a science supervisor, and

TABLE V

GRADE TEACHING

Types of Information	K, 1, 2 or 3		4, 5 or 6		3 thru 6		1 and 2		1 thru 6	
	#	%	#	%	#	%	#	%	#	%
Classroom Teaching Situation										
Departmentalized	3	1.97	4	3.08	24	100.00	4	100.00	15	93.75
Self-Contained	149	98.03	126	96.92	0	0.00	0	0.00	1	6.25
Totals	152	100.00	130	100.00	24	100.00	4	100.00	16	100.00
Number of Years Teaching Experience										
0 to 3 Years	79	52.32	42	32.56	6	25.00	0	0.00	4	25.00
4 or More Years	72	47.68	87	67.44	18	75.00	4	100.00	12	75.00
Totals	151	100.00	129	100.00	24	100.00	4	100.00	16	100.00
Sex										
Male	3	1.99	23	17.69	8	33.33	0	0.00	5	31.25
Female	148	98.01	107	82.31	16	66.67	4	100.00	11	68.75
Totals	151	100.00	130	100.00	24	100.00	4	100.00	16	100.00
Science Methods Course										
Yes	114	75.00	96	73.85	12	50.00	3	100.00	9	60.00
No	38	25.00	34	26.15	12	50.00	0	0.00	6	40.00
Totals	152	100.00	130	100.00	24	100.00	3	100.00	15	100.00

TABLE V (Continued)

Types of Information	K, 1, 2 or 3		4, 5 or 6		3 thru 6		1 and 2		1 thru 6	
	#	%	#	%	#	%	#	%	#	%
Age										
Below 20	4	2.63	0	0.00	0	0.00	0	0.00	0	0.00
20 to 29	70	46.05	41	31.54	4	16.67	0	0.00	3	18.75
30 to 39	10	6.58	16	12.31	5	20.83	0	0.00	2	12.50
40 to 49	23	15.13	26	20.00	7	29.17	2	50.00	6	37.50
50 to 59	31	20.39	36	27.69	8	33.33	2	50.00	2	12.50
60 or Above	14	9.22	11	8.46	0	0.00	0	0.00	3	18.75
Totals	152	100.00	130	100.00	24	100.00	4	100.00	16	100.00
Hours of Course Work										
1 to 6 Hours	29	19.73	15	12.71	0	0.00	1	25.00	1	6.67
7 to 12 Hours	82	55.78	56	47.46	5	21.74	0	0.00	3	20.00
13 to 18 Hours	19	12.93	22	18.64	5	21.74	1	25.00	3	20.00
19 to 24 Hours	13	8.84	13	11.02	5	21.74	1	25.00	0	0.00
25 to 30 Hours	2	1.36	3	2.54	2	8.70	0	0.00	3	20.00
Above 30 Hours	2	1.36	9	7.63	6	26.08	1	25.00	5	33.33
Totals	147	100.00	118	100.00	23	100.00	4	100.00	15	100.00
Science Supervisor										
Yes	38	25.00	40	30.77	24	100.00	4	100.00	16	100.00
No	114	75.00	90	69.23	0	0.00	0	0.00	0	0.00
Totals	152	100.00	130	100.00	24	100.00	4	100.00	16	100.00
Science Workshop or Institute										
Yes	50	32.89	50	39.06	22	91.67	3	75.00	14	87.50
No	102	67.11	78	60.94	2	8.33	1	25.00	2	12.50
Totals	152	100.00	128	100.00	24	100.00	4	100.00	16	100.00

in having a science workshop or institute experience.

The course work in science was divided into six groups: (1) 1 to 6 hours, (2) 7 to 12 hours, (3) 13 to 18 hours, (4) 19 to 24 hours, (5) 25 to 30 hours and (6) more than 30 hours. A breakdown by groups is reported in Table VI.

Table VI indicates that those teachers with 1 to 6 hours of science course work differ from the sample in not having a science methods course (only a small difference is indicated) and in being older than the sample. It should be noted that the difference indicated between those teachers who have a science workshop or institute experience and those teachers who do not is very small.

Those teachers with 7 to 12 hours of science course work differ from the sample in having less teaching experience. Those teachers with 13 to 18 hours of science course work differ from the sample in having less teaching experience and in teaching the intermediate grades. It should be noted that the difference indicated in science supervisors and science workshop or institute experience is not great.

Those teachers with 19 to 24 hours of science course work differ from the sample in having an equal distribution of teachers in the primary and the intermediate grade categories. They also differ in having a science supervisor (not a great difference is indicated) and in having a science workshop or institute experience.

The respondents with 25 to 30 hours of science course work differ from the sample in having an equal distribution of teachers in departmentalized and self-contained classroom teacher groups, in being older than the sample, in being distributed in the intermediate grades or grades 1 through 6, in having a science supervisor, and in having a science

TABLE VI

COURSE WORK

Types of Information	1-6 Hours		7-12 Hours		13-18 Hours		19-24 Hours		25-30 Hours		More 30 Hours	
	#	%	#	%	#	%	#	%	#	%	#	%
Classroom Teaching Situation												
Departmentalized	1	2.17	10	6.80	10	20.00	8	25.00	5	50.00	13	56.52
Self-Contained	45	97.83	137	93.20	40	80.00	24	75.00	5	50.00	10	43.48
Totals	46	100.00	147	100.00	50	100.00	32	100.00	10	100.00	23	100.00
Number of Years Teaching Experience												
0 to 3 Years	7	15.56	80	54.79	27	54.00	11	34.38	3	30.00	3	13.04
4 or More Years	38	84.44	66	45.21	23	46.00	21	65.62	7	70.00	20	86.96
Totals	45	100.00	146	100.00	50	100.00	32	100.00	10	100.00	23	100.00
Sex												
Male	4	8.70	11	7.48	5	10.20	6	18.75	1	10.00	11	47.83
Female	42	91.30	136	92.52	44	98.80	26	81.25	9	90.00	12	52.17
Totals	46	100.00	147	100.00	49	100.00	32	100.00	10	100.00	23	100.00
Science Methods Course												
Yes	22	48.89	116	78.91	37	74.00	22	68.75	7	77.78	18	78.26
No	23	51.11	31	21.09	13	26.00	10	31.25	2	22.22	5	21.74
Totals	45	100.00	147	100.00	50	100.00	32	100.00	9	100.00	23	100.00

TABLE VI (Continued)

Types of Information	1-6 Hours		7-12 Hours		13-18 Hours		19-24 Hours		25-30 Hours		More 30 Hours	
	#	%	#	%	#	%	#	%	#	%	#	%
Age												
Below 20	1	2.17	2	1.36	1	2.00	0	0.00	0	0.00	0	0.00
20 to 29	3	6.52	76	51.70	20	40.00	12	37.50	3	30.00	4	17.39
30 to 39	7	15.22	11	7.48	9	18.00	1	3.13	0	0.00	2	8.70
40 to 49	10	21.74	24	16.33	7	14.00	10	31.25	2	20.00	7	30.43
50 to 59	21	45.65	24	16.33	8	16.00	6	18.75	4	40.00	7	30.43
60 or Above	4	8.70	10	6.80	5	10.00	3	9.37	1	10.00	3	13.05
Totals	46	100.00	147	100.00	50	100.00	32	100.00	10	100.00	23	100.00
Grade Teaching												
K, 1, 2 or 3	29	63.04	82	56.16	19	38.00	13	40.63	2	20.00	2	8.70
4, 5 or 6	15	32.61	56	38.36	22	44.00	13	40.63	3	30.00	9	39.13
3 thru 6	0	0.00	5	3.42	5	10.00	5	15.63	2	20.00	6	26.09
1 and 2	1	2.17	0	0.00	1	2.00	1	3.11	0	0.00	1	4.35
1 thru 6	1	2.18	3	2.06	3	6.00	0	0.00	3	30.00	5	21.73
Totals	46	100.00	146	100.00	50	100.00	32	100.00	10	100.00	23	100.00
Science Supervisor												
Yes	17	36.96	37	25.17	24	48.00	19	59.38	7	70.00	13	56.52
No	29	63.04	110	74.83	26	52.00	13	40.62	3	30.00	10	43.48
Totals	46	100.00	147	100.00	50	100.00	32	100.00	10	100.00	23	100.00
Science Workshop or Institute												
Yes	19	41.30	42	28.77	24	48.00	20	62.50	6	60.00	16	72.73
No	27	58.70	104	71.23	26	52.00	12	37.50	4	40.00	6	27.27
Totals	46	100.00	146	100.00	50	100.00	32	100.00	10	100.00	22	100.00

workshop or institute experience.

Those teachers with more than 30 hours of science course work differ from the sample in being departmentalized classroom teachers (there is not a great difference indicated), in being older than the sample, in teaching in the intermediate grades, in having a science supervisor and in having experience in a science workshop or institute. It should be noted that the difference is not great between the males and females in this group.

The writer also felt that more insight might be gained by providing information concerning the types of science courses which had been taken by the respondents. The respondents were asked to indicate the number of hours that they had taken in each of the following fields of science: (1) general biology, (2) zoology, (3) botany, (4) chemistry (5) physics, (6) physical science, (7) meteorology, (8) astronomy, and (9) geology. Most of the teachers had taken a general biology course. Courses in geology were reported next most frequently with courses in physical science, botany, zoology, chemistry, and physics following in order of the number of hours taken. Very few of the respondents had taken courses in astronomy or meteorology. This information is reported in Table VII.

Participation in a science methods course was noted for two groups: (1) those teachers who had a science methods course, and (2) those teachers who did not have a science methods course. This information is reported in Table VIII.

Table VIII indicates that teachers who have a science methods course differ from the sample in having less teaching experience (the difference is very small). It should be noted also that the difference in the grade level that they are teaching is small between the primary grade teachers

TABLE VII

BREAKDOWN OF SCIENCE COURSE WORK INTO SUBJECTS

Subjects	1-3 hours		4-6 hours		7-8 hours		10-12 hours		13-16 hours		More Than 16 hours		Totals	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Hours of General Biology	49	21.68	136	60.18	26	11.50	8	3.54	3	1.33	4	1.77	226	73.33
Hours of Zoology	31	31.31	54	54.55	5	5.05	7	7.07	1	1.01	1	1.01	99	32.14
Hours of Botany	45	40.91	48	43.64	6	5.45	3	2.73	1	0.91	7	6.36	110	35.71
Hours of Chemistry	19	19.59	44	45.36	19	19.59	6	6.19	4	4.12	5	5.15	97	31.49
Hours of Physics	23	29.49	46	58.97	7	8.97	0	0.00	1	1.28	1	1.29	78	25.85
Hours of Physical Science	54	43.90	57	46.34	9	7.32	1	0.81	1	0.81	1	0.82	123	39.98
Hours of Meteorology	8	66.67	3	25.00	0	0.00	0	0.00	0	0.00	1	8.33	12	3.89
Hours of Astronomy	11	68.75	4	25.00	0	0.00	0	0.00	0	0.00	1	6.25	16	5.19
Hours of Geology	36	27.69	81	62.31	8	6.15	3	2.31	1	0.77	1	0.77	130	42.21

TABLE VIII

SCIENCE METHODS COURSE

Types of Information	Have a Methods Course		Have No Methods Course	
	#	%	#	%
Classroom Teaching Situation				
Departmentalized	28	11.97	20	21.98
Self-Contained	206	88.03	71	78.02
Totals	234	100.00	91	100.00
Number of Years Teaching				
0 to 3 Years	120	51.50	11	12.22
4 or More Years	113	48.50	79	87.78
Totals	233	100.00	90	100.00
Grade Teaching				
K, 1, 2 or 3	114	48.72	38	42.22
4, 5 or 6	96	41.03	34	37.78
3 thru 6	12	5.13	12	13.33
1 and 2	3	1.28	0	0.00
1 thru 6	9	3.84	6	6.67
Totals	234	100.00	90	100.00
Sex				
Male	28	11.97	11	12.22
Female	206	88.03	79	87.78
Totals	234	100.00	90	100.00

TABLE VIII (Continued)

Types of Information	Have a Methods Course		Have No Methods Course	
	#	%	#	%
Hours of Course Work				
1 to 6 Hours	22	9.91	23	27.38
7 to 12 Hours	116	52.25	31	36.90
13 to 18 Hours	37	16.67	13	15.48
19 to 24 Hours	22	9.91	10	11.90
25 to 30 Hours	7	3.15	2	2.38
Above 30 Hours	18	8.11	5	5.96
Totals	222	100.00	84	100.00
Science Supervisor				
Yes	75	32.05	45	49.45
No	159	67.95	46	50.55
Totals	234	100.00	91	100.00
Science Workshop or Institute				
Yes	88	37.61	50	56.18
No	146	62.39	39	43.82
Totals	234	100.00	89	100.00
Age				
Below 20	3	1.28	1	1.10
20 to 29	107	45.73	11	12.09
30 to 39	26	11.11	7	7.69
40 to 49	35	14.96	30	32.97
50 to 59	48	20.51	30	32.97
60 or Above	15	6.41	12	13.18
Totals	234	100.00	91	100.00

and the intermediate grade teachers.

The teachers who do not have a science methods course differ from the sample in being older and in having science workshop or institute experience. It should be noted also that the differences in the grade level that they are teaching are small between the primary grade teachers and the intermediate grade teachers. The difference is very small between those teachers who have a science supervisor and those teachers who do not have a science supervisor.

It is then seen by a comparative analysis of each group to the sample that there are differences that occur in each group other than in the self-contained classroom teachers. By analyzing each question or statement by comparison of the total response to each total group response, some insight might be gained on the responses that were made. These insights should be helpful in making recommendations for improvements that could be made in the quality of the elementary science program.

Findings of the Study

The following section is a report of the responses that were made to the questions or statements designed to elicit the opinions of the sample to selected factors concerning science and science teaching at the elementary school level. Each question has been subjected to a breakdown of responses by percent based upon the total number of responses in each category.

In addition to considering the response of the sample as a group, certain comparisons were made among groups to provide insight into differences that might occur which would not be indicated by the total responses. Each question or statement then is broken down into the

following analysis: (1) all respondents; (2) departmentalized classroom teachers; (3) self-contained classroom teachers; (4) teachers with 0 to 3 years teaching experience (inexperienced teachers); (5) teachers with 4 or more years teaching experience (experienced teachers); (6) respondents teaching kintergraten, grade one, grade two, or grade three (primary grade teachers); (7) respondents teaching grades four, five, or six (intermediate grade teachers); (8) respondents teaching grades three through six; (9) respondents teaching grades one and two; (10) respondents teaching grades one through six; (11) teachers who have a science methods course; (12) teachers who do not have a science methods course; (13) teachers with one to six hours of science course work; (14) teachers with seven to twelve hours of science course work; (15) teachers with thirteen to eighteen hours of science course work; (16) teachers with nineteen to twenty-four hours of science course work; (17) teachers with twenty-five to thirty hours of science course work; and (18) teachers with more than thirty hours of science course work. After much consideration, the investigator felt that graphs illustrating the breakdown of all 18 factors would provide the clearest representation of the data. These graphs for each statement or question are represented in Figure 1 through Figure 133.

Evidence of Time Devoted to Teaching Science

Since the review of the literature indicates that teachers are reluctant to teach science in the elementary school, the investigator felt that establishment of the amount of time the sample devotes to teaching science should be the first consideration given in this study.

The respondents were asked to report the amount of time that they

devote to teaching science in an open-ended question which asked them to respond in terms of times per year, days per month, days per week, or hours per day. An open-ended question was used because it was felt this approach might provide a more accurate view of the existing conditions than would be likely to result if selected choices for the respondents to check were provided. From the responses given the investigator formed the following categories: (1) none, (2) less than thirty minutes a day, (3) thirty minutes to one hour a day, (4) once a week, (5) once a month and (6) all day. This information is provided in Figure 1.

Figure 1 illustrates that most of the respondents indicate that they teach science from thirty minutes to one hour a day with less than thirty minutes a day the second choice. Since there is such a small percent of the respondents who indicate they are not teaching science at all or only once a week or once a month, there appears to be an indication that at least in this sample teachers are indicating that they teach more science than would be expected from the review of the literature.

Figure 1 also provides a comparison of the various groups established to provide insight into differences that might occur in the responses of various groups to the total responses made. There is a significant difference in the responses that were made between departmentalized classroom teachers and self-contained classroom teachers. This might be expected for the departmentalized teachers have as their major responsibility the teaching of science or a combination of science and some other subject-matter area. The category of "teaching science all day" originated for this group, and it is seen that most of this group indicate that they do teach science all day. There is little evidence of differences among the number of years teaching experience groups. The

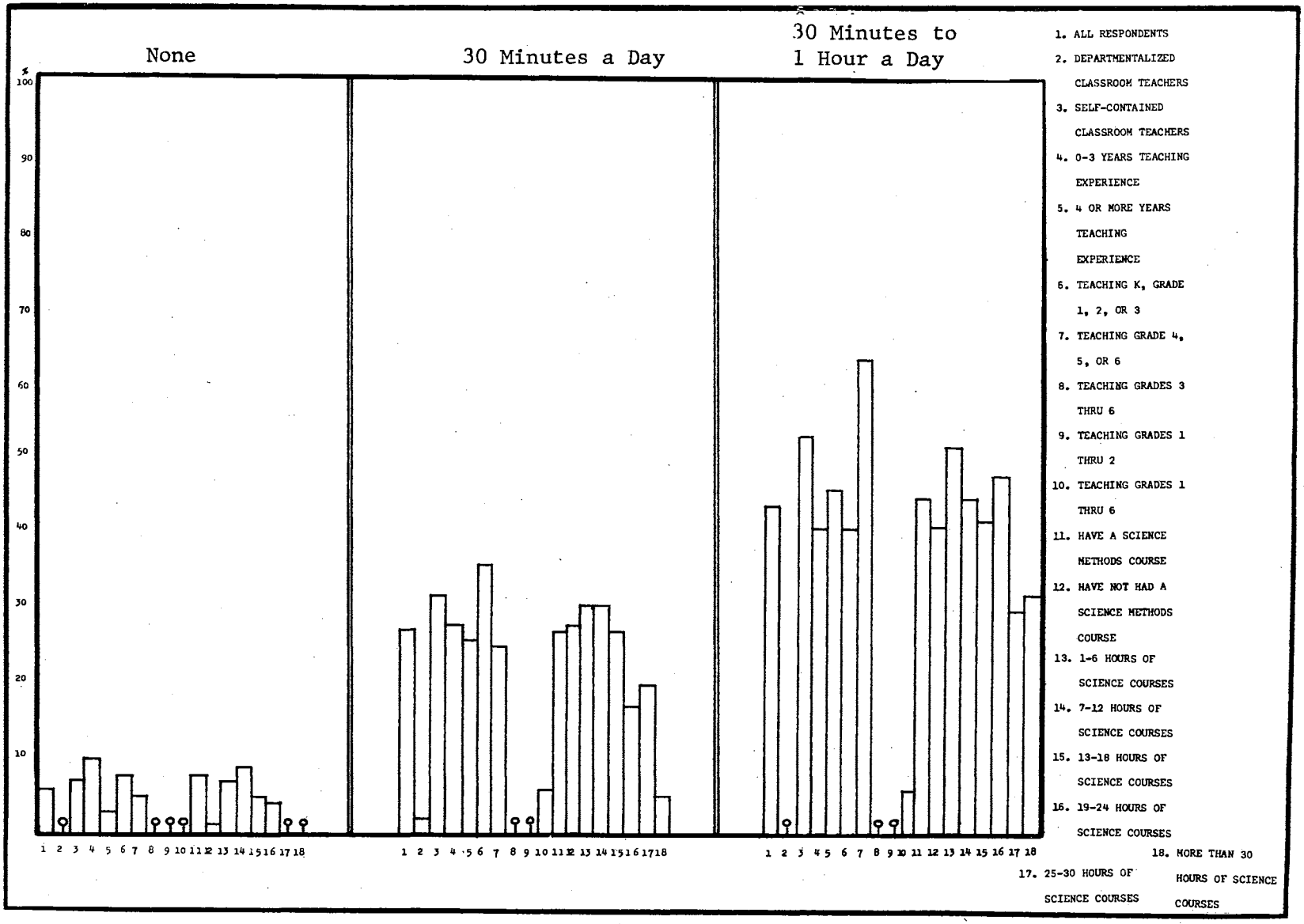

Figure 1. Approximate Time Devoted to Teaching Science

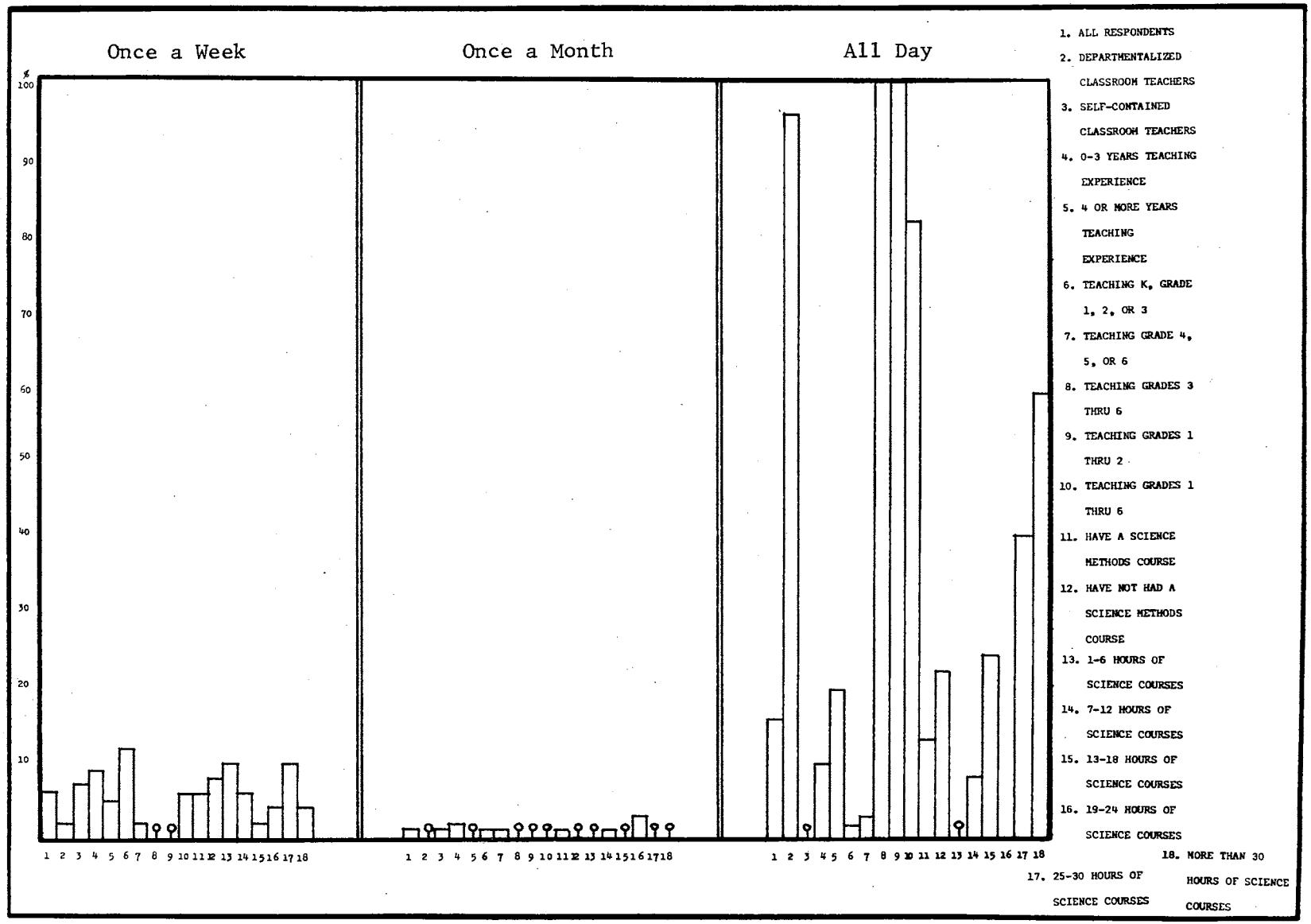

Figure 1. (continued)

differences that occur among the grade level that the teachers are teaching and the total response appear to be due to the categories that were established for the departmentalized classroom teachers. They are the teachers involved in the categories for teaching grades three through six, one and two, and one through six. There does not appear to be a significant difference in the responses of those teachers who have a science methods course and those who do not have a science methods course. The differences that occur in the amount of science course work again appear to be due to the fact that the departmentalized classroom teachers have more science course work in the areas of difference than do the self-contained classroom teachers.

The respondents were also asked to report on how much of the total time devoted to science teaching they used in science demonstration or experimentation. This was an open ended question from which the following categories were formed: (1) none, (2) less than 30 minutes a day, (3) 30 minutes to one hour a week, (4) one to three hours a week, (5) less than once a month, and (6) as much as is needed. The last category was not considered to be satisfactory, but there were a few respondents who made the category mandatory. This information is reported in Figure 2.

Figure 2 indicates that there was no clear cut pattern shown by the sample on the matter of providing demonstration or experimentation. There was a close percent distribution in four categories with 30 minutes to one hour a week first, with less than 30 minutes a day, none, and one to three hours a week following in this order. Very few indicated less than once a month and as much as is needed.

The comparative analysis shows that there is some variation among the comparative groups. The departmentalized classroom teachers vary

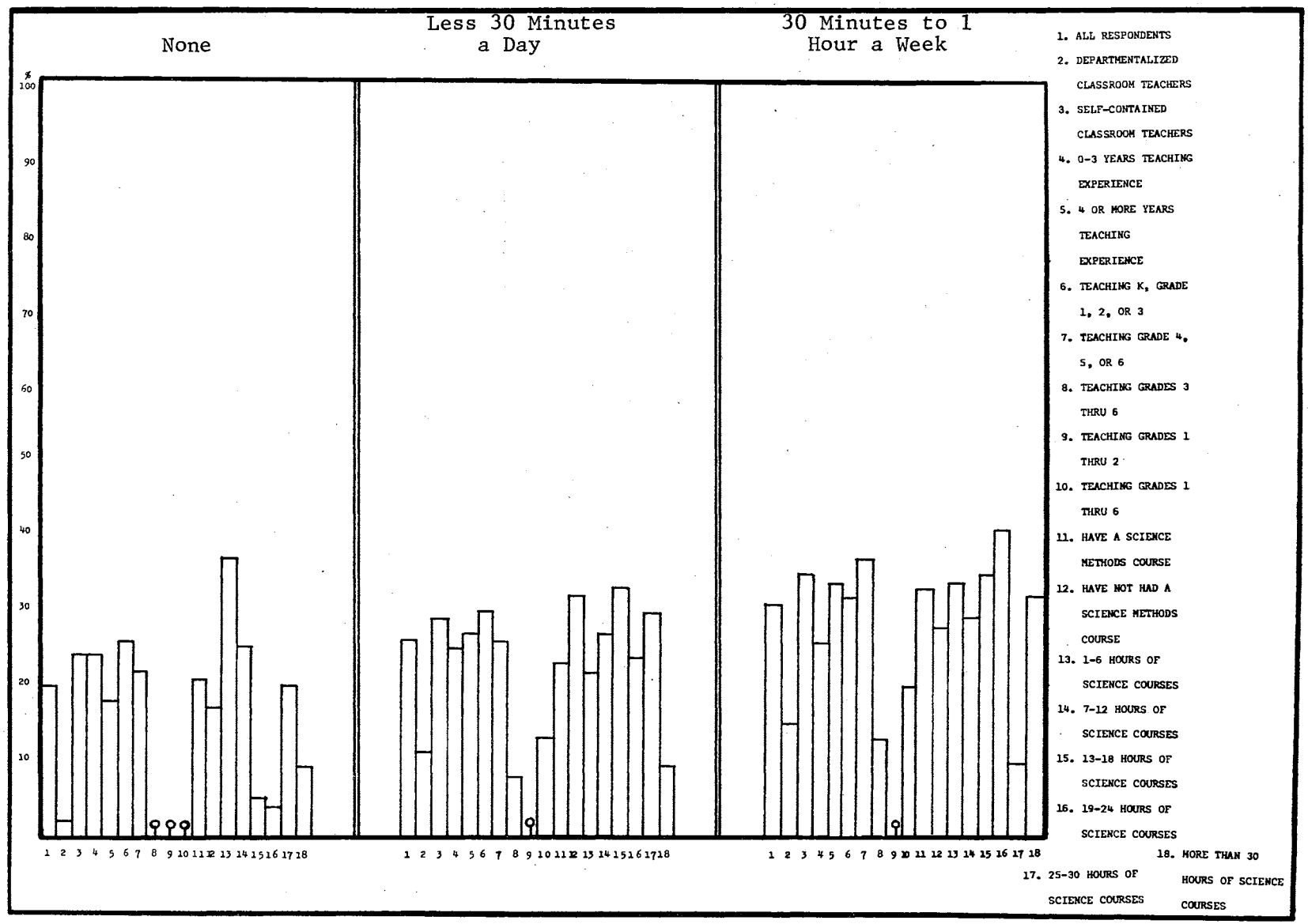

Figure 2. Approximate Time Devoted to Science Demonstrations and Experimentation

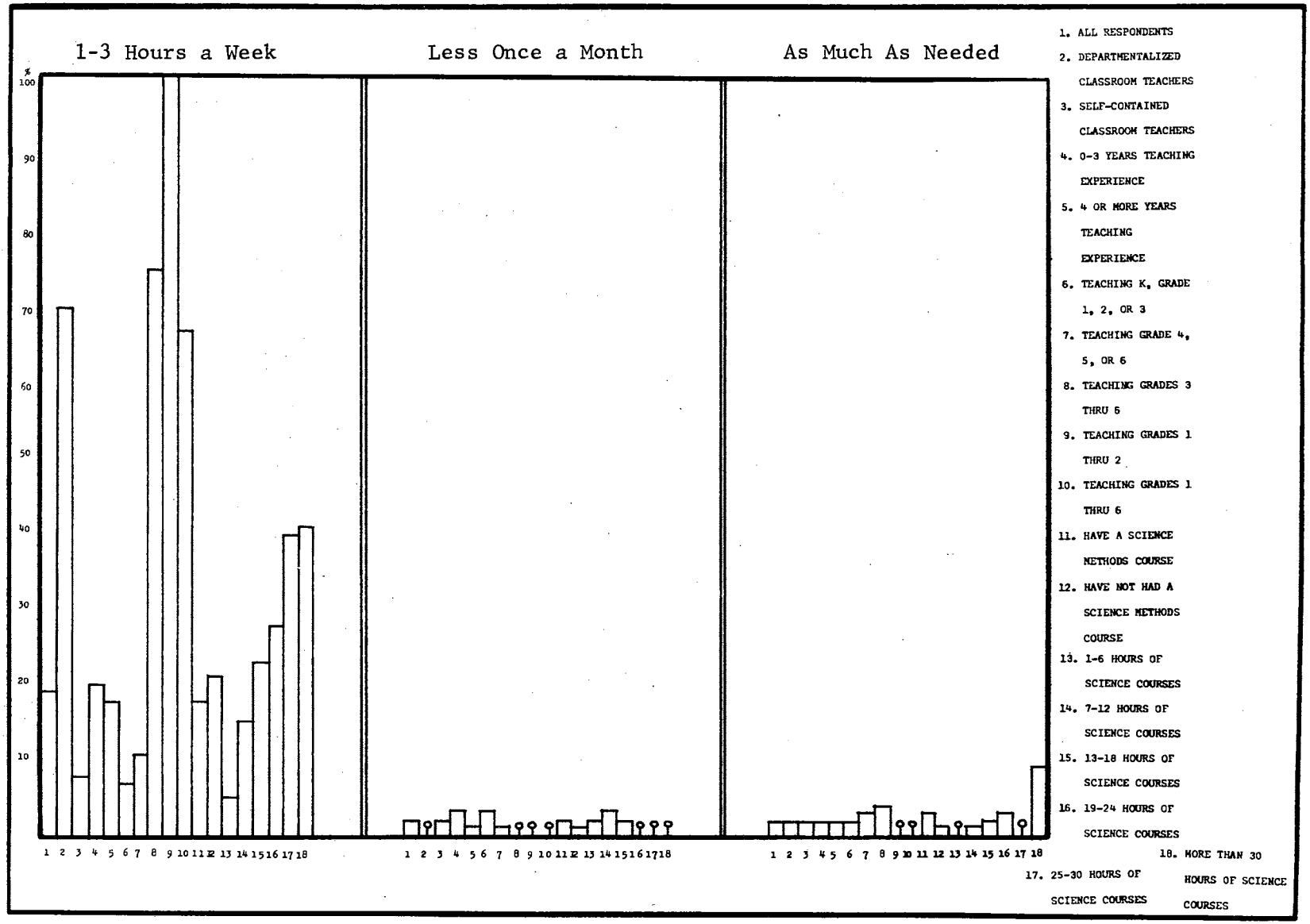

Figure 2. (continued)

in that most of the teachers indicate they spend from one to three hours a week in demonstration and experimentation. This result might be expected when one considers the fact that these teachers spend more time in teaching science.

There is little evidence of difference in the teachers' opinions attributed to the number of years of teaching experience. The differences that occur between the grade levels appears to be due to the categories that were established for the departmentalized classroom teachers. There does not appear to be a significant difference between the individuals who have or do not have a science methods course. Those respondents with a smaller amount of course work appear to devote less time to demonstration and experimentation than those with more science course work. There is a noticeable exception to this generalization in the group that has 25 to 30 hours of science course work. This group has a surprising percent of individuals who provide no demonstration or experimentation and who provide less than 30 minutes a day for these activities.

Expressed Opinions Concerning Teacher Preparation

The review of the literature indicated that teachers were not adequately prepared to teach science and that this was a probable reason for their reluctance to teach it. The respondents were asked to express their opinions on thirteen statements concerning their preparation to teach science at the elementary school level.

The teachers in the sample were asked to respond to the statement that their present science background was sufficient for teaching science at the elementary school level with a yes or no. A majority of the teachers indicated that they did not feel that their present background

was sufficient. This information is illustrated in Figure 3.

The comparative analysis of the groups indicate some differences. While a majority of the departmentalized teachers felt that they were prepared to teach science, a majority of the self-contained classroom teachers felt that they were not prepared to teach science. There was little difference indicated by the number of years teaching experience. There were few differences in the grade level that the teachers were teaching other than those due to the categories established for the departmentalized teachers. The teachers of grades 1 and 2 indicated a greater agreement with the statement. Those teachers with a science methods course indicate a feeling of adequate preparation; those teachers who do not have a science methods course indicate a feeling that their science background is insufficient. The more science course work the respondents have the more they feel that their present science background is sufficient for teaching science at the elementary school level.

The respondents were asked to respond to the statement that they were not familiar with science and would prefer leaving the teaching of science to those who are familiar with science. More than three-fourths of the respondents gave a negative response to this statement. This information is illustrated in Figure 4. The comparative analysis indicates that the groups differ only in the degree of disagreement with the statement. The departmentalized teachers, the teachers of grades 3-6 the teachers with a methods course, and the teachers with more course work indicate a greater degree of disagreement with the statement than their comparative groups. There is little difference indicated in the number of years teaching experience.

The respondents were asked, in three questions, to report their

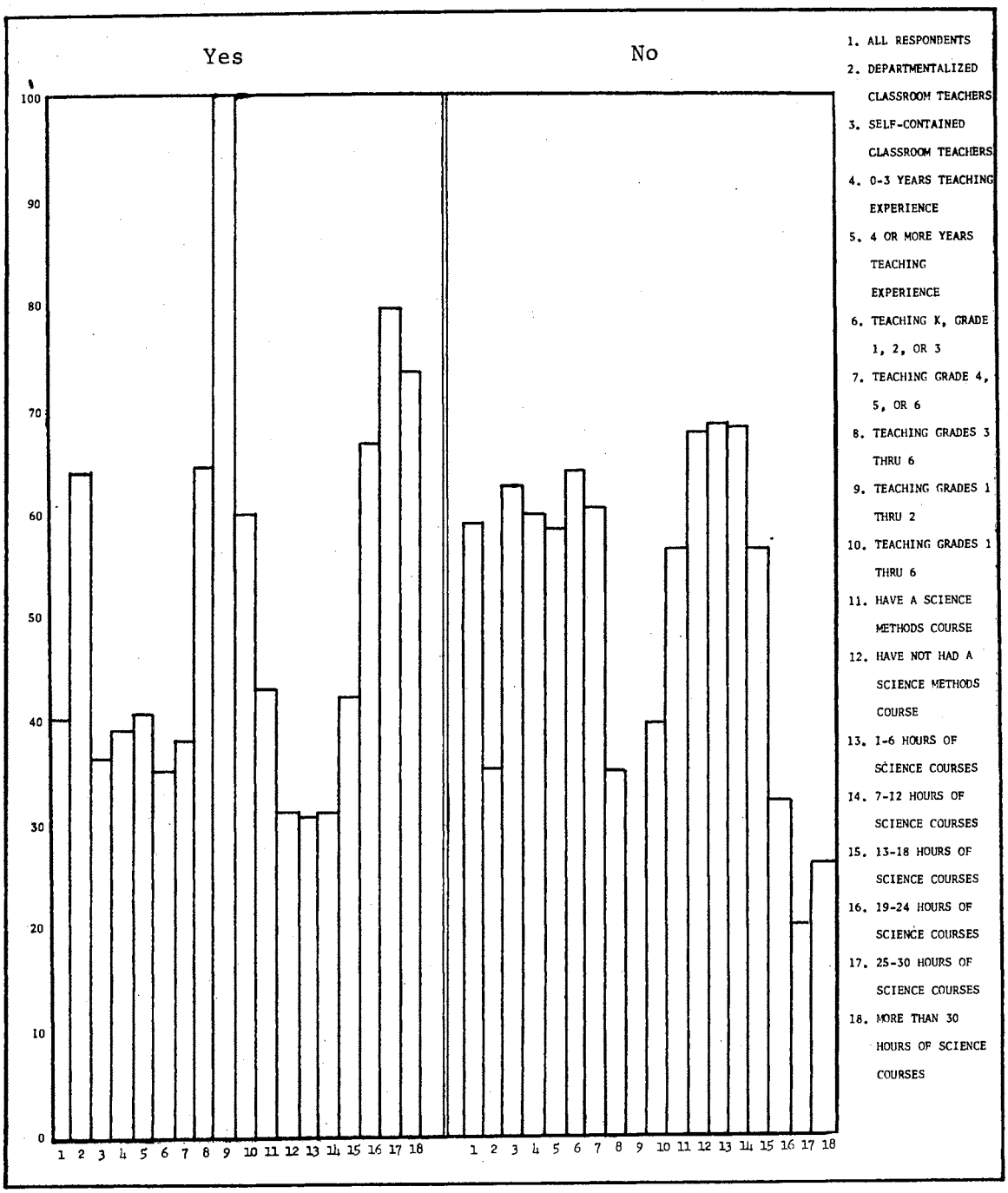

Figure 3. Feeling That Present Background Is Sufficient for Teaching Science

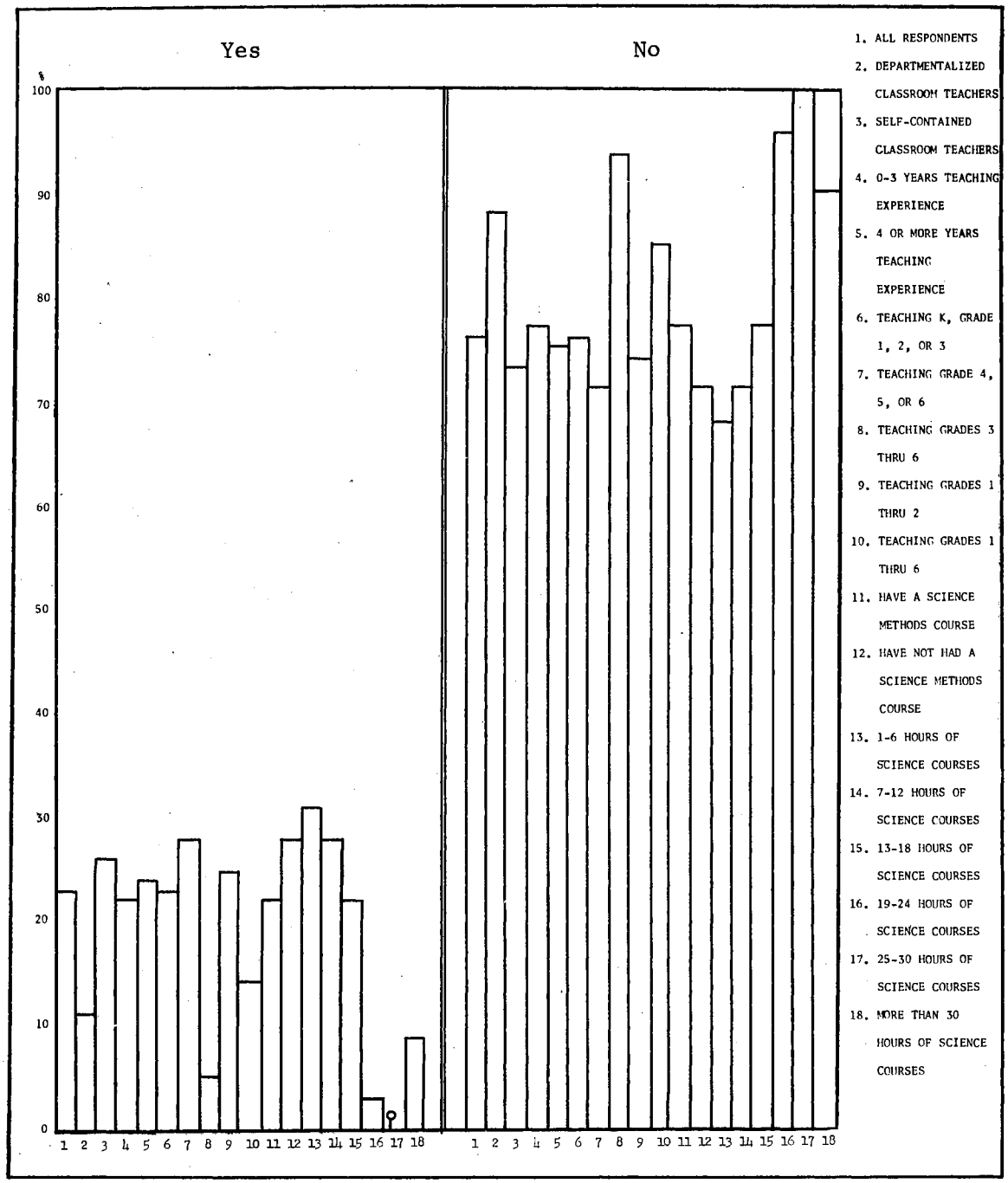

Figure 4. Not Familiar With Science and Would Prefer Others Teach Science

opinions on the type of science preparation that they need to do an adequate job of teaching science at the elementary school level. First, they were asked if a teacher need be familiar only with the knowledge that is present in junior high school textbooks (Figure 5). Second, they were asked if a teacher need be familiar only with the knowledge presented in high school biology, chemistry and physics textbooks (Figure 6). Third, they were asked if a teacher need be familiar only with the knowledge presented in the basic college introductory courses in science (Figure 7).

The opinions expressed by the respondents to all three questions were negative. These responses indicated that they felt that teachers should know more than is provided in junior high or high school biology, chemistry and physics textbooks as well as more knowledge than is presented in the basic college science introductory courses. There were no great differences in the responses of the various comparative groups.

Figure 5 indicates that the self-contained classroom teachers, the teachers of grades 1-2, and the teachers with 25-30 hours of science course work show a greater degree of disagreement with the statement than do their comparative groups. The teachers of grades 3-6 and the teachers with 1 to 6 or 13 to 18 hours of science course work indicate smaller disagreement with the statement.

Figure 6 illustrates that the inexperienced teachers, the primary teachers, the teachers of grades 1-2, the teachers with a methods course and the teachers with 19 to 24 hours indicate a greater degree of disagreement with the statement than do their comparative groups. The teachers of grades 3-6 and the teachers with 7 to 12 hours of science course work indicate a lower degree of disagreement with the statement.

Figure 7 illustrates that the self-contained classroom teachers and

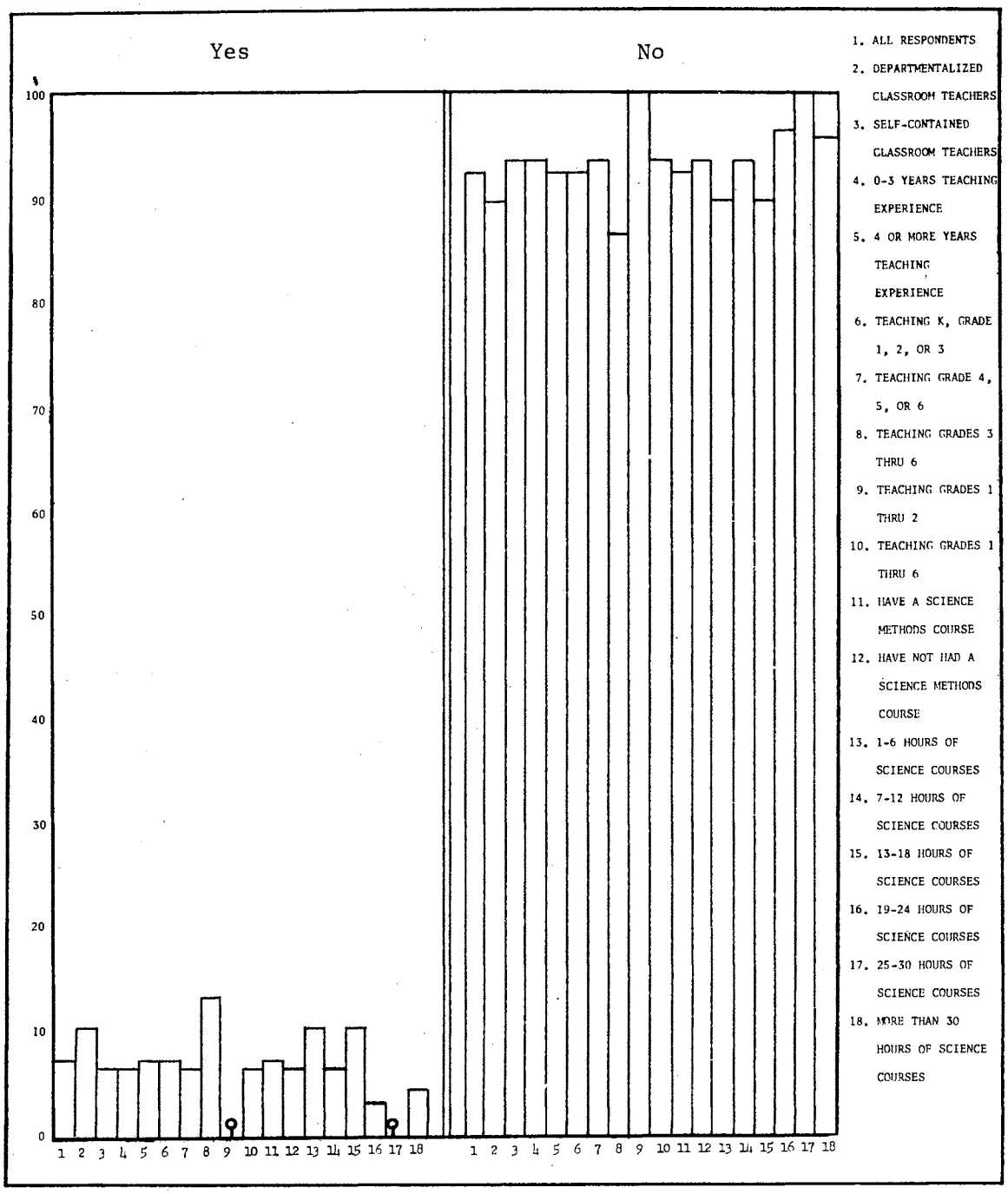

Figure 5. To Do an Adequate Job of Teaching Science in the Elementary School a Teacher Need Be Familiar Only With the Knowledge Presented in Junior High School Textbooks

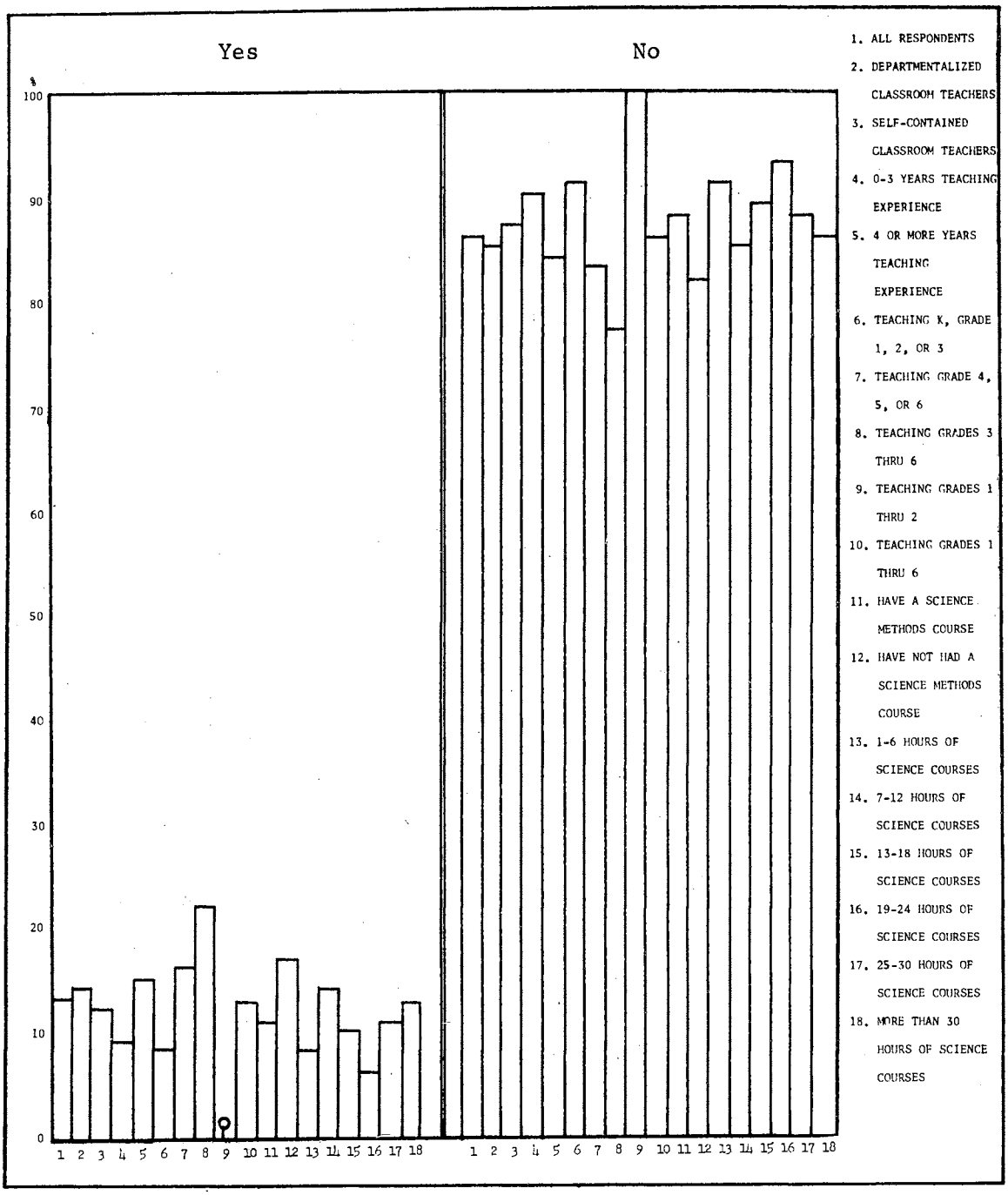

Figure 6. To Do an Adequate Job of Teaching Science in the Elementary School a Teacher Need Be Familiar Only With the Knowledge Presented in High School Biology, Chemistry, and Physics Textbooks

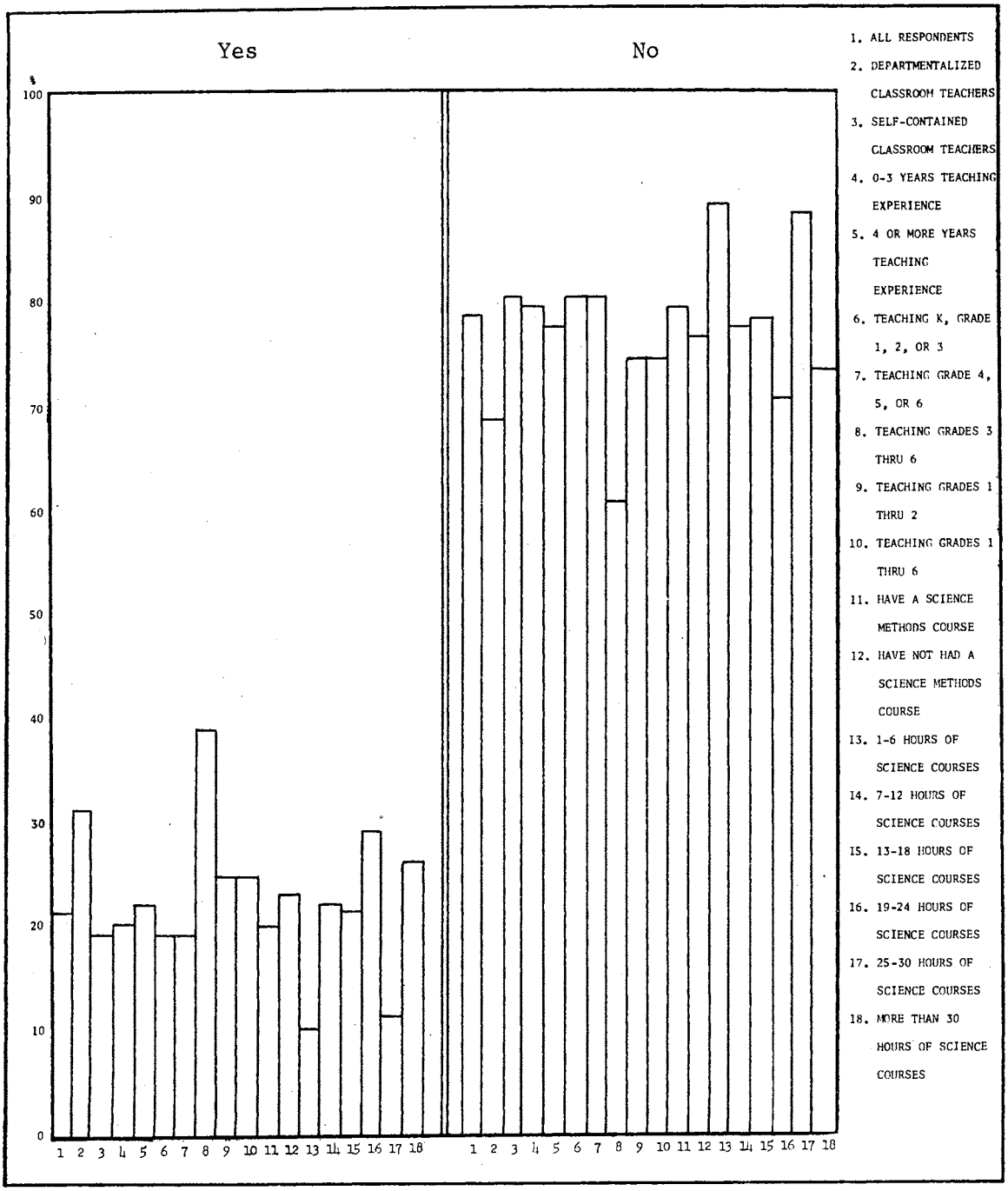

Figure 7. To Do an Adequate Job of Teaching Science in the Elementary School a Teacher Need Be Familiar Only With the Knowledge Presented in the Basic College Science Introductory Courses

the teachers with 1 to 6 hours or 25 to 30 hours of science course work indicate a higher degree of disagreement with the statement than do their comparative groups. The teachers of grades 3 through 6 and the teachers with 19 to 24 hours of science course work indicate smaller disagreement with the statement.

The teachers indicated that the science courses which they had taken in college did not provide them with an adequate background for teaching science. This information is illustrated in Figure 8. The negative response to this statement is only slightly larger than the positive response. The comparative analysis indicates a number of differences among the groups. The departmentalized classroom teachers indicate that they did receive an adequate preparation from their college science courses; the self-contained classroom teachers responded negatively. The inexperienced teachers were equally divided in their feelings on the adequacy of their preparation. The experienced teachers indicate a slight negative response. The differences that occur in the grade teaching are due to the type of classroom teaching situation. The teachers of grades 3-6 and 1-2 indicated greater agreement with the statement. Those teachers with a science methods course indicated slight agreement with the statement; those teachers without a science methods course indicate disagreement with the statement. The number of hours of course work indicated that those teachers with more course hours in science felt that they received adequate preparation in their college courses and that those who had fewer science course hours felt that their courses did not prepare them for teaching science.

The teachers indicated a need for additional science preparation on the college level to prepare them for teaching science. This information

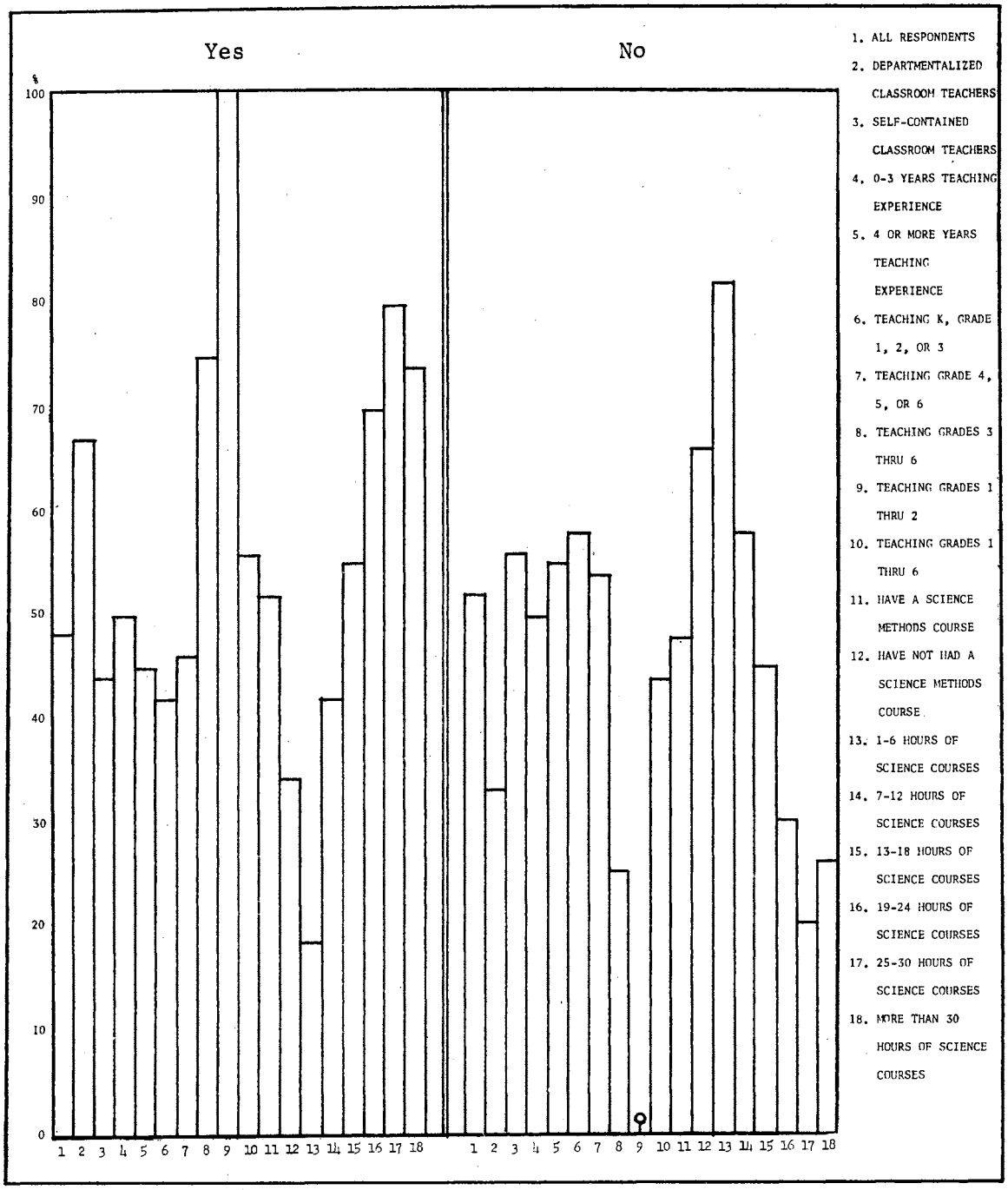

Figure 8. Science Courses Taken in College Provided an Adequate Background for Teaching Science

is reported in Figure 9. The comparative analysis indicates some differences in the comparative groups. The self-contained classroom teachers indicate a positive response, the departmentalized classroom teachers indicate a negative response. The inexperienced teachers indicate a higher degree of agreement than the experienced teachers. There was little difference expressed in the grade level that the teachers were teaching with the exception of the teachers of grades one and two who indicated a negative response. There was little difference in the responses of those teachers who had a methods course and those teachers who did not have a science methods course. The differences that occured in the number of hours of science course work indicated that the smaller the amount of course work the teachers have the more they agreed with the statement and that the more hours of science course work the more they disagreed with the statement.

The teachers indicate the need for a special science course for elementary teachers in the teaching of science that would provide orientation to subject matter suitable for teaching in the elementary school. The response to this statement is illustrated in Figure 10 which shows that the total response and all groups were very positive in their opinion that such a course should be provided. The comparative analysis indicates that the only groups that expressed a difference in response are the experienced and inexperienced teachers. The inexperienced teachers show a lower degree of positive response than do the experienced teachers.

The teachers indicate that the breadth of their pre-service requirements left little time to pursue science to the depth needed for preparing them to teach science. Figure 11 reports this information. The comparative analysis indicates some differences in the opinions expressed among

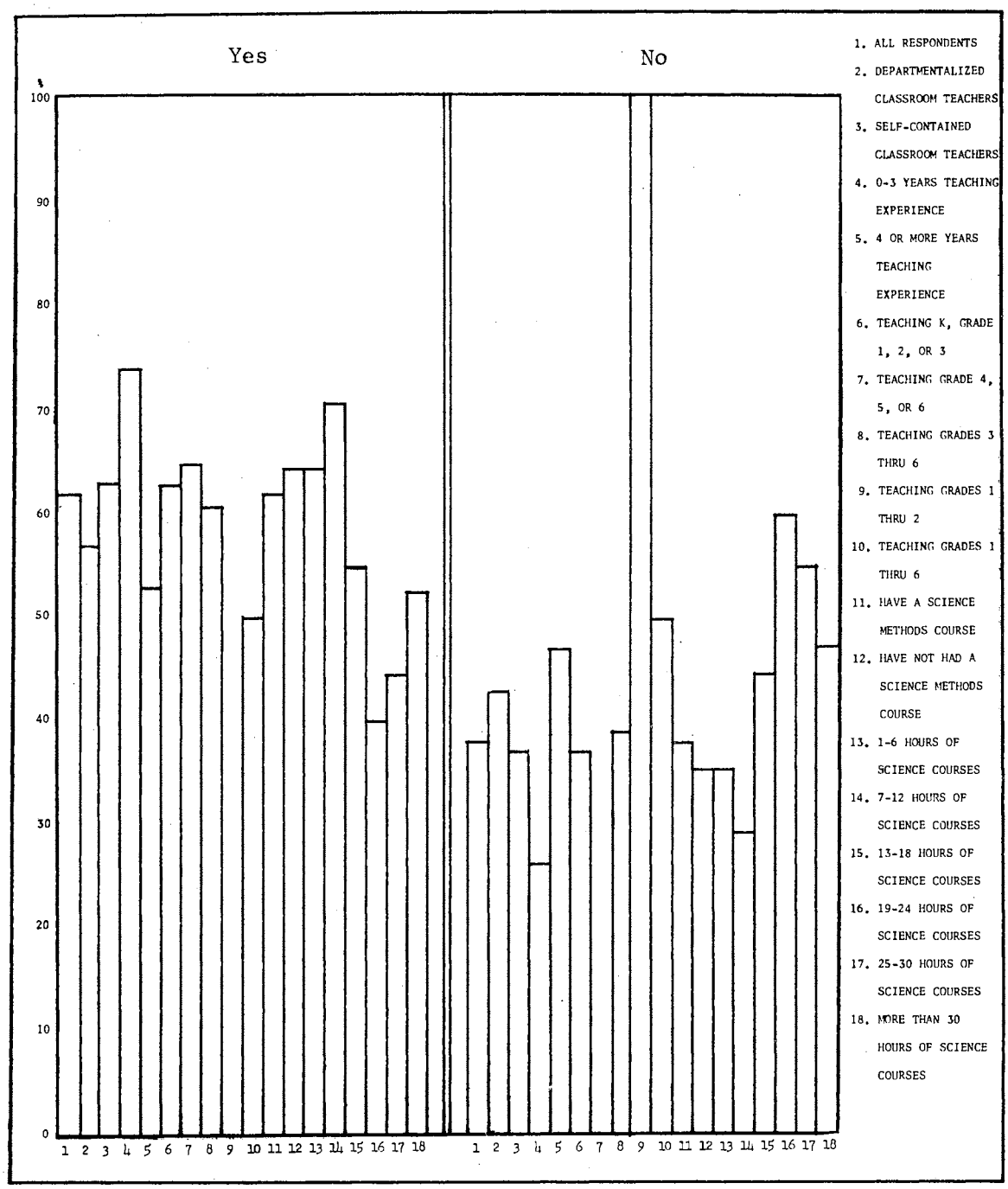

Figure 9. Feel the Need for Additional Science Preparation on the College Level

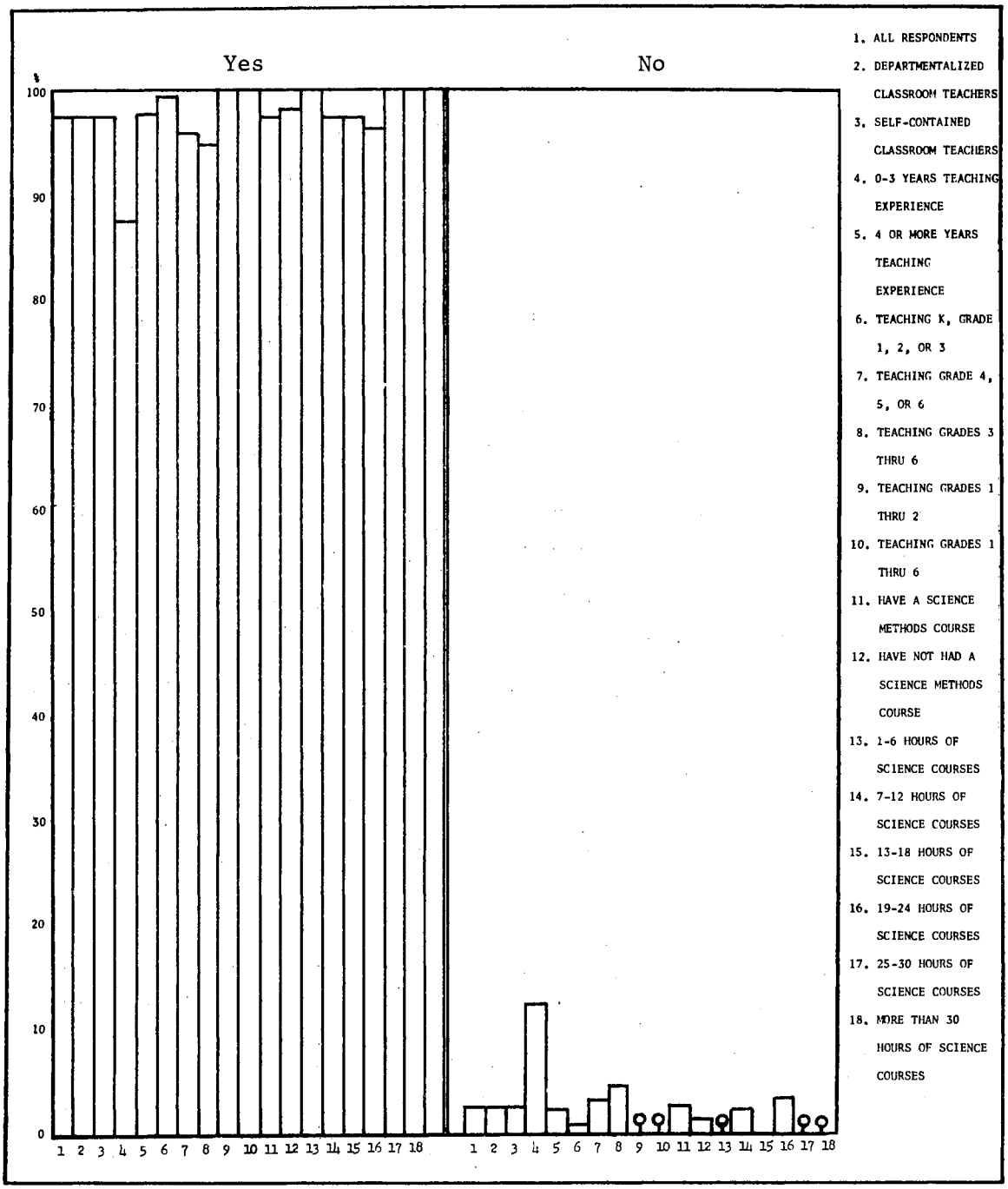

Figure 10. Special Science Courses Should be Offered to Provide Orientation of Subject Matter That Is Suitable for Teaching Science in the Elementary Grades

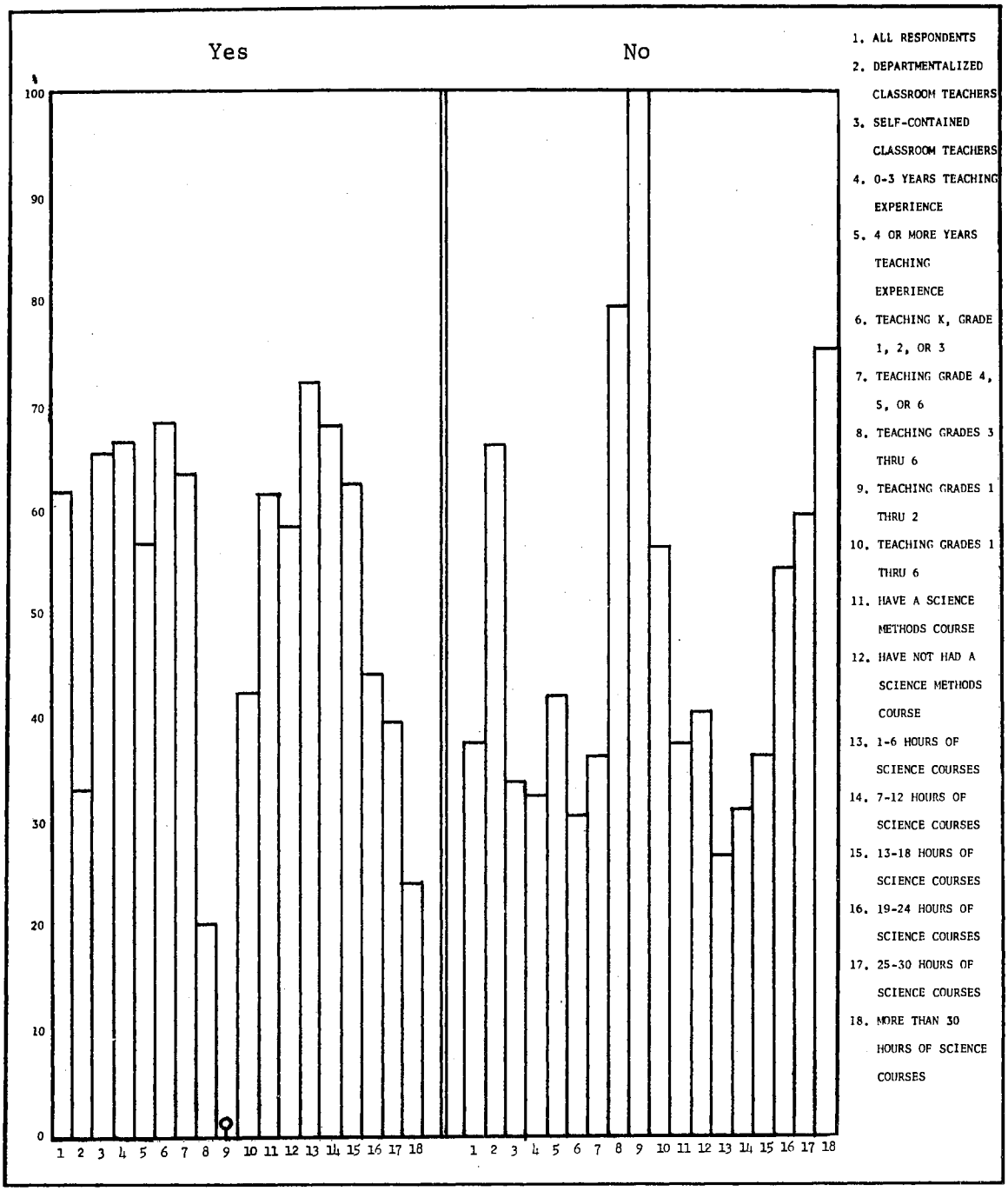

Figure 11. The Breadth of Pre-Service Requirements Left Little Time to Pursue Science to the Depth Needed to Prepare for Teaching Science

the various groups.

The departmentalized classroom teachers disagree with the statement; the self-contained classroom teachers indicate an equal agreement with the statement. The inexperienced teachers indicate a higher degree of agreement with the statement than do the experienced teachers. The differences that occur in the grade level that the teachers were teaching appear to be due to those established for the departmentalized classroom teachers where all groups indicate disagreement with the statement. There is little difference indicated between those teachers who have a science methods course and those who do not have a science methods course. The science course work indicates that those teachers with less course work have a higher degree of agreement with the statement and that those teachers with more science course work have a higher degree of disagreement with the statement.

The teachers were asked to respond to the statement that they feel that their science background is out of date and that they would prefer not to teach science. Figure 12 reports this information and illustrates that the teachers did not agree with the statement. The comparative analysis shows that some of the groups disagree with the statement to a higher degree than others. The departmentalized classroom teachers disagree to a higher degree than do the self-contained classroom teachers. The inexperienced classroom teachers disagree to a higher degree than do the experienced classroom teachers. The differences that occur in the grade teaching appear to be due to those categories established for the departmentalized classroom teachers. All groups indicate a strong disagreement with the statement. There is little difference in the response of those teachers who have a science methods course and those who

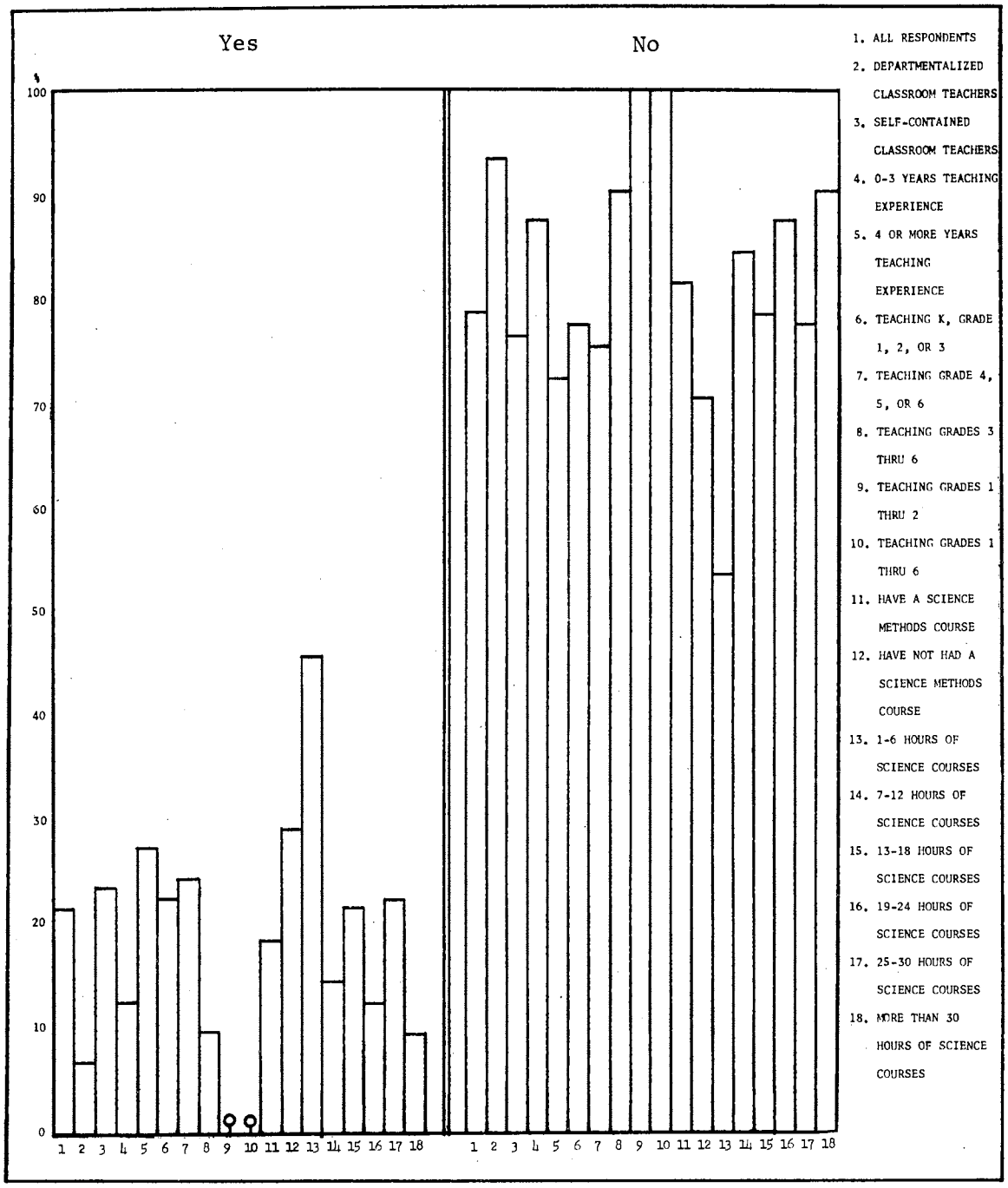

Figure 12. Feeling That Science Background Is Out of Date and Would Prefer Not Teaching Science

do not have a science methods course. In general, the more science course work the teacher has the greater the indication of disagreement with the statement. The exceptions are in a lower number of negative responses by the 13-18 hour and the 25-30 hour groups.

The teachers indicate that they would like to up-date their science background but do not have the time available to do so. This indication is only slight. Figure 13 reports this information.

The comparative analysis indicates little difference in the response due to type of classroom teaching situation. There is indecision by the inexperienced teachers but a more positive response by the experienced teachers. The grade teaching indicates a higher degree of agreement by the primary teachers and indecision by the teachers of grades one and two. The number of hours of science course work indicates that the more course work the teachers have the more they disagree with the statement with the exception of the group that has 13-18 hours or 25-30 hours of science course work. These groups indicate a higher degree of agreement with the statement.

The teachers indicate that they have kept their science background up-to-date by reading current scientific information. (This indication is only a slight difference in response.) This information is illustrated in Figure 14.

The comparative analysis indicates considerable variation among the groups. There is an indication of a much higher degree of agreement by the departmentalized teachers; the self-contained classroom teachers indicate indecision. The experienced teachers indicate a higher degree of agreement than do the inexperienced teachers. The intermediate grade teachers indicate a higher degree of agreement than do the primary grade

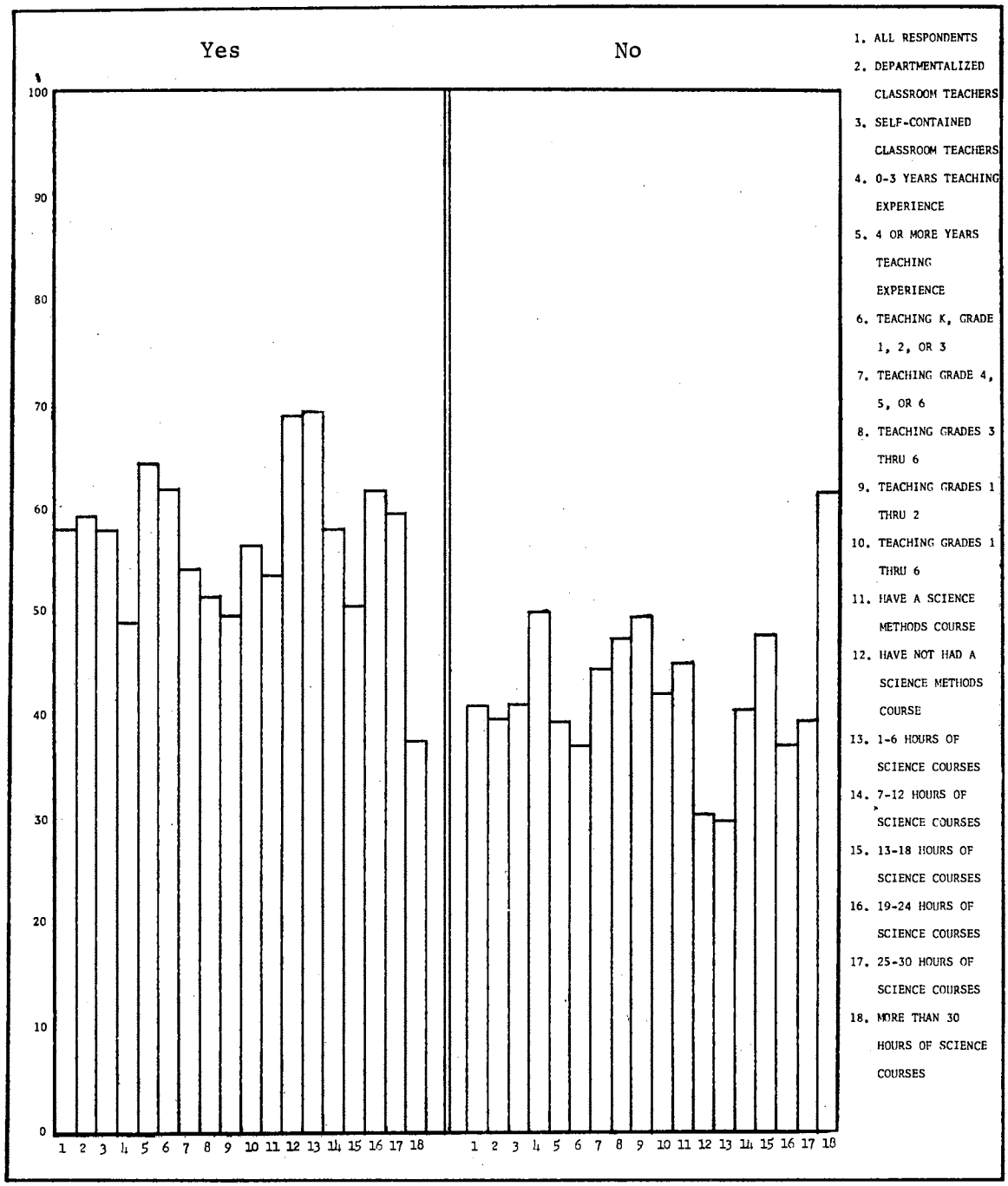

Figure 13. Would Like to Up-Date Science Background but Do Not Have the Time Available for Doing So

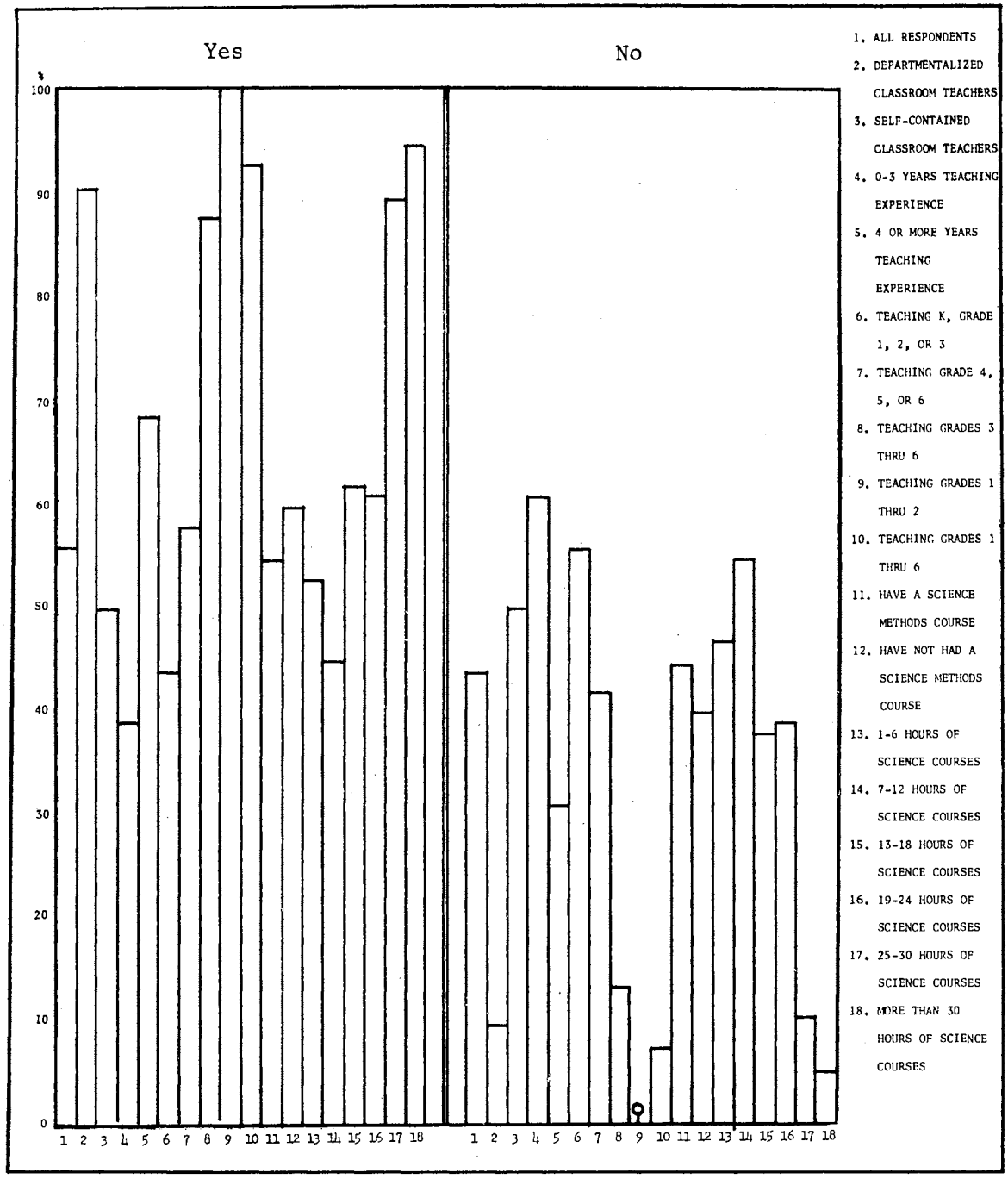

Figure 14. Have Kept Science Background Up-To-Date by Reading Current Scientific Information

teachers. Other differences that occur in this group are in the departmentalized groups with all indicating a higher degree of agreement with the statement. The teachers who do not have a science methods course appear to indicate a higher degree of agreement than do the teachers with a science methods course. In general, the science course hours indicate that the more science course hours the teachers have the greater their agreement with the statement. The exception that occurs is in the group with 7 to 12 hours of science course work, and they show a stronger negative response.

The teachers indicate they would like to up-date their science background by attending classes which offer special methods and materials for elementary teachers. This information is illustrated in Figure 15.

The comparative analysis indicates that the groups are in general agreement with the total response. The exceptions are the groups in grade teaching that were established for the departmentalized classroom teachers. The teachers of grades 1 and 2 indicate a lower degree of positive response; the teachers of grades 1 through 6 a higher degree of positive response. The departmentalized classroom teachers, the inexperienced teachers, and those teachers with no methods course indicate a higher degree of agreement than do others in their comparative groups. In general, the more science course work the teachers have the greater is their agreement with the statement with the exception of slightly smaller agreement by the group with 19 to 24 hours.

The Belief That Science is a Man's Field

The literature indicated that an indirect factor influencing the teaching of science at the elementary school level might be due to a

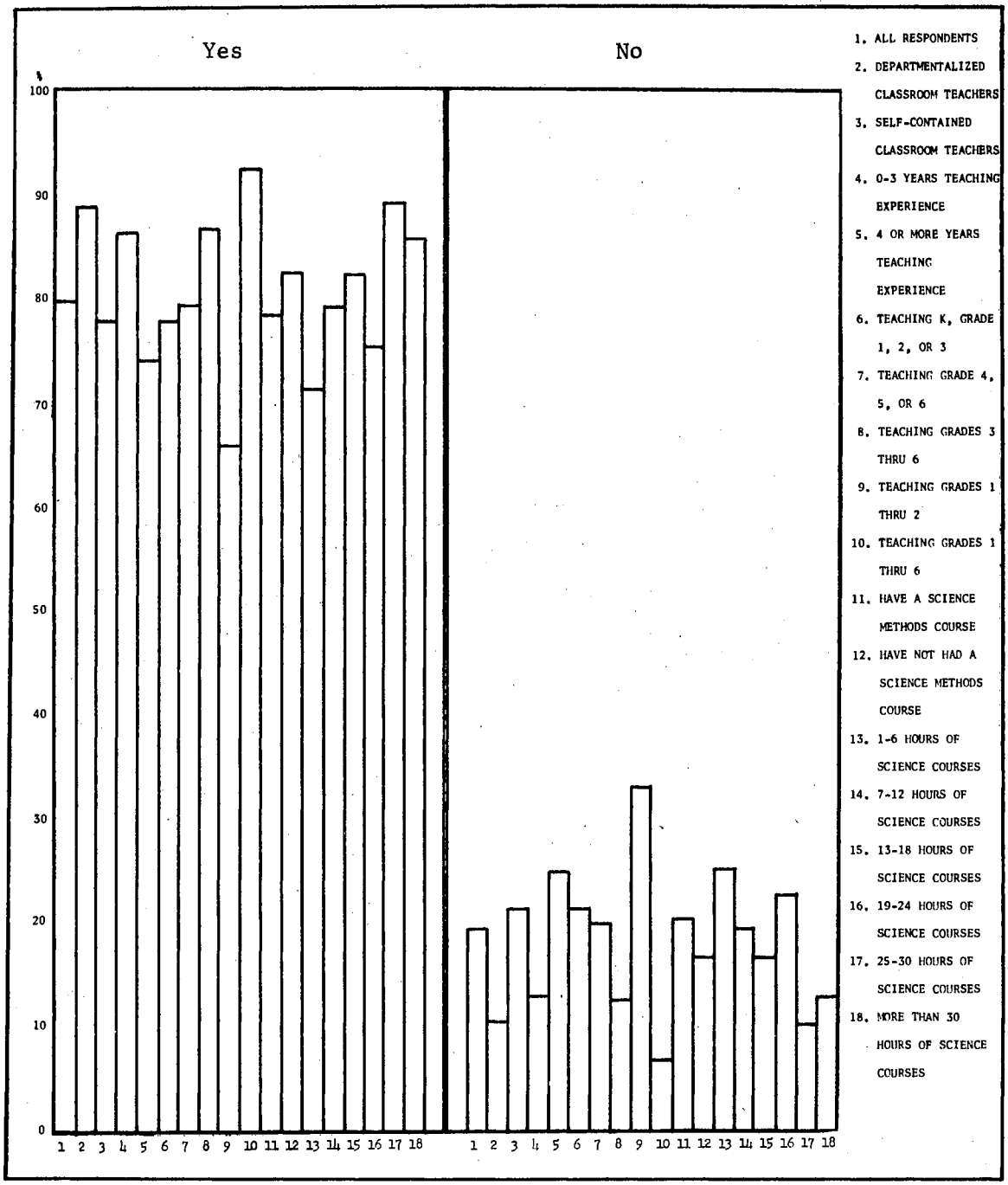

Figure 15. Would Like to Up-Date Science Background by Attending Special Science Classes for Elementary Science Teaching

feeling that science is a man's field. Most elementary teachers are women. This sample is no exception, as can be seen in Table II. The investigator asked four questions concerning this factor. The questions were distributed in the opinionnaire in an attempt to alleviate their influence upon one another.

The teachers were asked to respond to the statement that men have more aptitude for teaching science than do women. Figure 16 reports this information and illustrates a negative response.

The comparative analysis shows that all groups are in general agreement. The total response varies only in the degree of agreement. The departmentalized teachers and the inexperienced teachers indicate greater agreement than do the others in their comparative groups. There is little difference between the intermediate grade teachers and the primary grade teachers, but the teachers of grades 3 through 6 and 1 and 2 show a greater disagreement. The teachers of grades 1 through 6 indicate smaller disagreement. The number of hours of science course work exhibits considerable differences in the responses among the groups although all disagree with the statement. Those teachers with 1 to 6, and 13 to 18 hours indicate smaller disagreement while teachers with 25 to 30 hours indicate greater disagreement with the statement.

The teachers indicate by a slight positive response that men are generally more familiar with science subject matter than are women. Figure 17 reports this information. The comparative analysis indicates that there are four groups that show a negative response. These groups are those teachers who teach grades 1 and 2 and grades 3 through 6 and the teachers with 7 to 12 or 19 to 24 hours of science course work. There is little difference indicated among the other groups provided for

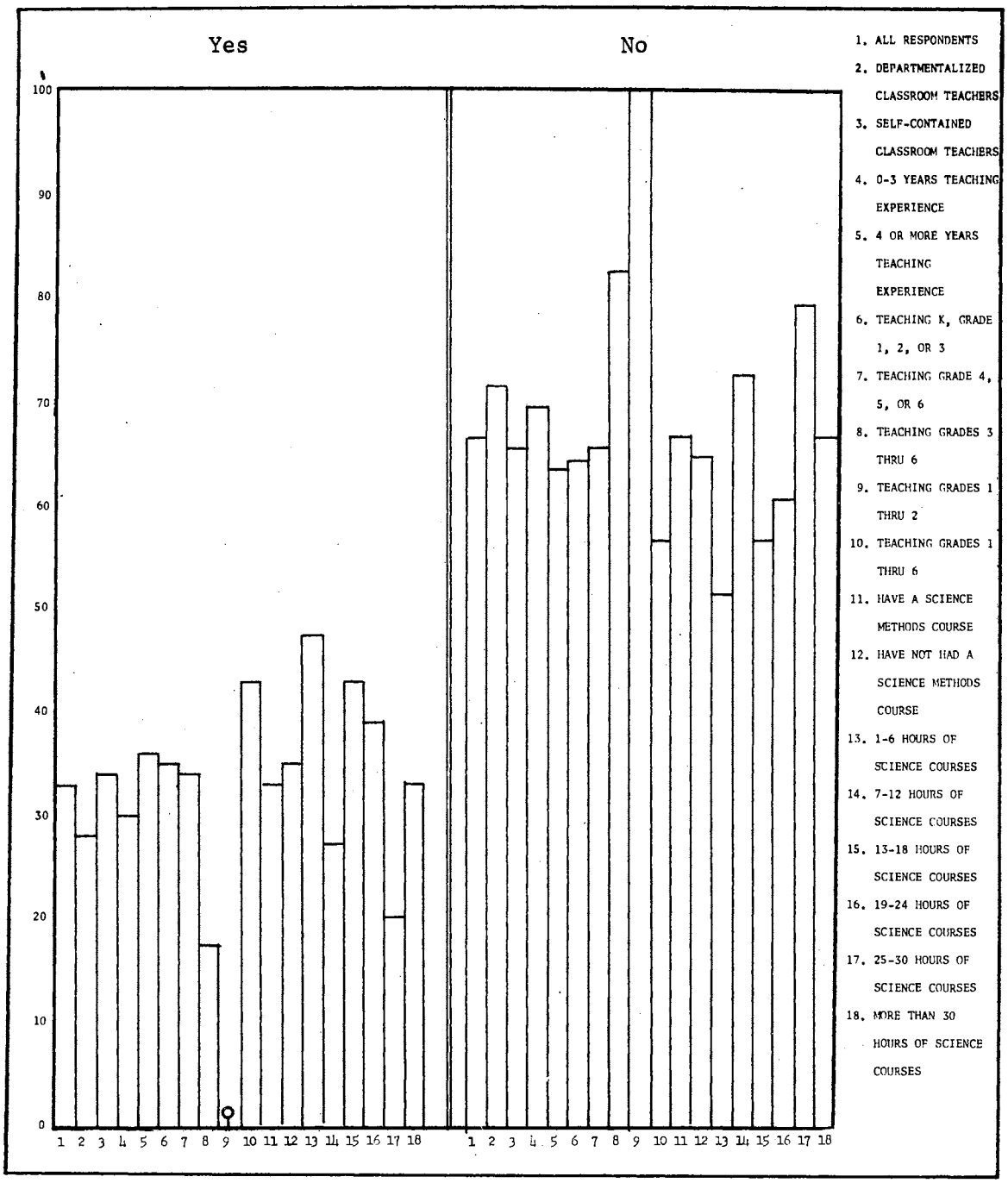

Figure 16. Men Have More Aptitude For Teaching Science

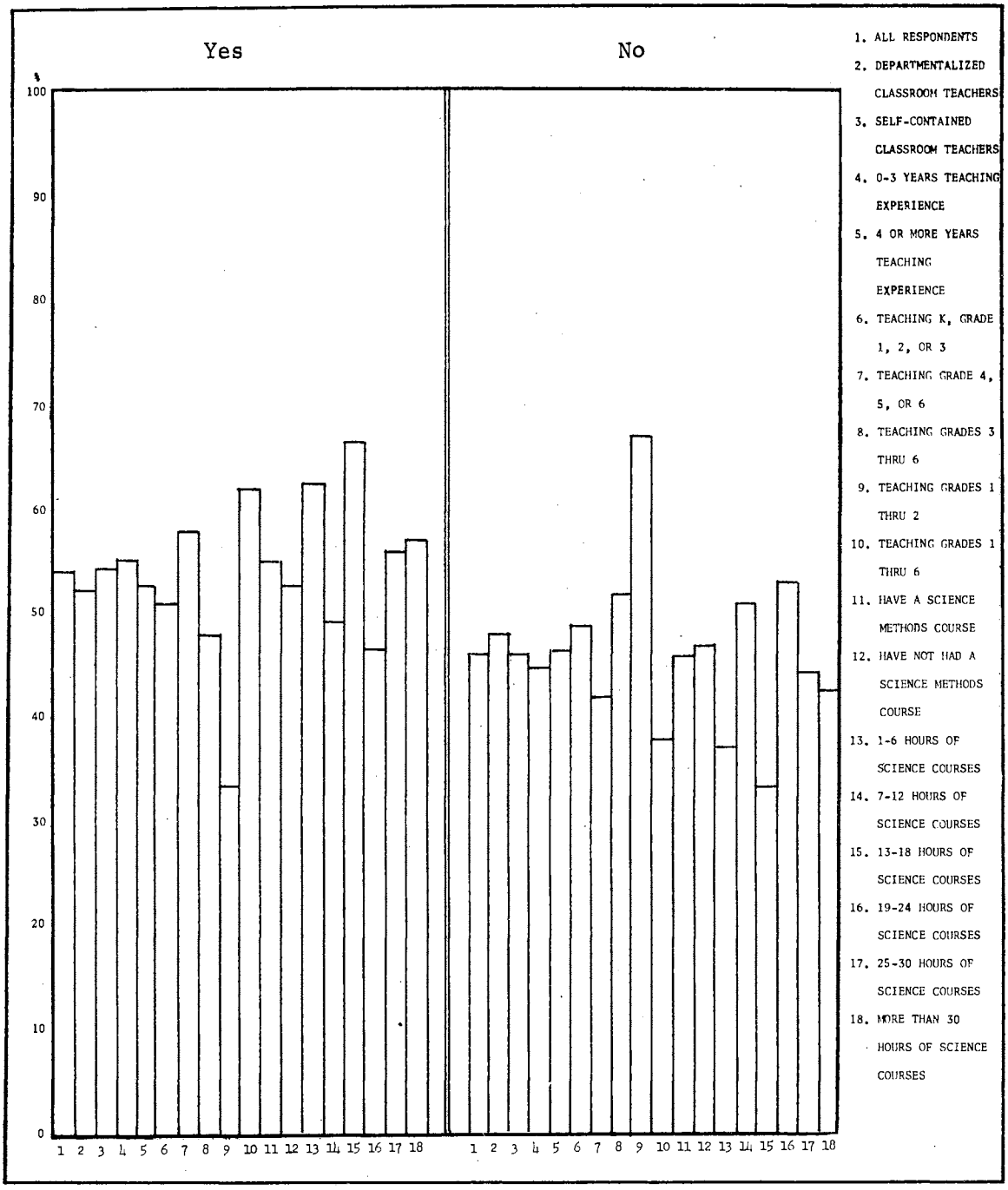

Figure 17. Men Are More Familiar With Science

comparison.

The teachers were asked to respond to the statement that men generally make better science teachers than do women. Figure 18 reports this information and illustrates a negative response. The comparative analysis indicates that all groups are in general disagreement with the statement and that where differences occur in the groups they are due to the degree of disagreement. The departmentalized classroom teachers indicate a greater response in disagreement than do the self-contained classroom teachers. The teachers with 25 to 30 hours of science course work express a higher degree of disagreement; those teachers with 13 to 18 hours indicate slight agreement. The primary grade teachers indicate a greater disagreement than do the intermediate grade teachers. The teachers of grades 3 through 6, 1 and 2, and 1 through 6 indicate a higher degree of disagreement than do the others in this group.

The teachers were asked to respond to the statement that men generally have a greater familiarity with the use of science materials and equipment than do women. Figure 19 illustrates this response and indicates a slight positive response. The comparative analysis illustrates that the noticeable exceptions in the groups are the departmentalized classroom teachers exhibiting indecision, those teachers of grades 3 through 6, and 1 and 2 indicating a negative response, and the teachers that have 25 to 30 hours of science course work indicating a negative response.

Understanding of the Modern Goals of Science Teaching

The literature has indicated that a factor that might influence the teaching of science at the elementary school level is the lack of

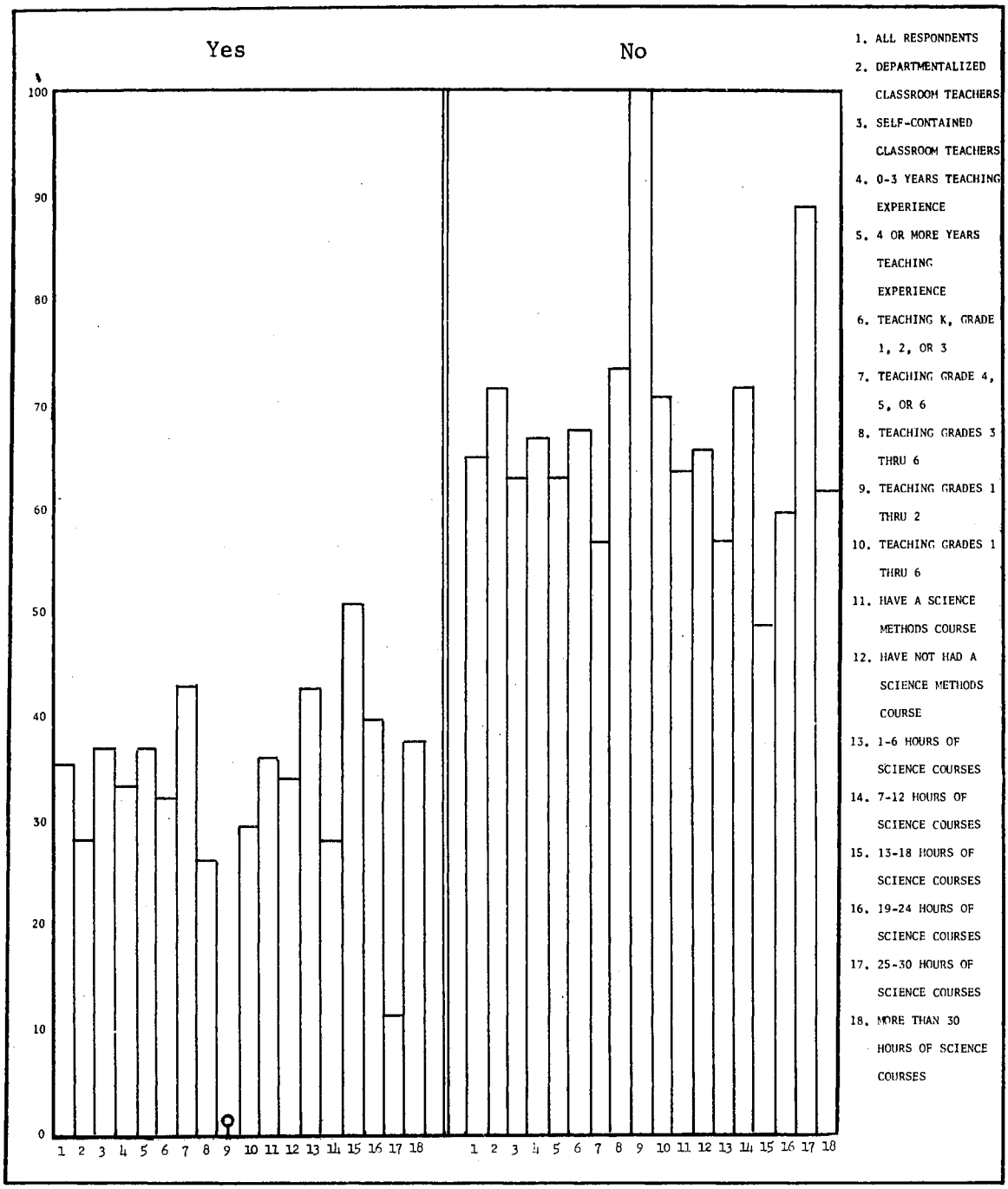

Figure 18. Men Make Better Science Teachers

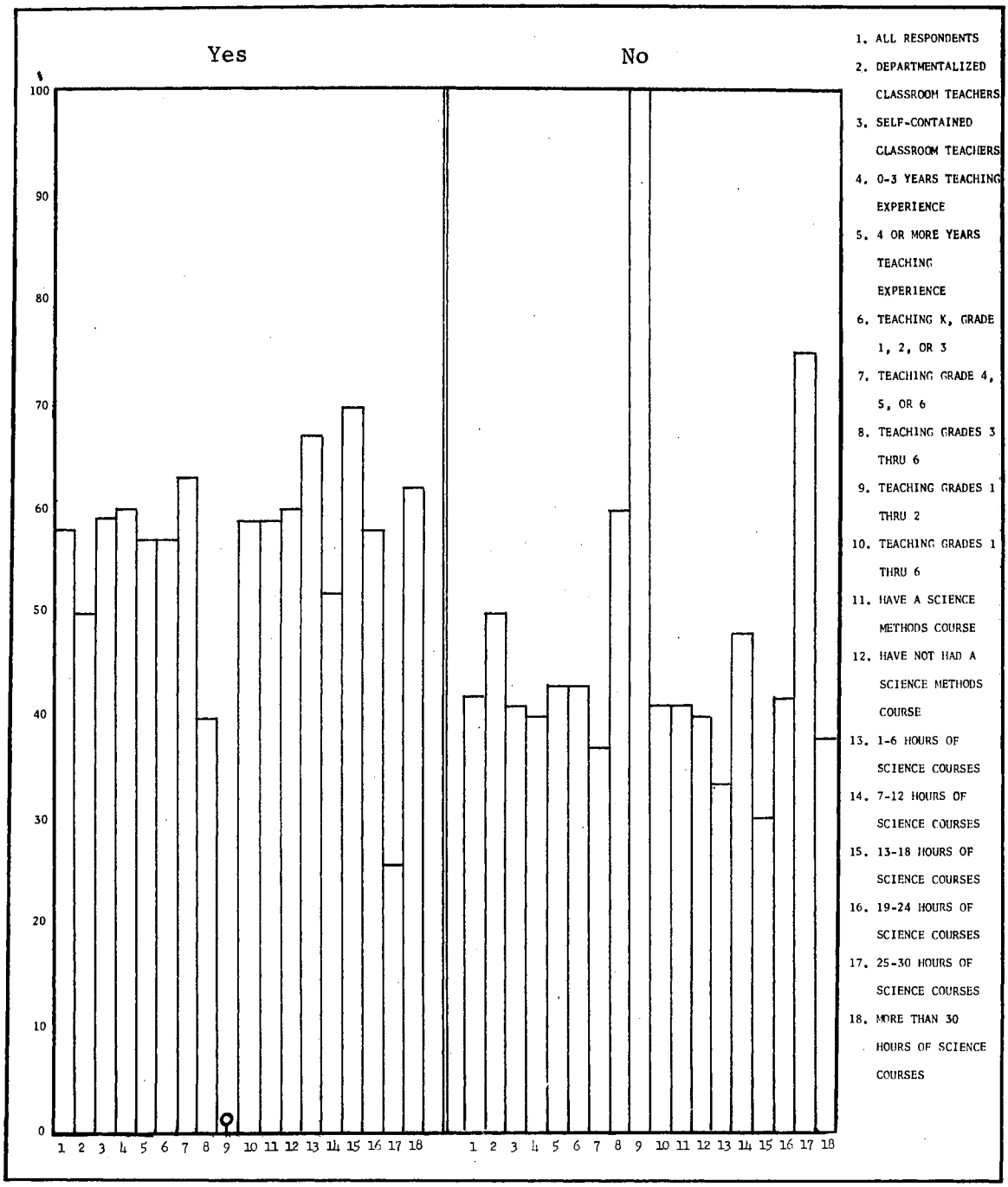

Figure 19. Men Have Greater Familiarity With the Use of Science Materials and Equipment

understanding of the modern goals of teaching science. Ten questions were developed to attempt to determine the opinions of the sample toward modern goals of science teaching.

The teachers were asked to respond to the statement that science in the elementary school should be taught as a reading course in order to provide integration of the science course and the basic communication skills. Figure 20 reports this information and illustrates a negative response. The comparative analysis indicates general disagreement with the statement by all the groups. The differences that occur are in the degree of negative response. Those teachers in the departmentalized classroom teaching situation, the inexperienced teachers, the intermediate grade teachers along with the teachers of grades 3 through 6 and 1 and 2, the teachers with a methods course, and the teachers with 13 to 18 hours of science course work indicate greater disagreement than do their comparative groups.

The respondents indicate, as shown in Figure 21, that science should be taught in the elementary school as a factual course in order to provide students with some knowledge of their environment. The comparative analysis shows considerable variation among the groups. The departmentalized classroom teachers indicate a higher degree of agreement than do the self-contained classroom teachers. The experienced teachers indicate agreement with the statement; the inexperienced teachers, disagreement. Primary grade teachers are undecided, but the intermediate grade teachers agree with the statement. Teachers of grades 1 through 6 indicate a higher degree of disagreement. Teachers of grades 1 and 2 are undecided. Teachers with a science methods course indicate disagreement; those teachers who do not have a science methods course agree. Teachers

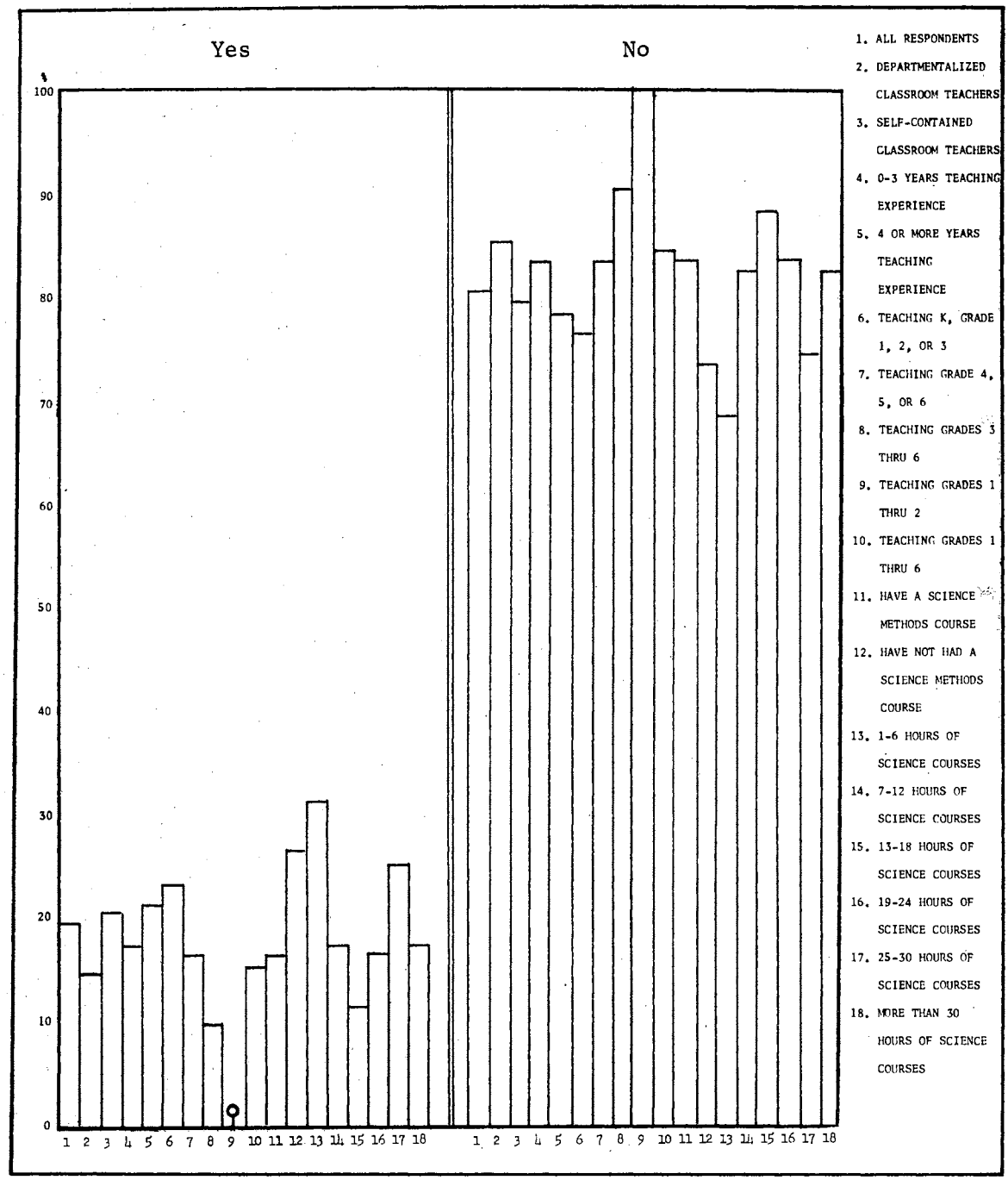

Figure 20. Science in the Elementary School Should Be Taught as a Reading Course

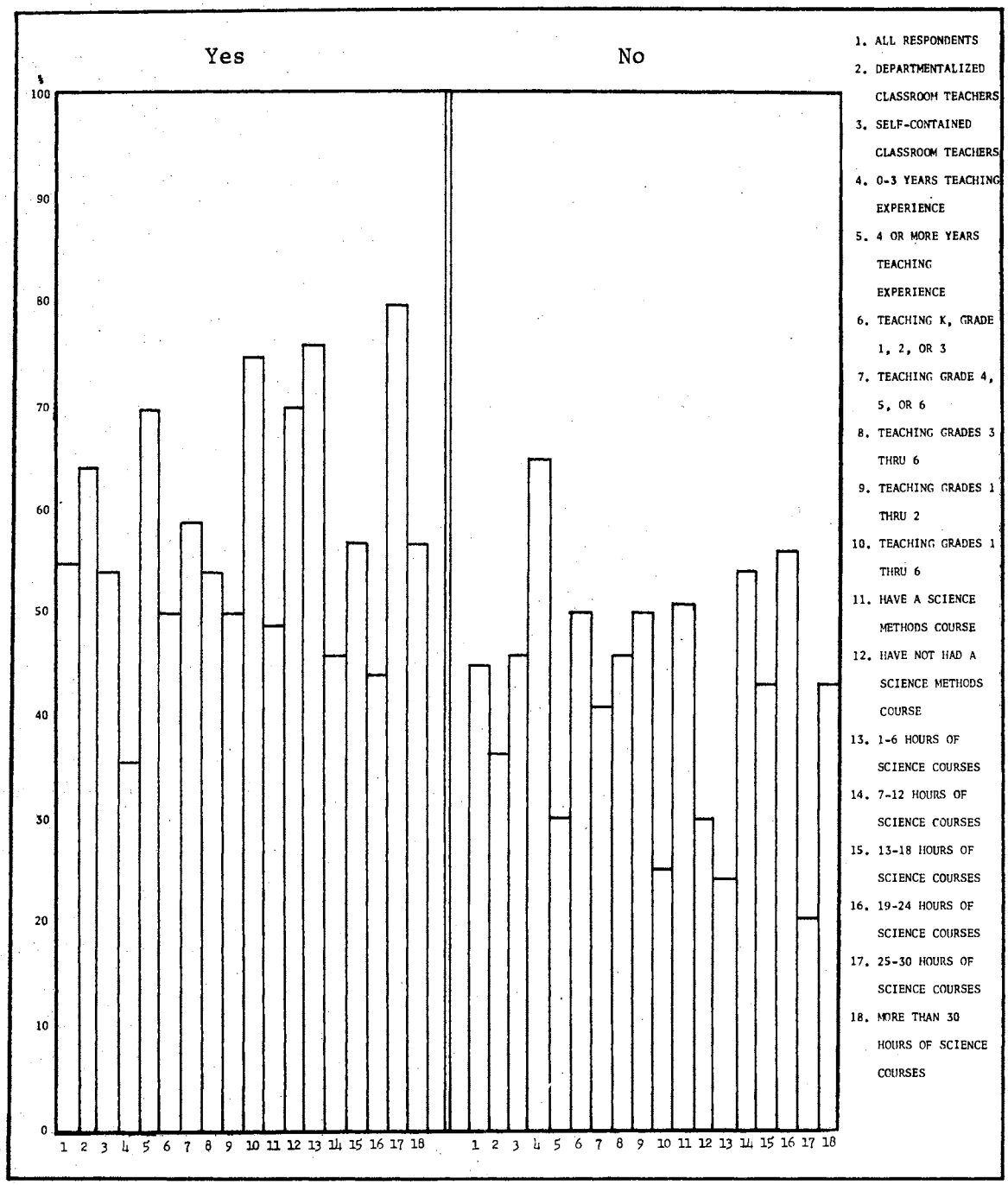

Figure 21. Science in the Elementary School Should Be Taught as a Factual Course

who have 1 to 6 hours of science course work and 25 to 30 hours indicate greater agreement. Teachers with 7 to 12 or 19 to 24 hours disagree.

The teachers expressed the opinion that students should be expected to know and if necessary memorize basic scientific facts. Figure 22 reports this information and illustrates a slight preference in agreement. The comparative analysis indicates considerable variation by the groups in their response. The departmentalized classroom teachers show greater agreement than do the self-contained classroom teachers. The inexperienced teachers indicate slight disagreement; the experienced teachers slight agreement. The primary teachers disagree; the intermediate teachers indicate agreement. The teachers of grades 1 through 6 indicate strong agreement, and teachers of grades 1 and 2 are undecided. There is slight agreement by the teachers without a methods course; the teachers with a methods course indicate less agreement. The hours of science course work indicate that teachers with 25 to 30 hours agree with the statement strongly and that teachers with 7 to 12, 19 to 24, and more than 30 hours show some degree of disagreement with the statement.

The teachers indicate that the need for the student to acquire factual information is not greater than the need for him to understand the ways in which hypotheses are developed. Figure 23 reports this information. The comparative analysis indicates that all of the groups disagree with the statement in varying degrees. The departmentalized classroom teachers, inexperienced teachers, teachers of grades 3-6 and 1-6, teachers with a methods course and those teachers with 7 to 12 hours or 19 to 24 hours of science course work indicate a higher degree of disagreement than do the others in their respective groups.

The teachers indicate that it is more important for the elementary

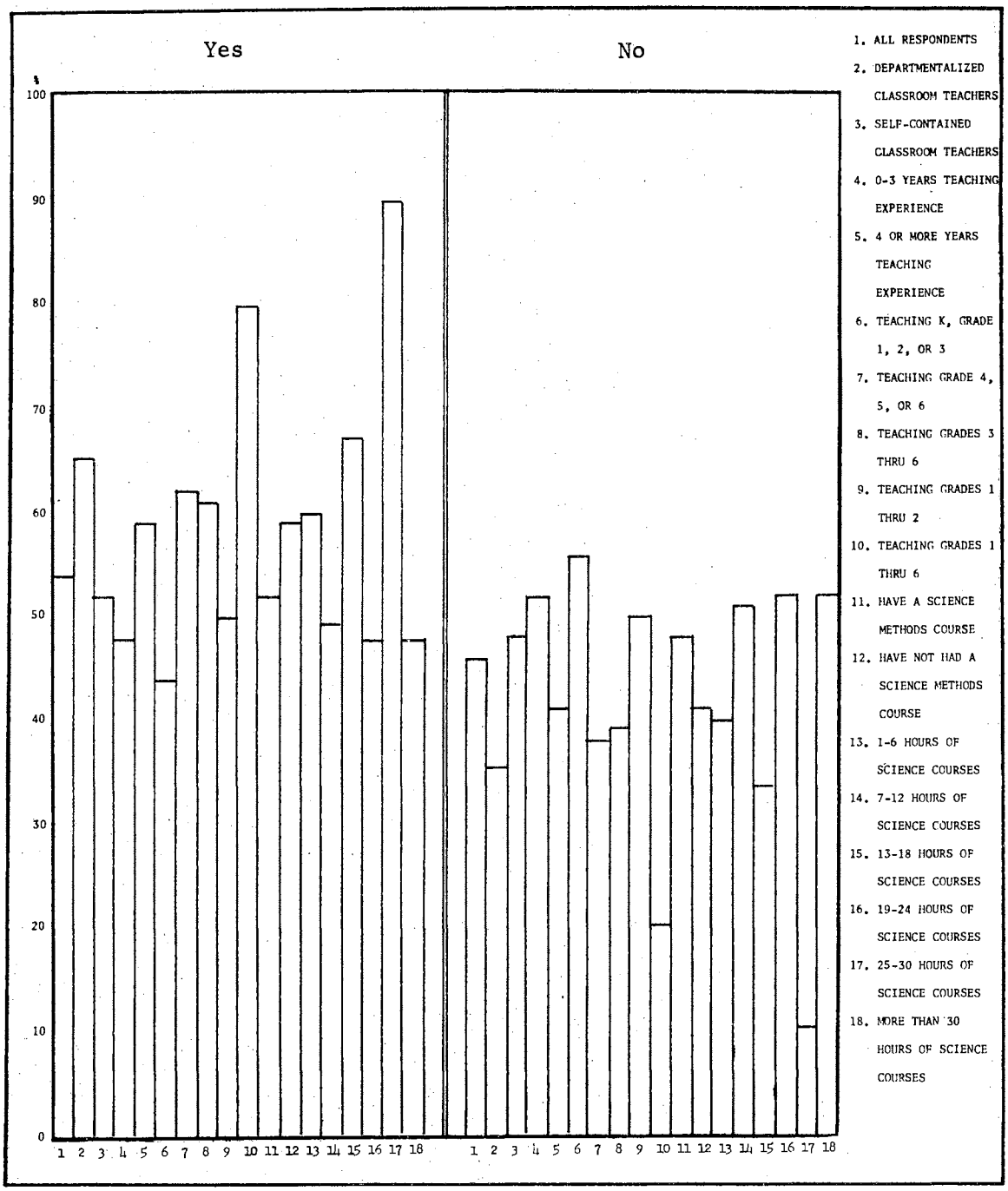

Figure 22. Students Should Be Expected to Know and Memorize Basic Scientific Facts

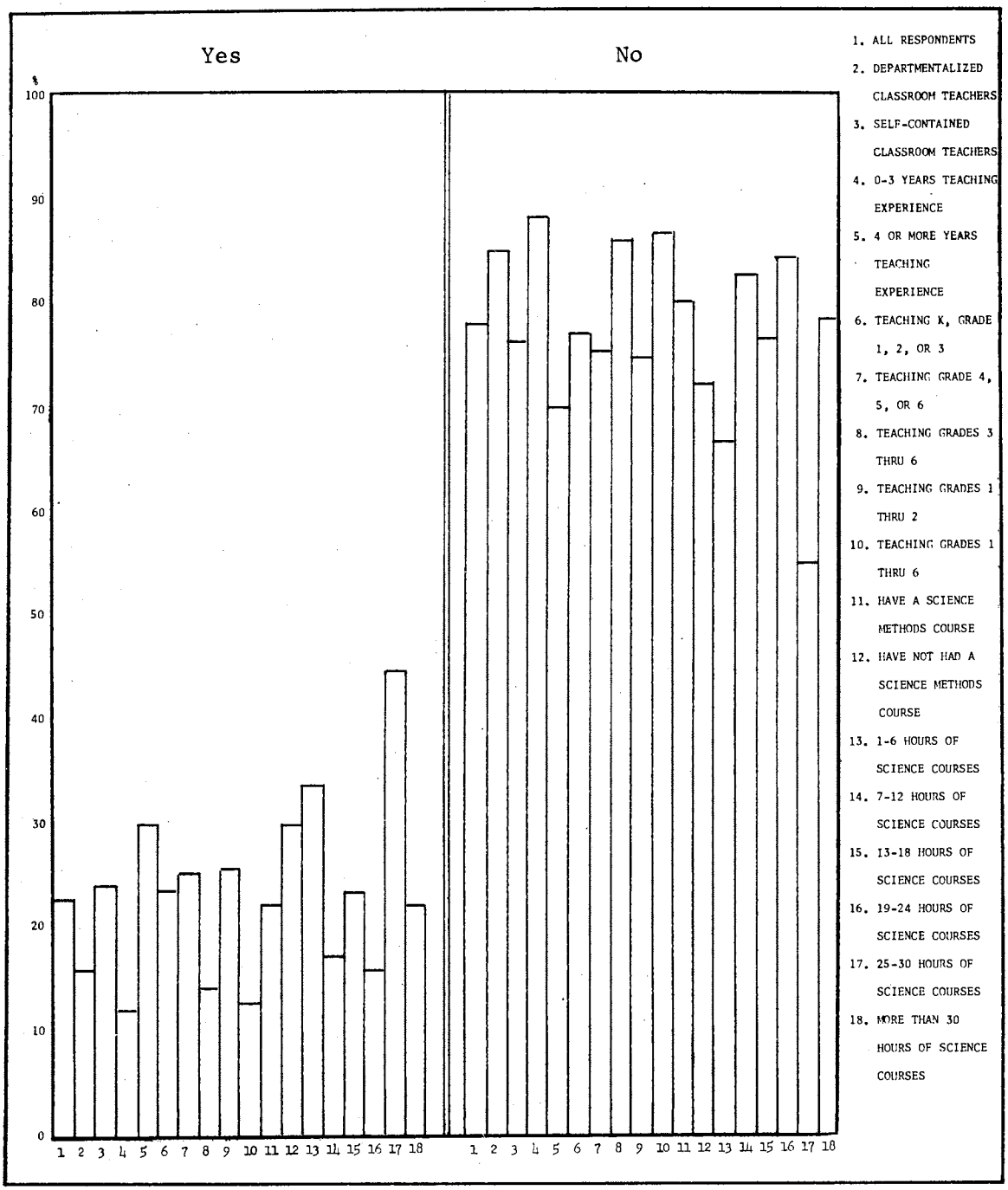

Figure 23. The Need for Acquiring Factual Information Is Greater Than the Need for Understanding the Ways in Which Hypotheses Are Developed

student to understand the purpose and method of science than for him to be acquainted with the latest theories and facts. Figure 24 presents this response. The comparative analysis indicates that all of the groups agree with the statement but that there is some variation in the degree of agreement. The departmentalized classroom teachers, the experienced teachers, the primary grade teachers, the teachers of grades 1-6, the teachers without a methods course, and the teachers with 1-6 hours or 25-30 hours of science course work show a stronger positive response than do the others in their respective groups.

The teachers indicate that a student comes to understand science through participating in science rather than through serving as a by-stander who reads about science. This information is provided in Figure 25. The comparative analysis indicates little differences among groups. All groups indicate a very strong agreement with the statement.

The teachers indicate that first-hand laboratory experiences do not demand skills which are above the capacities of elementary school children. This information is reported in Figure 26. The comparative analysis indicates few differences among the groups. The inexperienced teachers, the teachers of grades 1 and 2, and the teachers with 7-12 or 19-24 hours of science course work indicate a stronger belief that the skills are not above the capacities of elementary school children.

The teachers indicate that in science the student work should be centered in laboratory-type experiments where real problems are explored. Figure 27 reports this information. The comparative analysis indicates few differences among the groups. The differences that occur in the grade teaching are due to those categories established for the

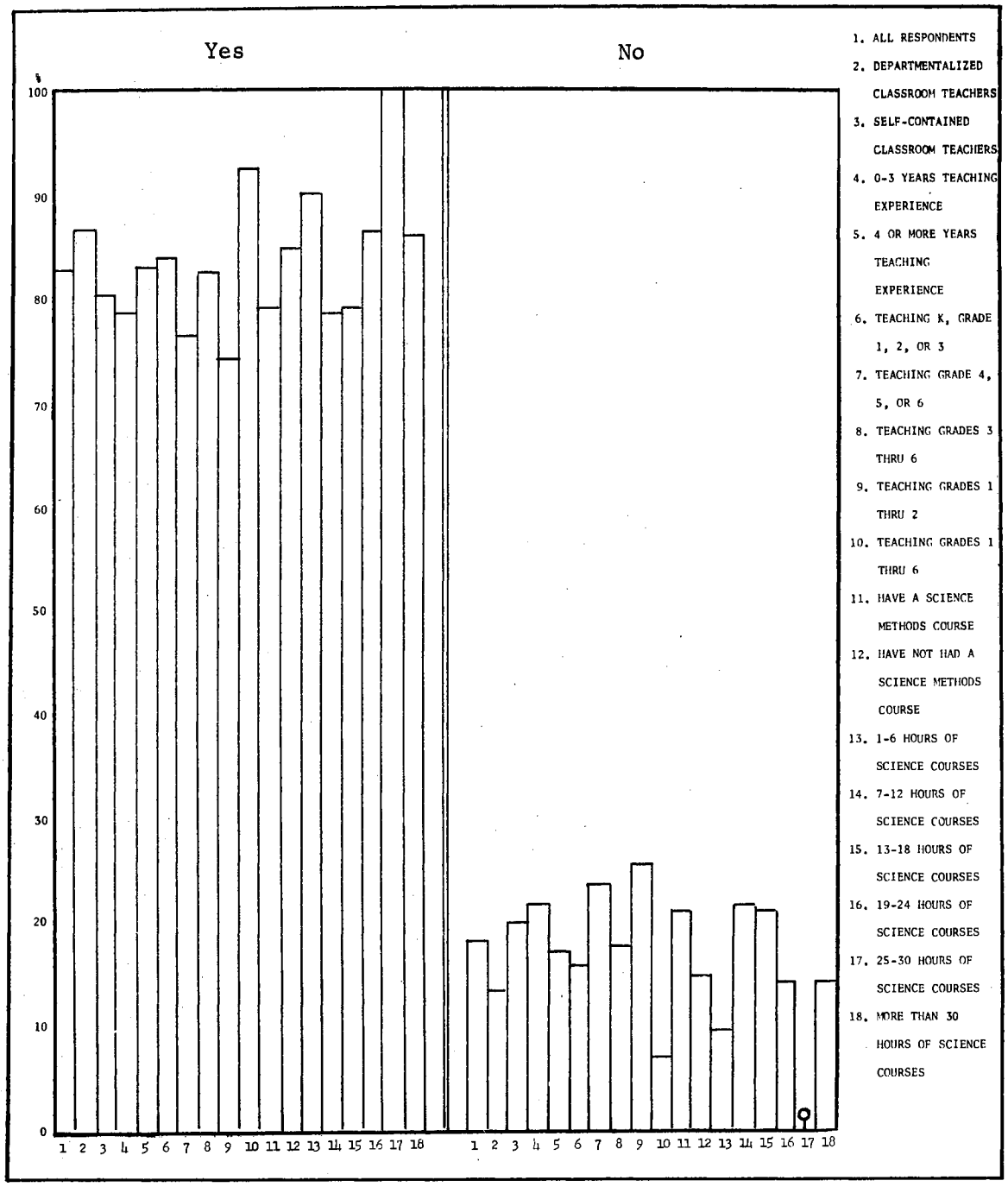

Figure 24. It Is More Important to Understand the Purpose and Methods of Science Than Be Acquainted With the Latest Theories and Facts

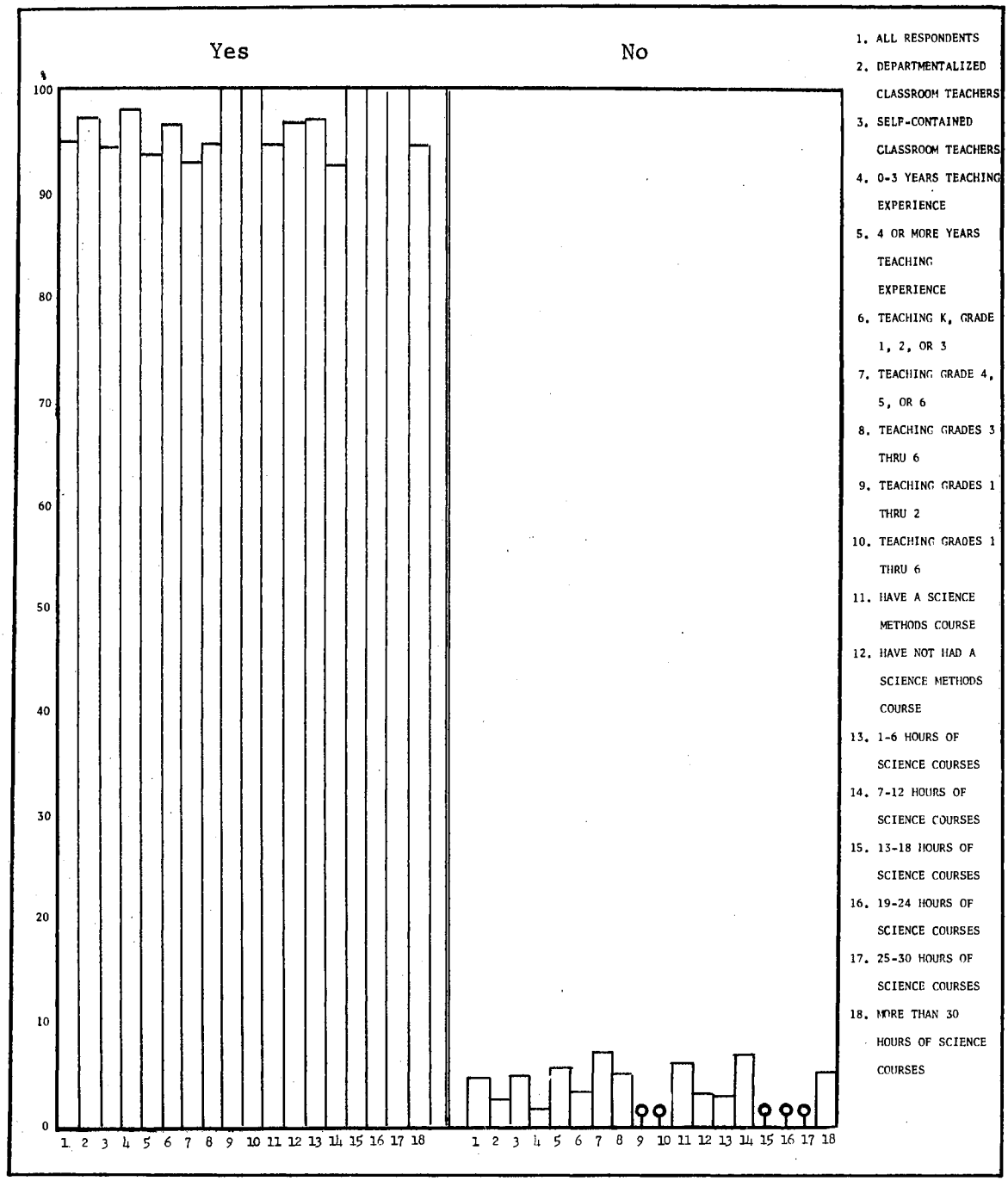

Figure 25. Students Understand Science Through Participating in Science Rather Than Reading About Science

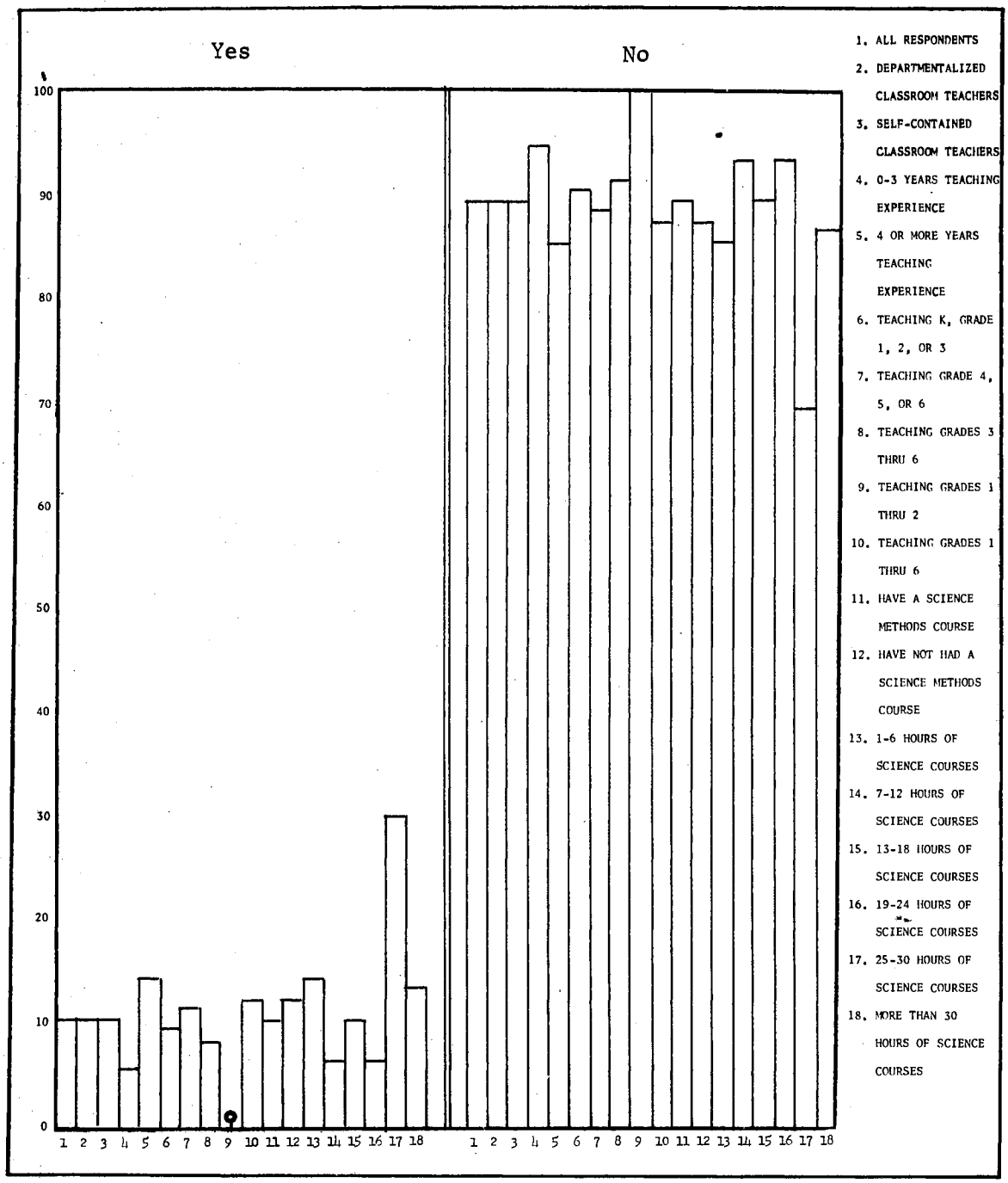

Figure 26. First-Hand Laboratory Experiences Demand Skills Which Are Above the Capacities of Elementary School Children

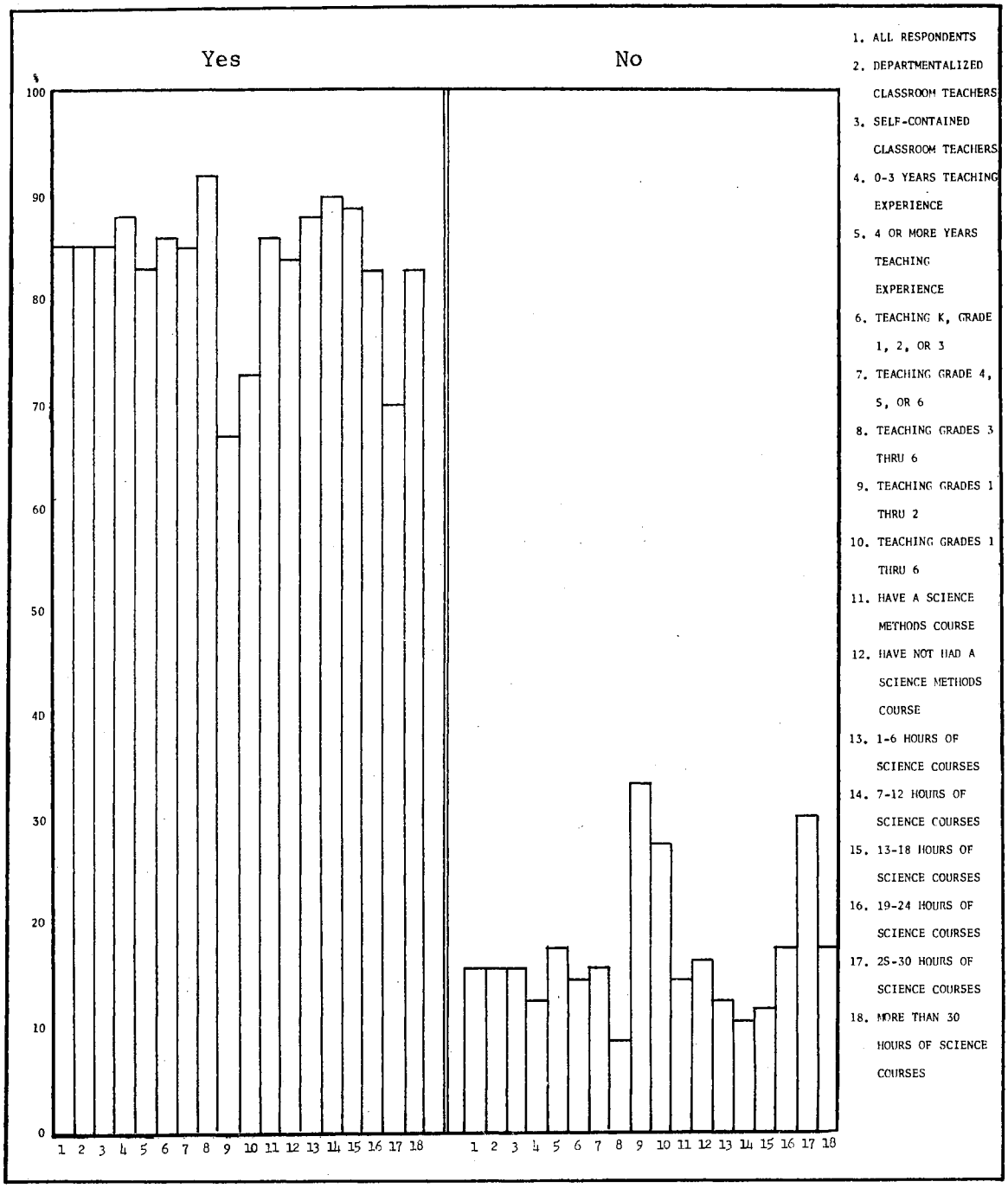

Figure 27. Work Should Be Centered in Laboratory Type Experiences Where Real Problems Are Explored

departmentalized classroom teachers. Teachers of grades 3-6 indicate stronger agreement than do the comparative groups. The only other variation to note is that of a lower degree of agreement by the teachers with 25 to 30 hours of science course work.

The teachers indicate that it is more important for children to learn the practical application of science than to learn the underlying scientific principles. Figure 28 reports this information. The comparative analysis indicates some differences among the groups. The primary grade teachers indicate a positive response; the intermediate grade teachers indicate a negative response to the statement. The group who teach grades one and two indicate a negative response. The teachers with 13-18 hours and more than 30 hours of science course work also indicate a negative response.

The teachers indicate that science in the elementary school should be taught as a method of inquiry in order to provide basic understanding of science. Figuer 29 illustrates this response. The comparative analysis indicates only slight degrees of differences in the responses of the groups.

The Major Responsibility of the Elementary Teacher Is in the Basic Communication Skills

The review of the literature indicates that a factor which might influence the teaching of science in the elementary school is that teachers feel they must concentrate on teaching the basic communication skills. Interviews with elementary school teachers and those responsible for teacher preparation also indicate that competition from other areas of subject matter might influence the time that could be devoted to teaching science. The investigator asked for the opinions of the teachers on five

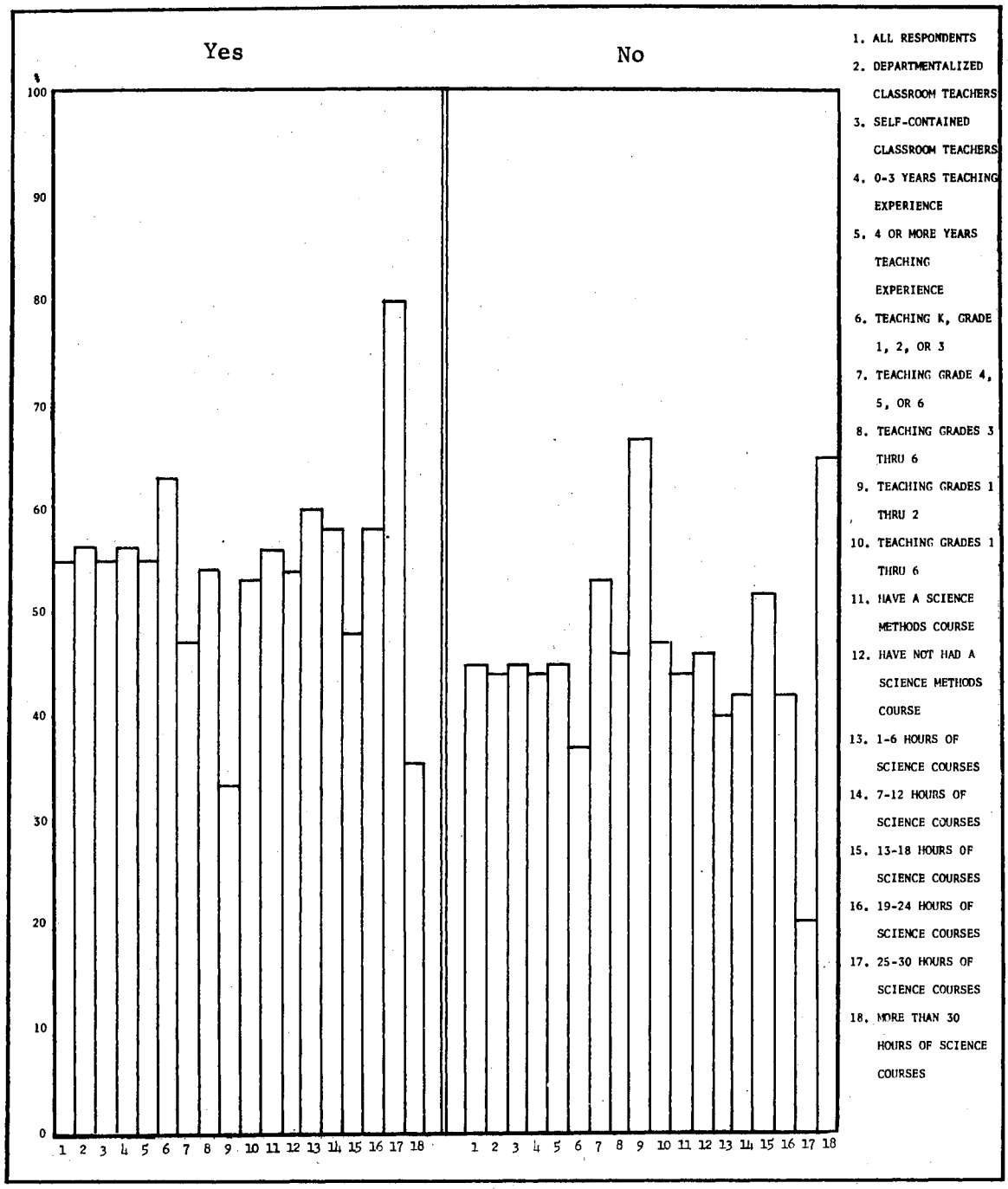

Figure 28. It Is More Important to Learn the Practical Applications of Science Than to Learn the Underlying Scientific Principles

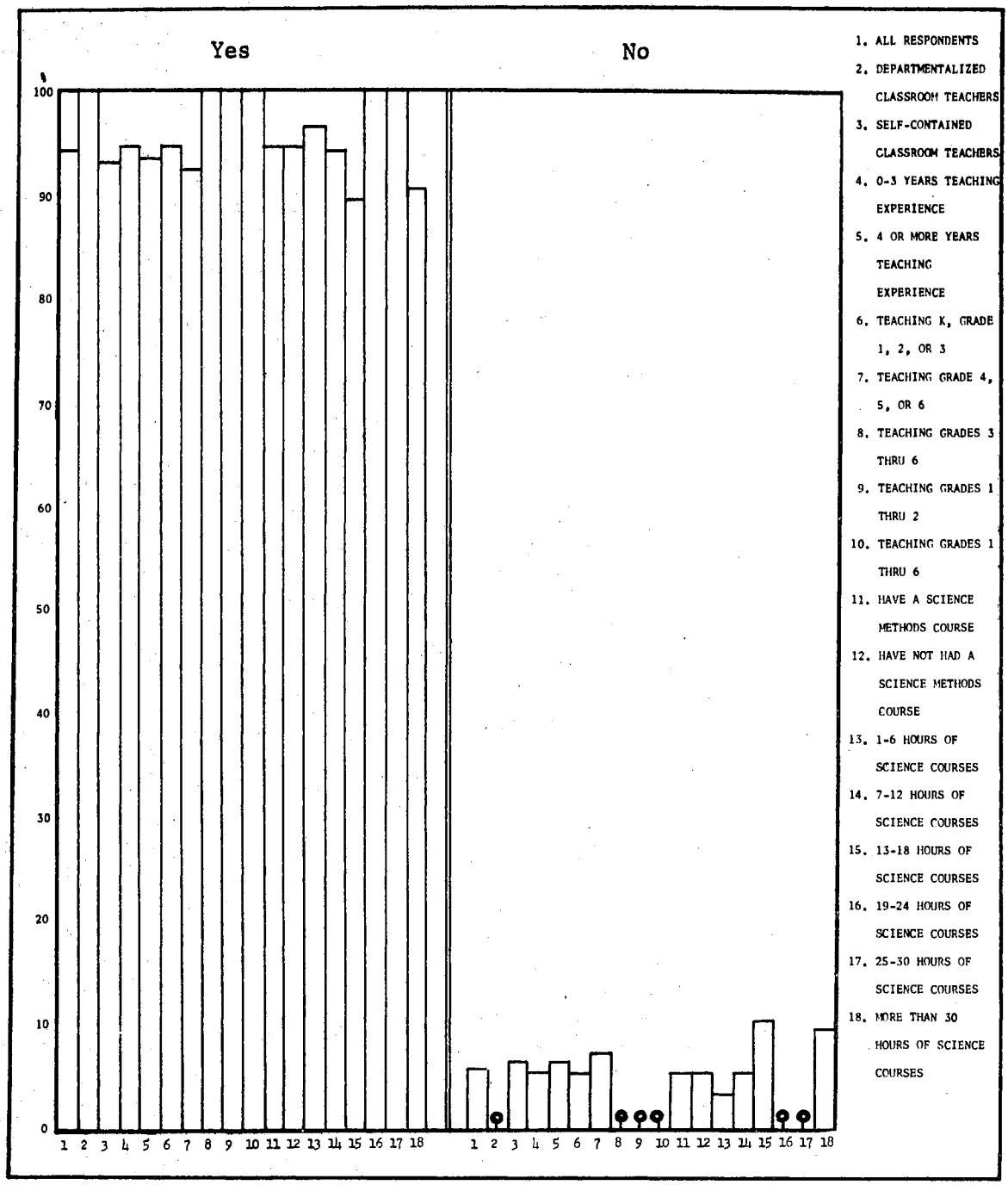

Figure 29. Science Should Be Taught as a Method of Inquiry

questions dealing with the competition of various areas of the elementary school program as factors influencing the teaching of science.

The teachers were asked to respond to the statement that they would like to devote more time to science teaching but that it interferes with the basic elementary program. Figure 30 reports the response to this statement and illustrates a negative response. The comparative analysis illustrates that with some variations all groups give a negative response. The departmentalized classroom teachers, the inexperienced teachers, the teachers of grades 3-6, 1 and 2, and 1-6, and the teachers with a science methods course show greater disagreement than do their comparative groups. The teachers with 19-24, 25-30, and more than 30 hours of science indicate greater disagreement than do their comparative groups. The teachers with 1-6 hours of science course work indicate a low degree of disagreement with the statement.

The teachers were asked to respond to the statement that they feel that the demands of the basic communication skills leave little time for science teaching. Figure 31 indicates the response to this statement and illustrates a slight positive response. The comparative analysis illustrates that there is a difference reported by the various groups. The departmentalized classroom teachers report a disagreement with the total response and with the self-contained classroom teachers. The inexperienced teachers indicate disagreement with the total response and with the experienced teachers. The differences that occur in the grade teaching are that the primary grade teachers agree with the statement and that the intermediate grade teachers indicate indecision. The other differences that occur in the grade teaching are due to the categories established for the departmentalized classroom teachers. All groups disagree with

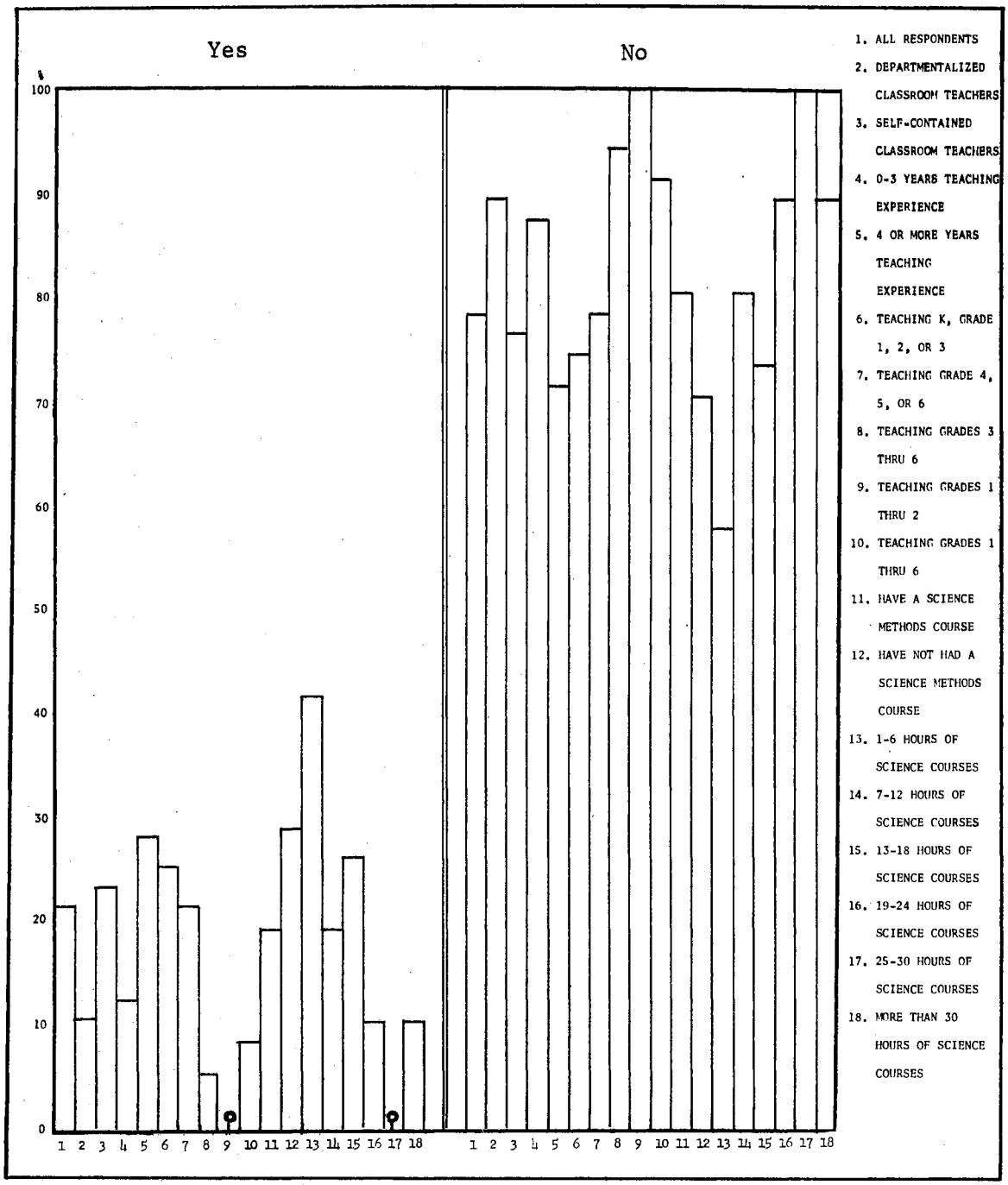

Figure 30. Science Interferes With the Basic Elementary School Program

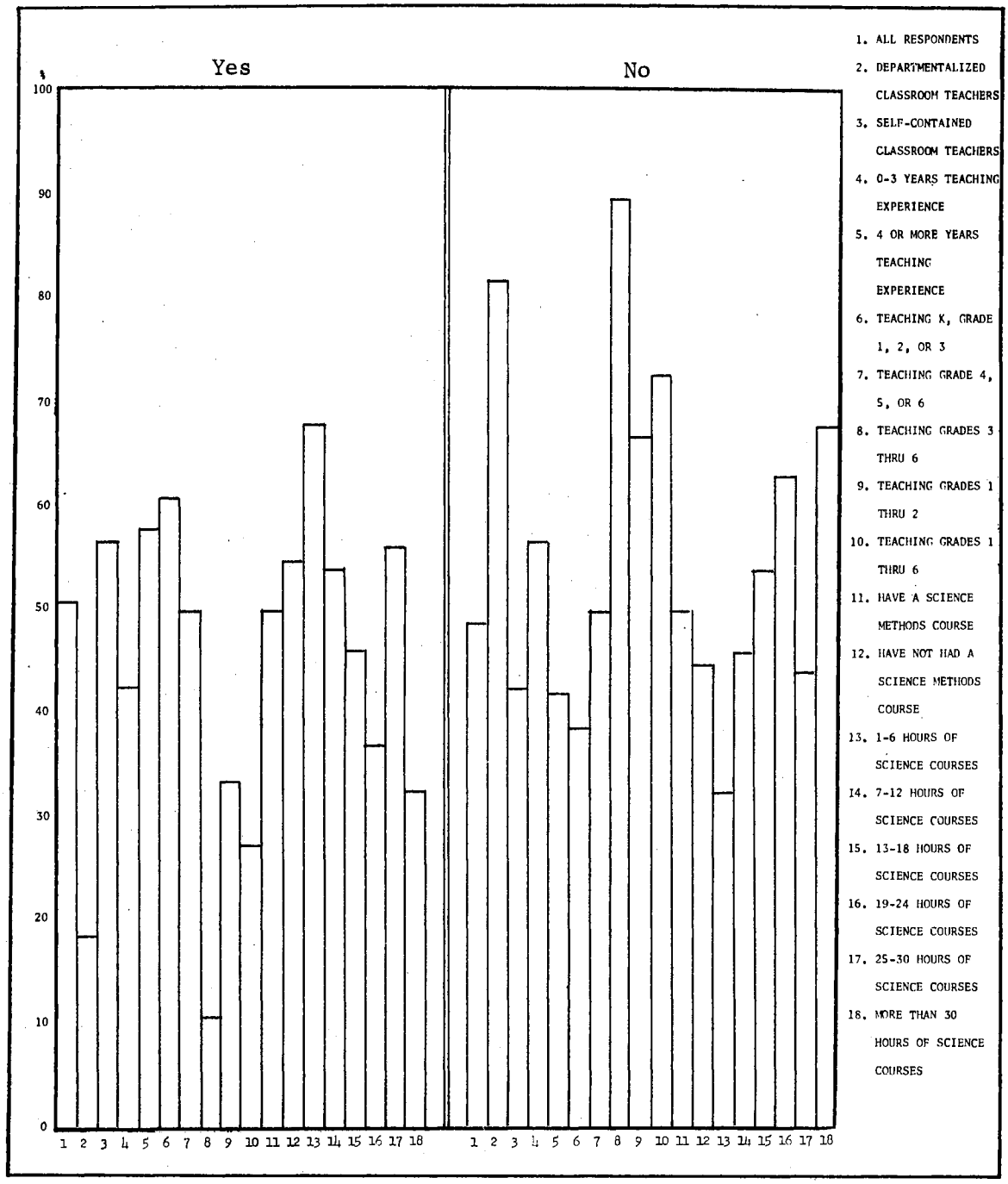

Figure 31. The Demands of the Basic Communication Skills Leave Little Time for Teaching Science

the statement. The teachers of grades 3-6 indicate greater disagreement. The teachers with a methods course are undecided in their response; those teachers without a methods course indicate slight agreement with the statement. In general, the more hours of science course work the teachers have the greater is the disagreement with the statement. The exception to this generalization is the group who have 25-30 hours of science course work and who indicate an agreement with the statement. (This is a slight degree of agreement.) The teachers with 1-6 hours and 7-12 hours of science course work also agree with the statement. The teachers with more than 30 hours of science course work indicate greater disagreement than do the comparative groups in this category.

The teachers were asked to respond to the statement that they would like to devote more time to the teaching of science but that the language arts are more essential. This information is provided in Figure 32 and illustrates a slight negative response. The comparative analysis indicates considerable variating in the groups. The departmentalized classroom teachers and the inexperienced teachers indicate greater disagreement than do their comparative groups. The primary teachers indicate a slight positive response; the intermediate teachers, a negative response. The other differences that occur in the grade teaching are due to those categories established for the departmentalized teachers. Teachers of grades 3-6 and 1-2 indicate greater disagreement. The teachers with a methods course disagree, but the teachers without a methods course show a slight agreement with the statement. With the exception of the group with 19-24 hours of science course work, the teachers with more hours of science course work indicate greater disagreement with the statement.

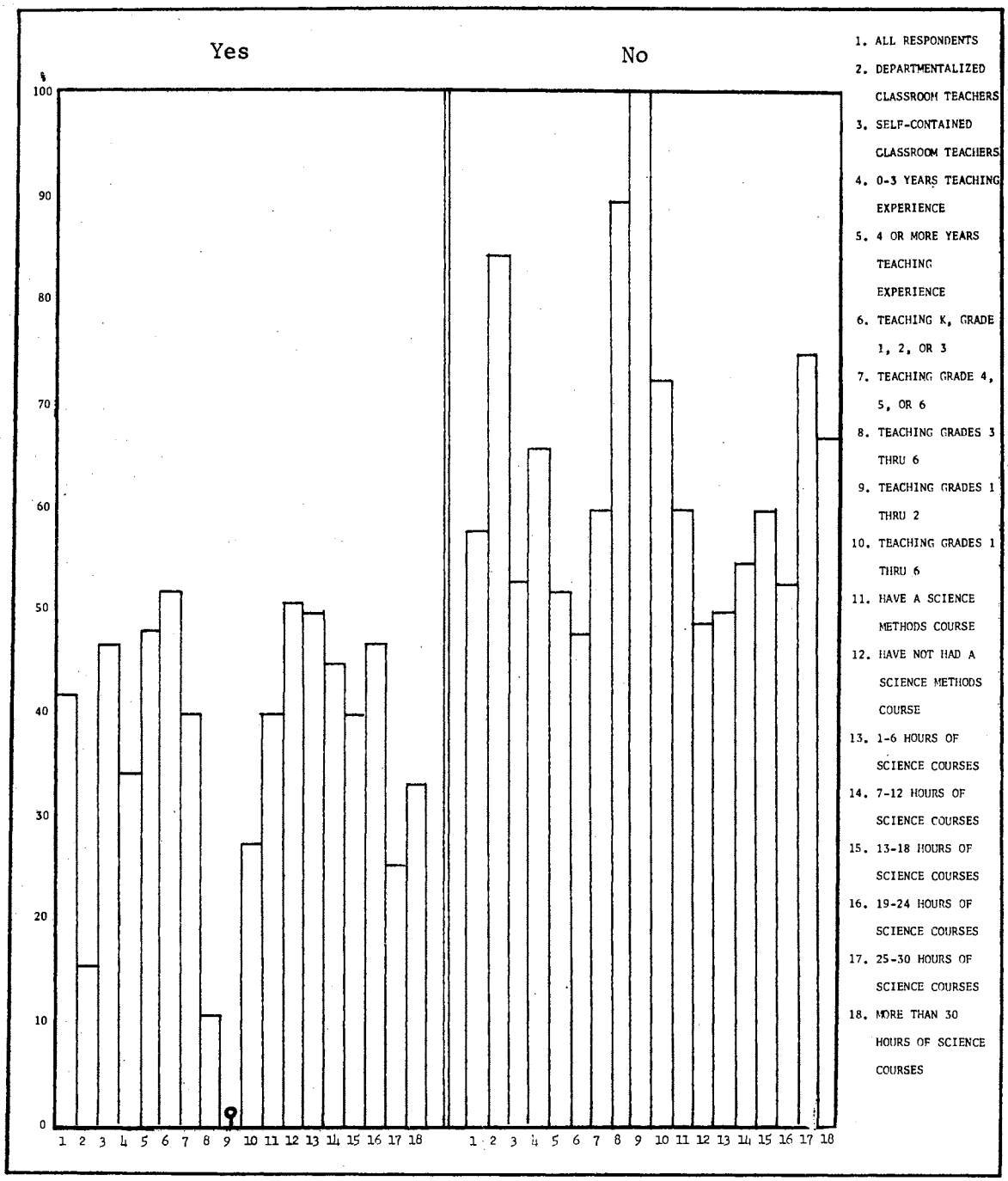

Figure 32. The Language Arts Are More Essential Than Teaching Science

As is illustrated in Figure 33, the teachers indicate that the social studies are not more essential than teaching science. The comparative analysis illustrates that the only differences that occur are in the degree of indication that social studies are not more essential. The departmentalized classroom teachers, the inexperienced teachers, teachers of grades 3-6, 1-2, and 1-6, the teachers with a science methods course, and the teachers with 25-30 hours or more than 30 hours of science course work report a greater agreement that social studies are not more essential.

The teachers were asked to respond to the statement that they would like to devote more time to science teaching but arithmetic is more essential. Figure 34 reports this information and illustrates a negative response. The comparative analysis illustrates that the differences that occur between the groups are in the degree of negative response. The departmentalized teachers, the experienced teachers, the intermediate grade teachers, the teachers of grades 1-2 and 3-6, teachers with a methods course, and teachers with more hours of science course work indicate greater disagreement.

Loss of Classroom Prestige in Teaching Science

The review of the literature indicates that a factor which might influence science teaching in the elementary school is a feeling among teachers that they might lose prestige in the classroom because of unfamiliarity with science subject matter. The investigator asked the teachers to respond to four questions dealing with unfamiliarity with the science subject matter.

The teachers were asked to respond to the statement that they would

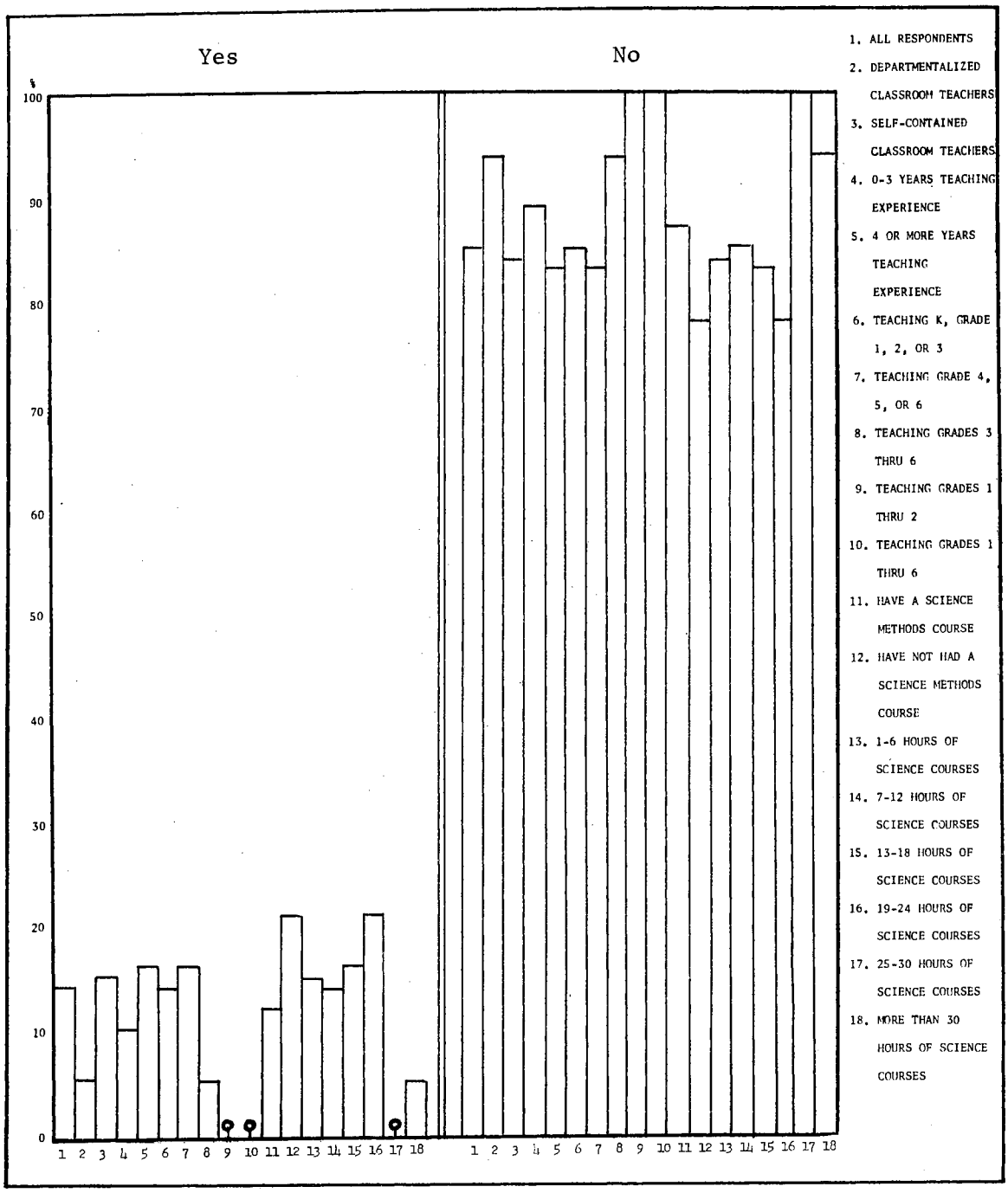

Figure 33. Social Studies Are More Essential Than Teaching Science

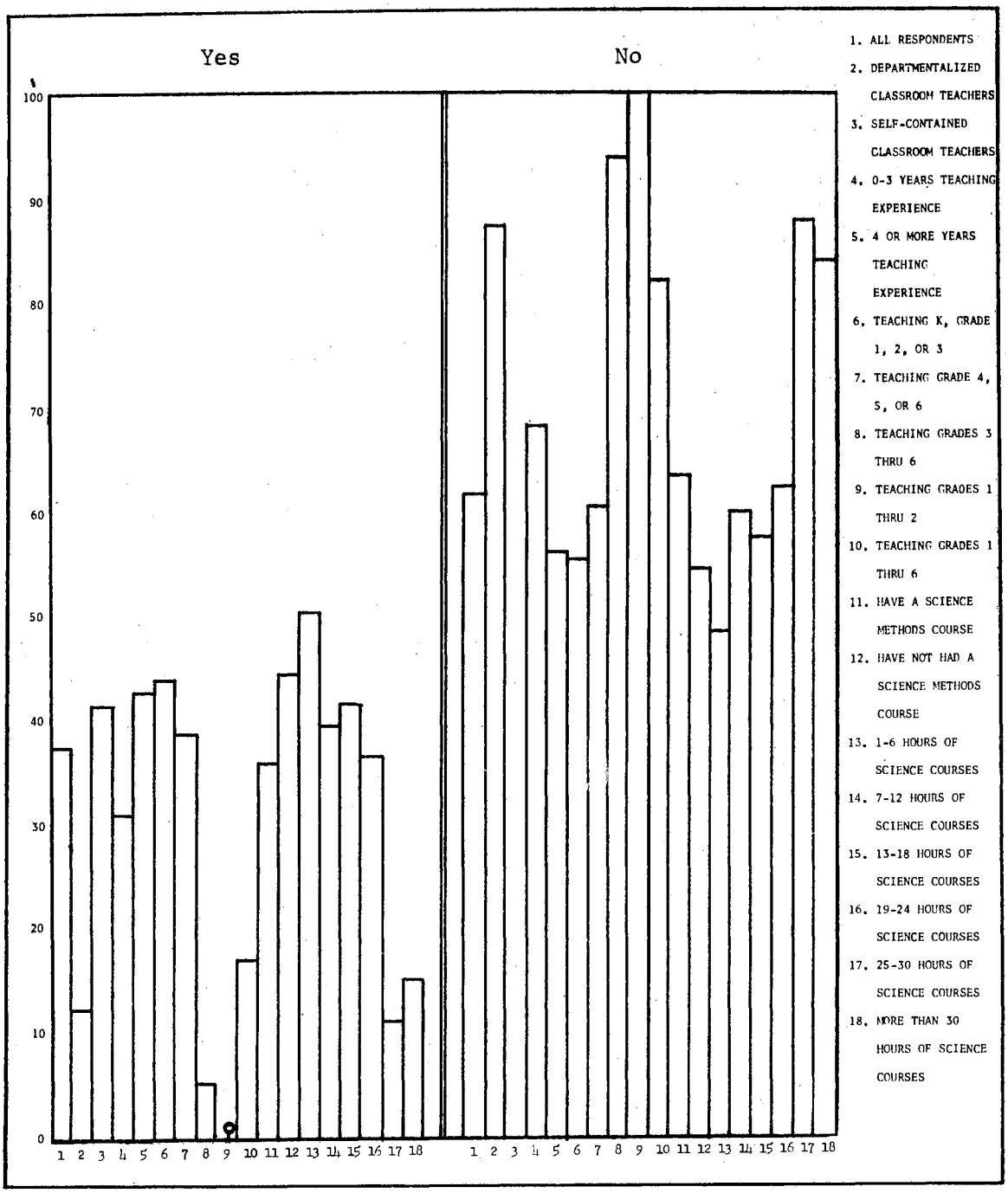

Figure 34. Arithmetic Is More Essential Than Teaching Science

devote more time to teaching science but they feel a loss of classroom prestige as a result of science questions being difficult to answer. Figure 35 illustrates their responses and indicates a disagreement with the statement. The comparative analysis indicates that the major differences which occur are that self-contained classroom teachers, intermediate grade teachers and teachers with 1-6 hours of science course work report less disagreement with the statement than do their comparative groups.

The teachers were asked to respond to the statement that they often find it difficult to answer some of the questions that their students ask concerning science. Figure 36 illustrates their responses and indicates slight agreement with the statement. The comparative analysis indicates considerable variation among the groups. The departmentalized classroom teachers indicate disagreement with the total response and with the response of the self-contained classroom teachers. The experienced teachers indicate a disagreement with the total response and with the response of the inexperienced teachers. The differences that occur in the grade teaching are due primarily to the established groups for the departmentalized groups indicating a positive response. There is less agreement indicated by the primary teachers. The more course work the teachers have the more they disagree with the statement.

The teachers were asked to respond to the statement that too often they have to answer "I don't know" to science questions asked by their students. Figure 37 reports this information and illustrates a negative response. The comparative analysis illustrates that the differences which occur among groups are in the degree of negative response. The departmentalized classroom teachers, the experienced teachers, the teachers of the primary grades, and those teachers with more hours of

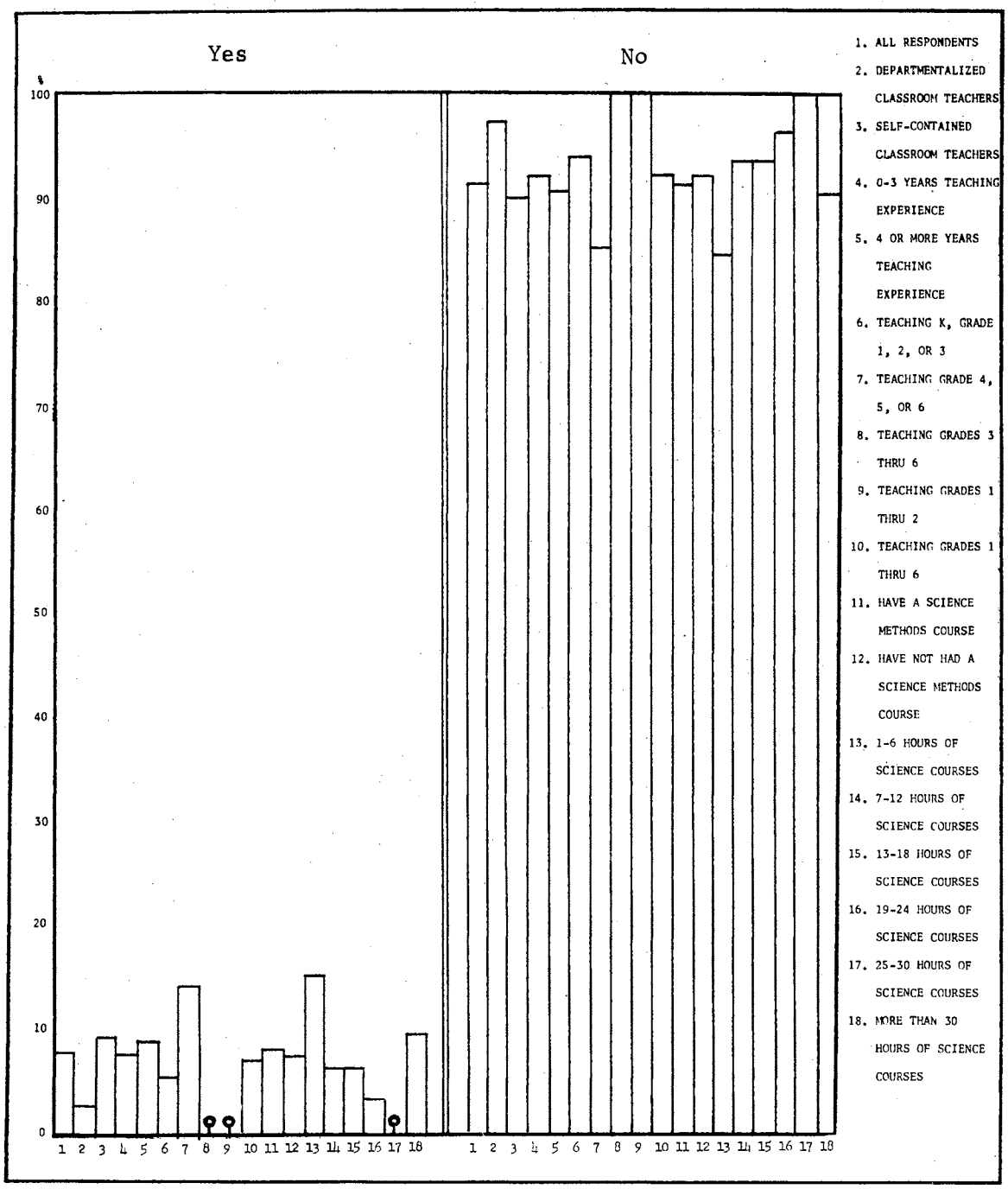

Figure 35. Feeling of a Loss of Classroom Prestige Due to the Difficulty of Answering Questions Concerning Science

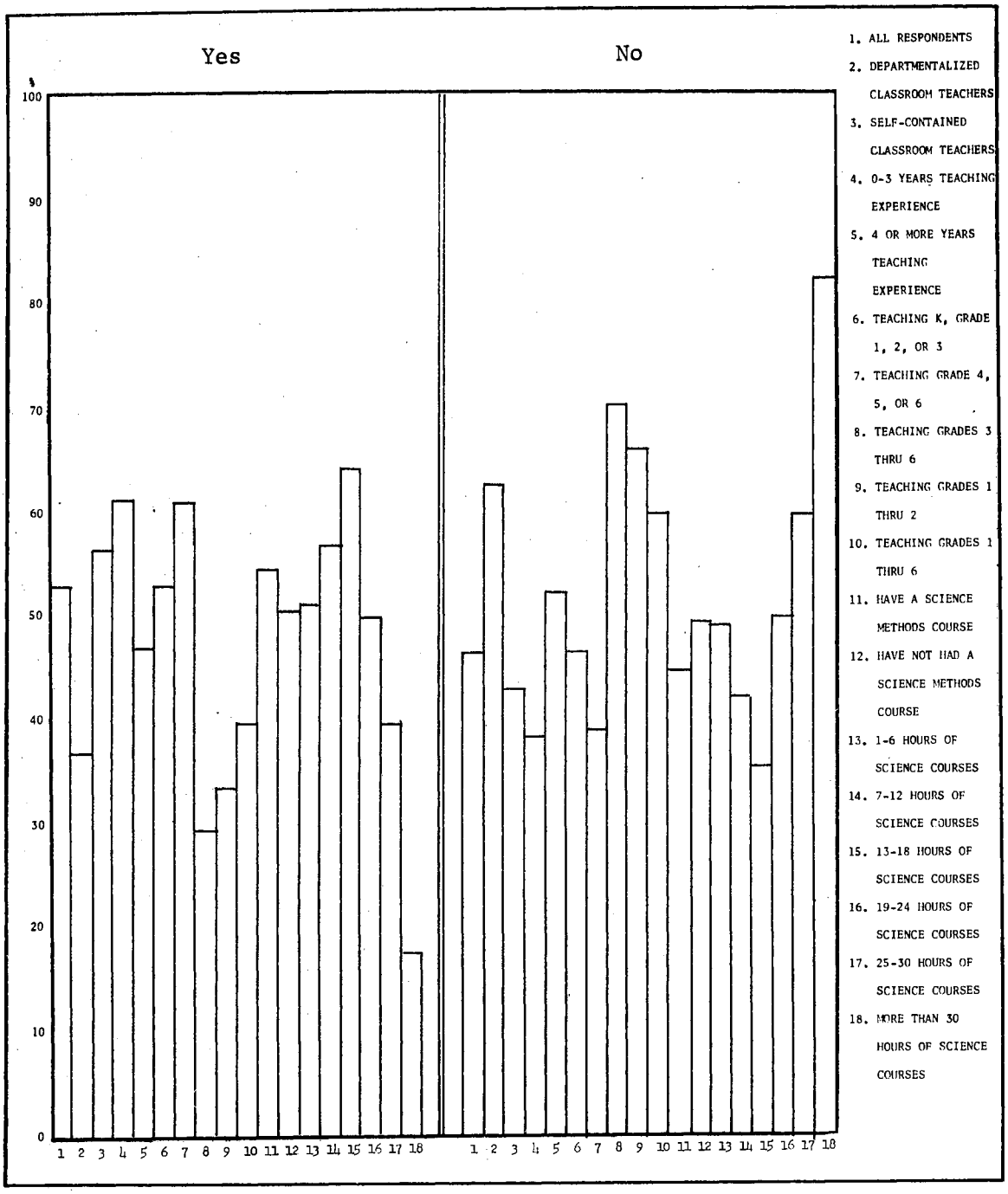

Figure 36. Often Find It Difficult to Answer Some of the Questions Concerning Science

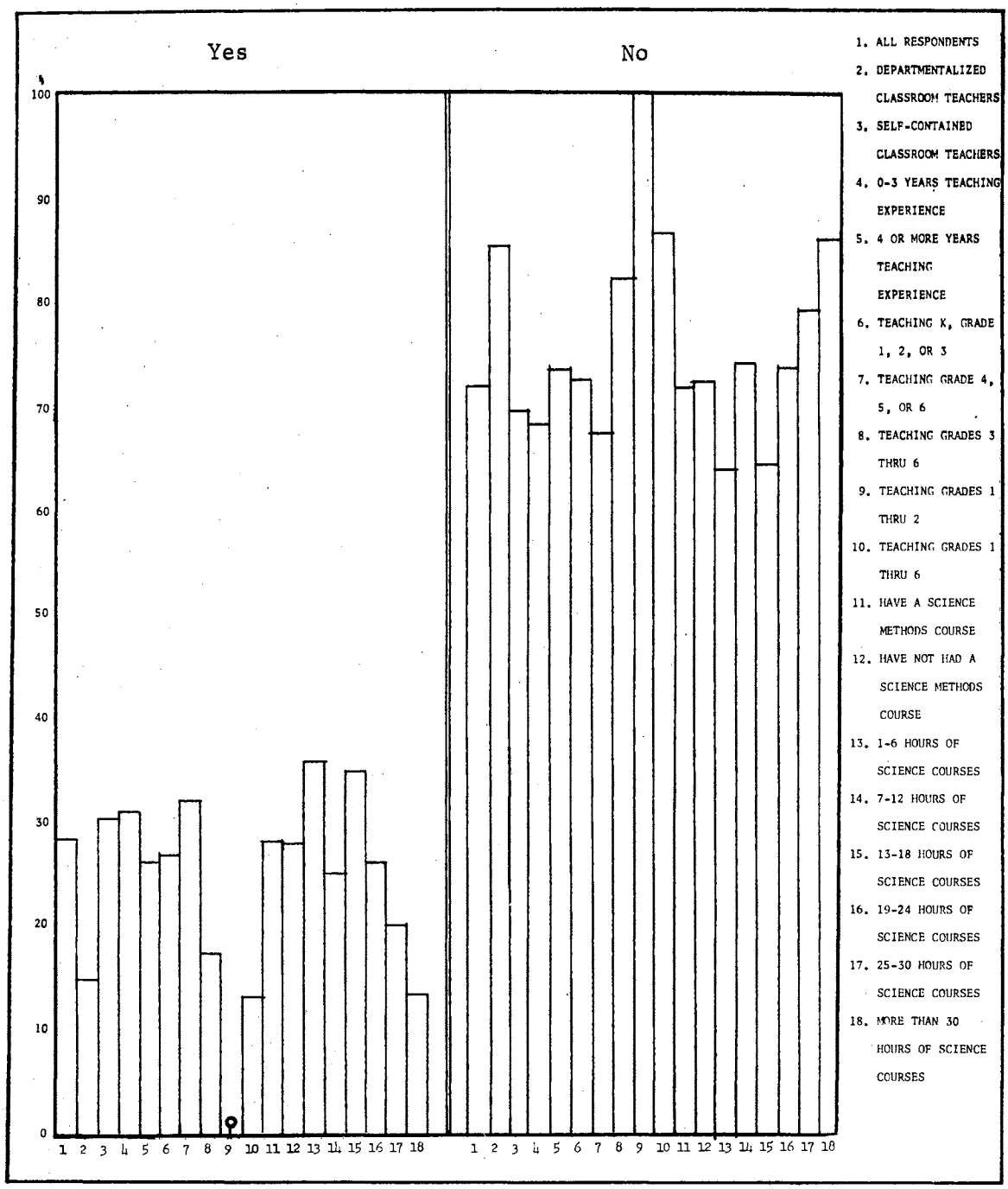

Figure 37. Too Often Answer "I Don't Know" to Science Questions

science course work indicate a higher degree of disagreement with their respective groups. The other differences that occur in the grade teaching are due to the categories established for the departmentalized classroom teachers who indicate greater disagreement with the statement.

The teachers were asked to respond to the statement that their students often want to study phases of science with which they are unfamiliar. Figure 38 reports this information and illustrates a negative response. The comparative analysis indicates some variation in the responses among the groups. The departmentalized classroom teachers indicate greater disagreement with the statement than do the self-contained classroom teachers. The experienced teachers indicate greater disagreement with the statement than do the inexperienced teachers. The only variation that occurs in the grade teaching is due to the established categories for the departmentalized classroom teachers who indicate greater disagreement with the statement. The teachers without a methods course indicate greater disagreement than those with a methods course. Those teachers with more hours of science course work indicate a higher degree of disagreement with the statement than do those with fewer hours.

Science Demands Too Much Time, Creates a Cluttered Classroom, or Disrupts Normal Classroom Routines

The investigator felt that interviews with elementary teachers and those concerned with teacher education indicated factors that might be influencing indirectly the teaching of science on the elementary school level. These were the time that would be involved in teaching science, the materials and equipment that are involved in teaching science, creating a cluttered classroom, and the activities involved in science

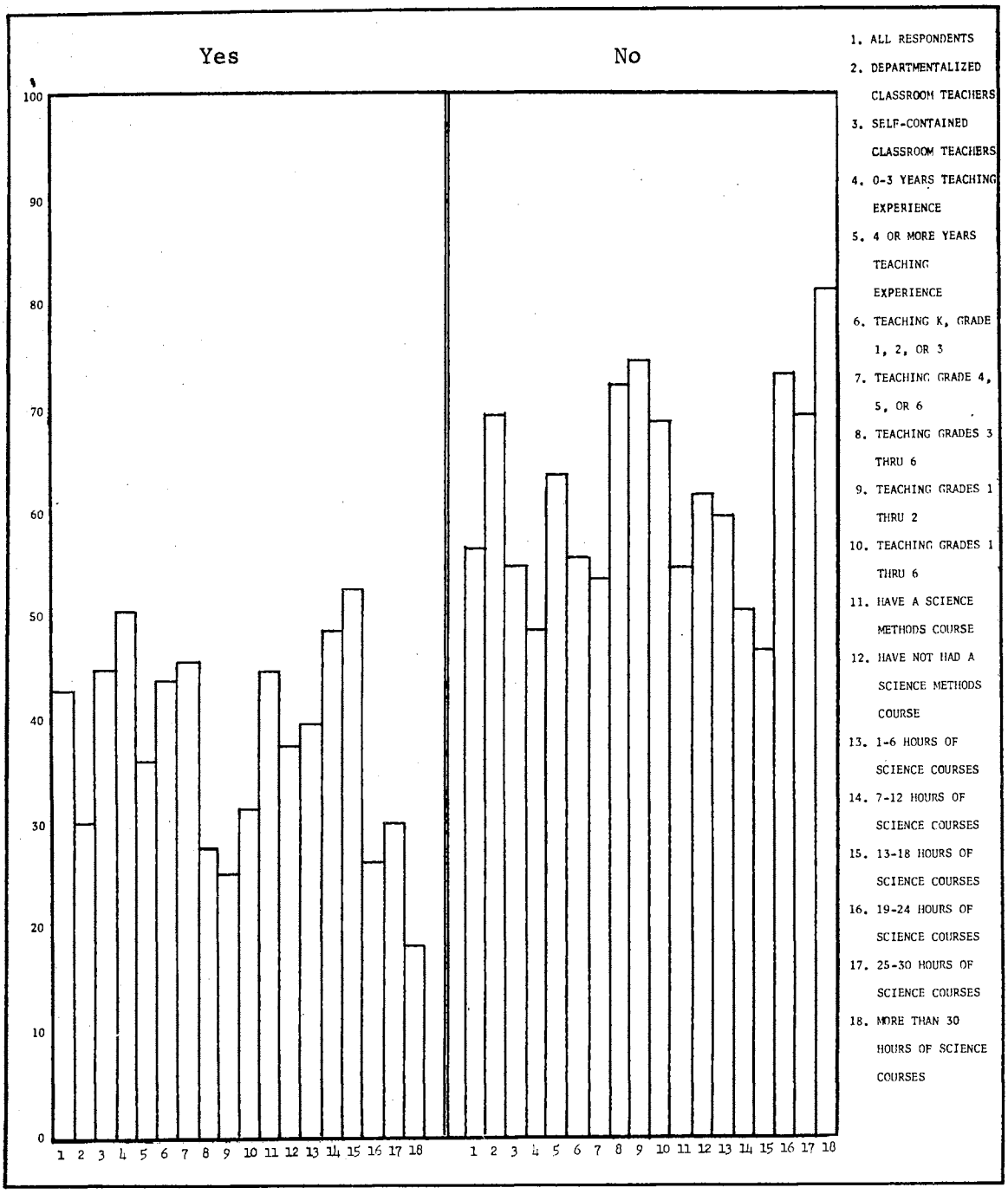

Figure 38. Students Often Want to Study Phases of Science Which Are Unfamiliar to the Teachers

teaching might disrupt normal classroom routines. Seven questions were asked of the sample to elicit their responses concerning these factors.

The teachers were asked to express their opinion whether they would like to teach "the scientific method" but that it takes too much time. Figure 39 reports this information and illustrates a negative response. The comparative analysis illustrates that the differences which occur among the groups are in a degree of negative response. The departmentalized classroom teachers, the inexperienced teachers and those teachers with a methods course all indicate a greater degree of disagreement with the statement than their comparative groups. The differences that occur in the grade teaching are due to those categories established for the departmentalized classroom teachers who indicate a greater disagreement with the statement. In general, the more course work the teachers had the greater the disagreement to the statement with the exception of those teachers with 25-30 hours of science course work.

The teachers were asked to express their opinion that they would provide more experimentation and demonstration in their classes if the use of the equipment was not too time consuming. Figure 40 reports this information and illustrates a negative response. The comparative analysis illustrates that the differences which occur among the groups are in the degree of negative responses. The departmentalized classroom teachers, the inexperienced teachers, and those teachers with a methods course indicate a greater disagreement with the statement than their comparative groups. The differences that occur in the grade teaching are due to those categories established for the departmentalized classroom teachers with these teachers indicating a greater disagreement with the statement. The teachers with 13-18 hours of science course work and more than 30 hours

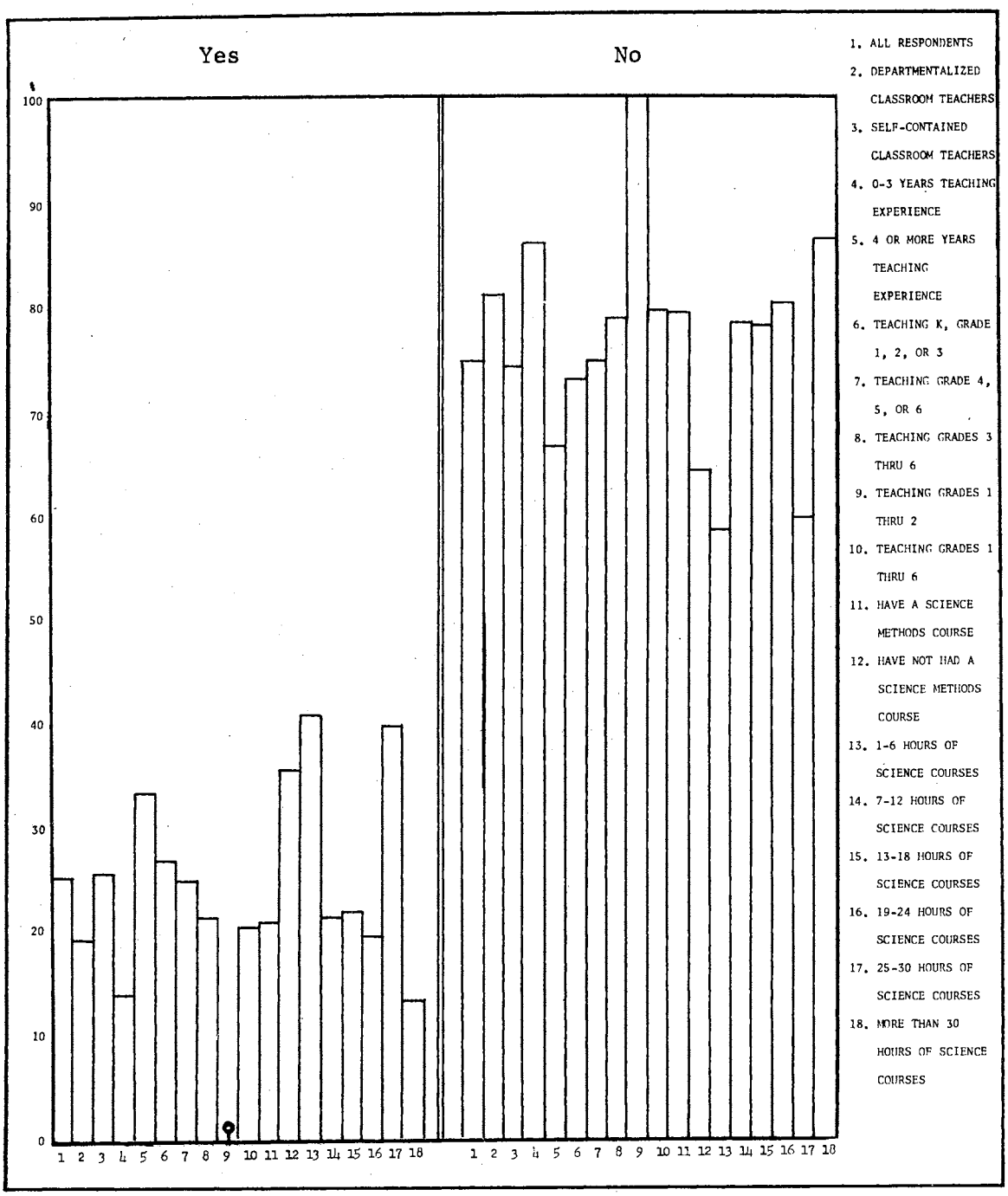

Figure 39. Teaching the Scientific Method Takes Too Much Time

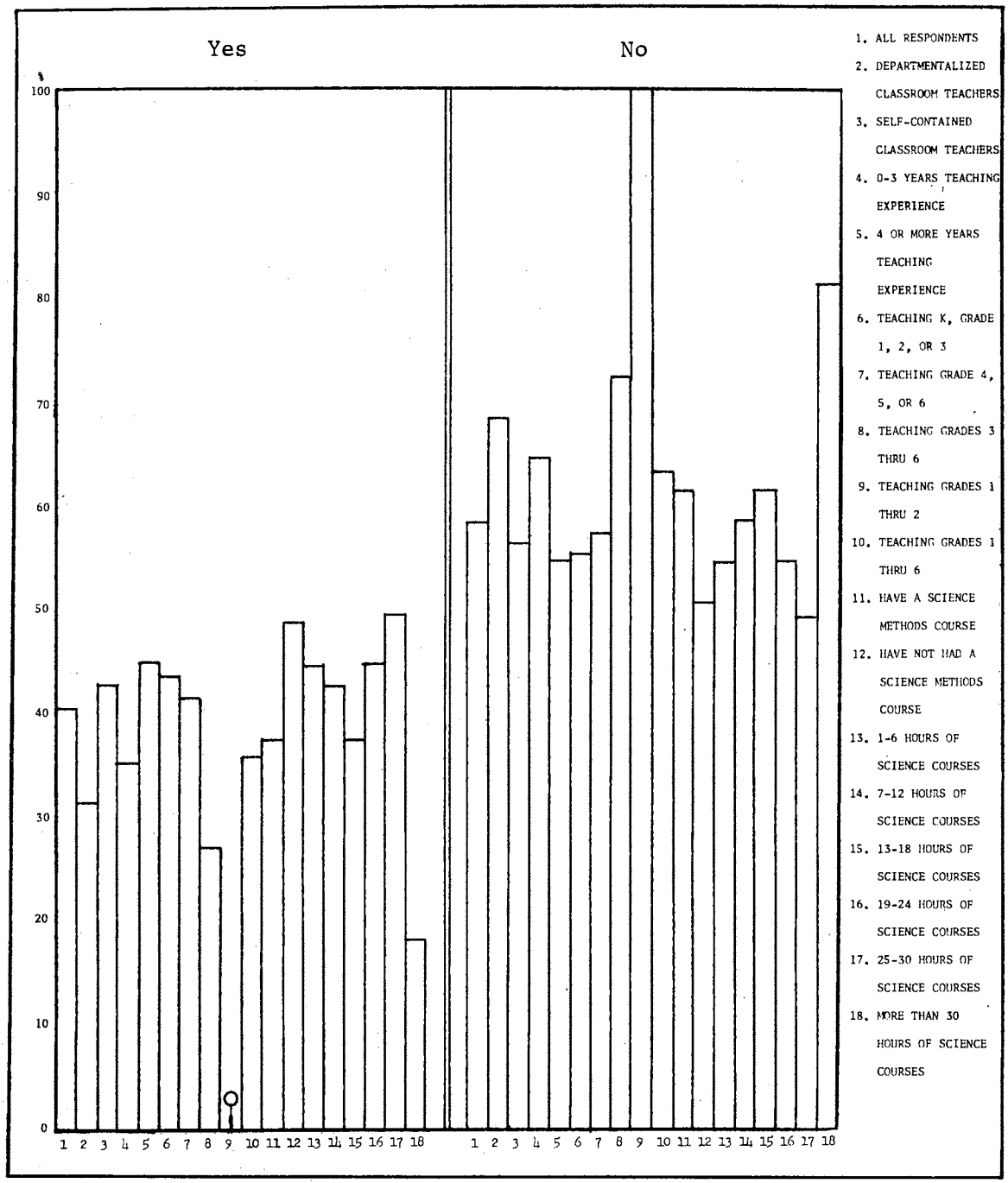

Figure 40. Experimentation and Demonstrations Require Equipment That Is Too Time Consuming

of science course work indicate a greater disagreement with the statement than their comparative groups.

The teachers were asked to express their opinion that the benefits that a student derives from actual first-hand laboratory-type experiments cannot be justified in terms of the amount of time that it demands. Figure 41 reports this information and illustrates a disagreement with the statement. The comparative analysis illustrates that the differences that occur among the groups are in the degree of negative response. The inexperienced teachers indicate a greater disagreement with the statement than the experienced teachers. Teachers with a methods course indicate a greater disagreement with the statement than those who do not have a methods course. The teachers with 7-12 hours and more than 30 hours of science course work indicate a greater disagreement with the statement than the others in their comparative groups.

The teachers were asked to express their opinion that they would like to teach their students the "scientific method" but it is too confusing. Figure 42 reports this information and illustrates a negative response. The comparative analysis indicates that the differences that occur among the groups are in the degree of negative response and that there are not great differences among the comparative groups. The groups established for the departmentalized teachers in the category for grade teaching indicate a greater disagreement than the others in their groups.

The teachers were asked to express their opinion that they would provide more experimentation in their classes if the use of equipment did not cause too much confusion in the classroom. Figure 43 reports this information and illustrates a negative response. The comparative analysis indicates that the differences that occur among the groups are in the

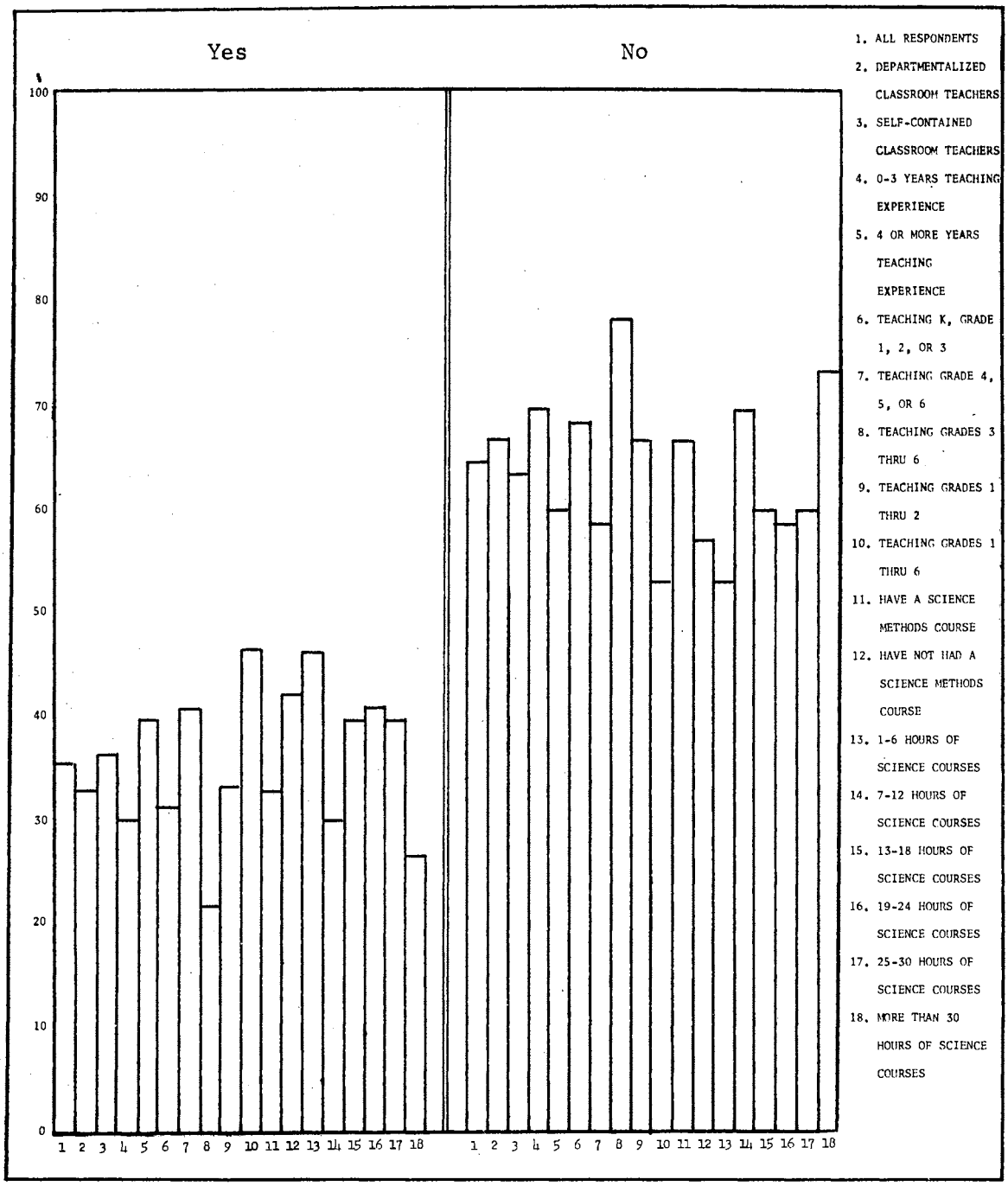

Figure 41. First Hand Laboratory Type Experimentation Can Not Be Justified in Terms of the Amount of Time It Demands

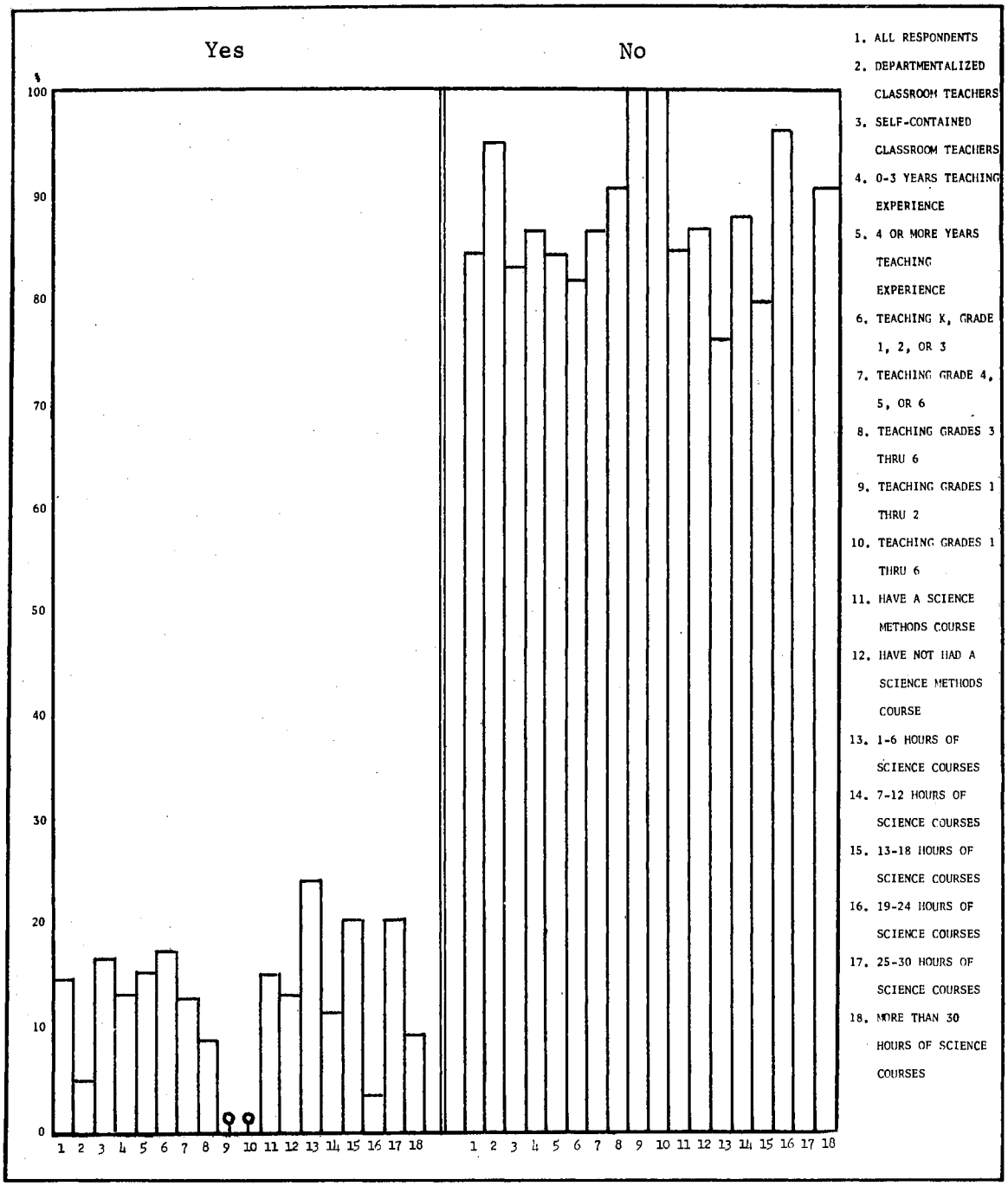

Figure 42. Teaching the "Scientific Method" Is Too Confusing

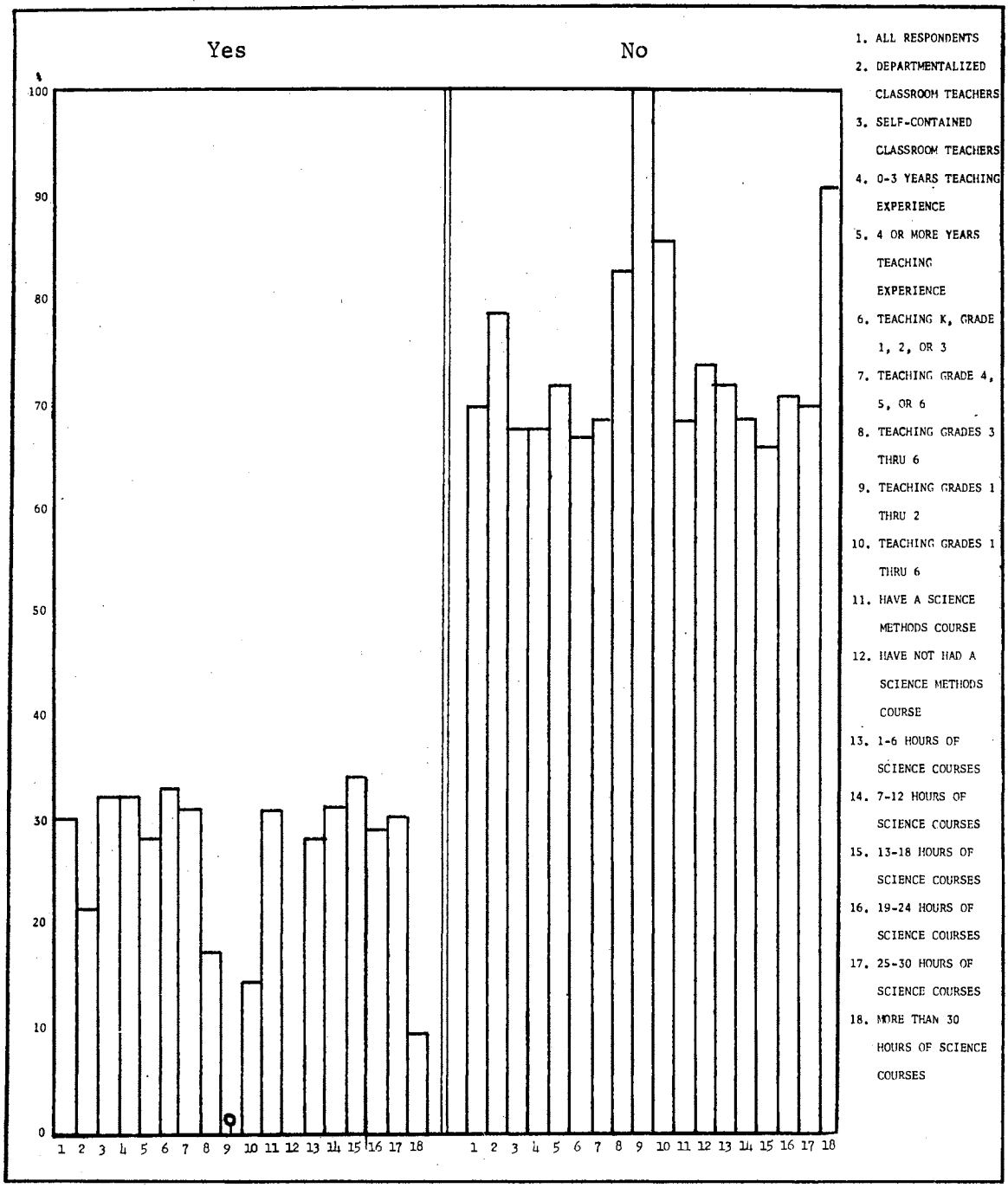

Figure 43. Experimentation and Demonstrations Require Equipment That Causes Too Much Confusion in the Classroom

degree of negative response. The departmentalized teachers, the experienced teachers, the teachers without a methods course, and those teachers that teach in the grades 3-6, 1-2, and 1-6 indicate a greater negative response than their comparative groups. The group that has more than 30 hours of science course work indicates a greater disagreement to the statement than the other groups in this category.

The teachers were asked to express their opinion that they would devote more time to teaching science but it creates a cluttered classroom. Figure 44 reports this information and illustrates a negative response. The comparative analysis indicates that the differences that occur between groups are in the degree of negative response and that there are not great differences among the comparative groups.

The teachers were asked to express their opinion that they would devote more time to teaching science but it disrupts normal classroom activities. Figure 45 reports this information and illustrates a negative response. The comparative analysis indicates that the differences that occur among the groups are in the degree of negative response. The Primary grade teachers indicate a greater degree of disagreement with the statement than the intermediate grade teachers. The teachers with 1-6 hours of science course work indicate less negative response than the other members of the category.

Availability and Use of Science Teaching Equipment and Materials

The review of the literature indicated that a factor which might influence science teaching in the elementary school is the possibility that the teachers feel they do not have access to science materials and equipment or that they do not know how to use science materials and equipment.

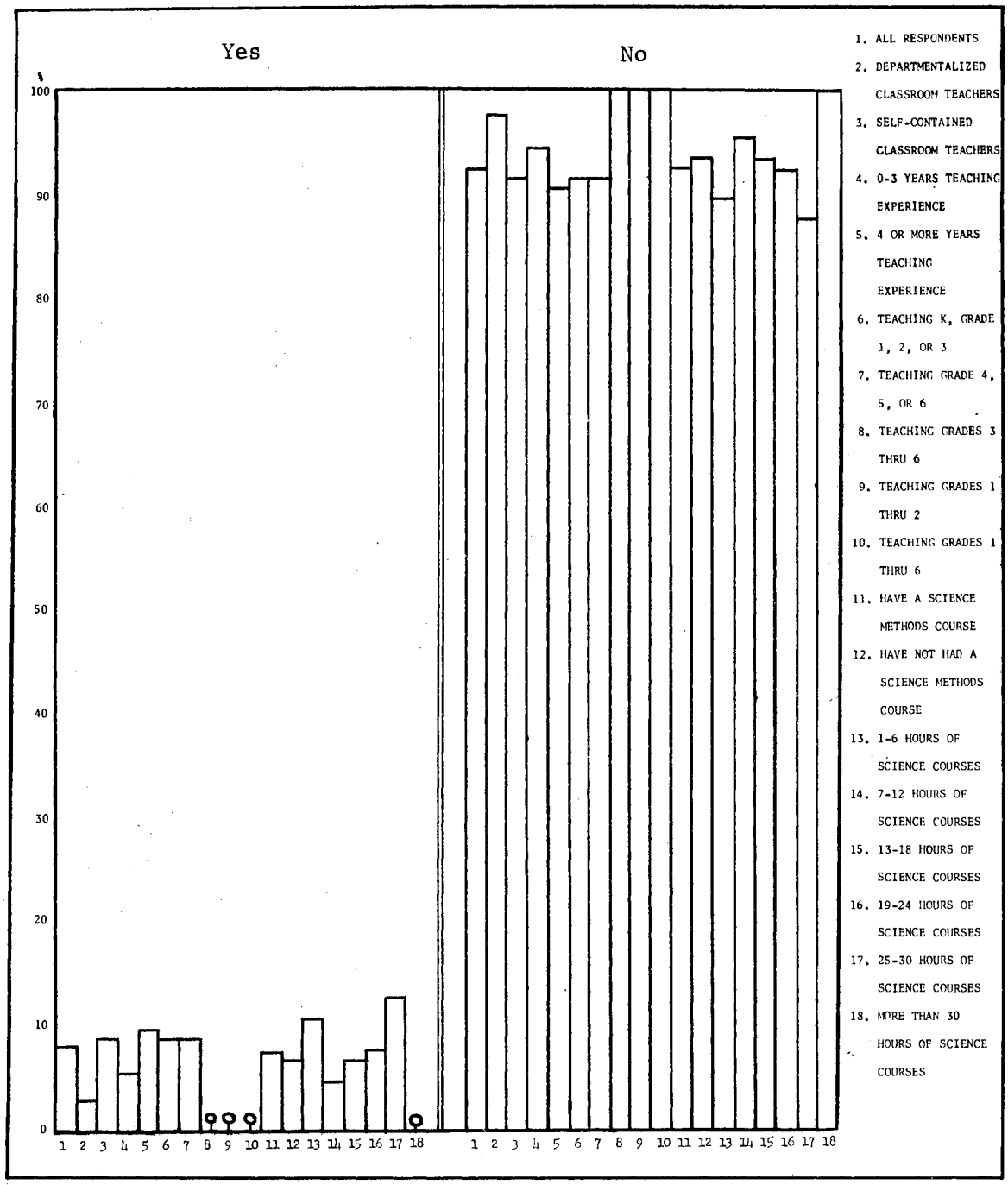

Figure 44. Teaching Science Creates a Cluttered Classroom

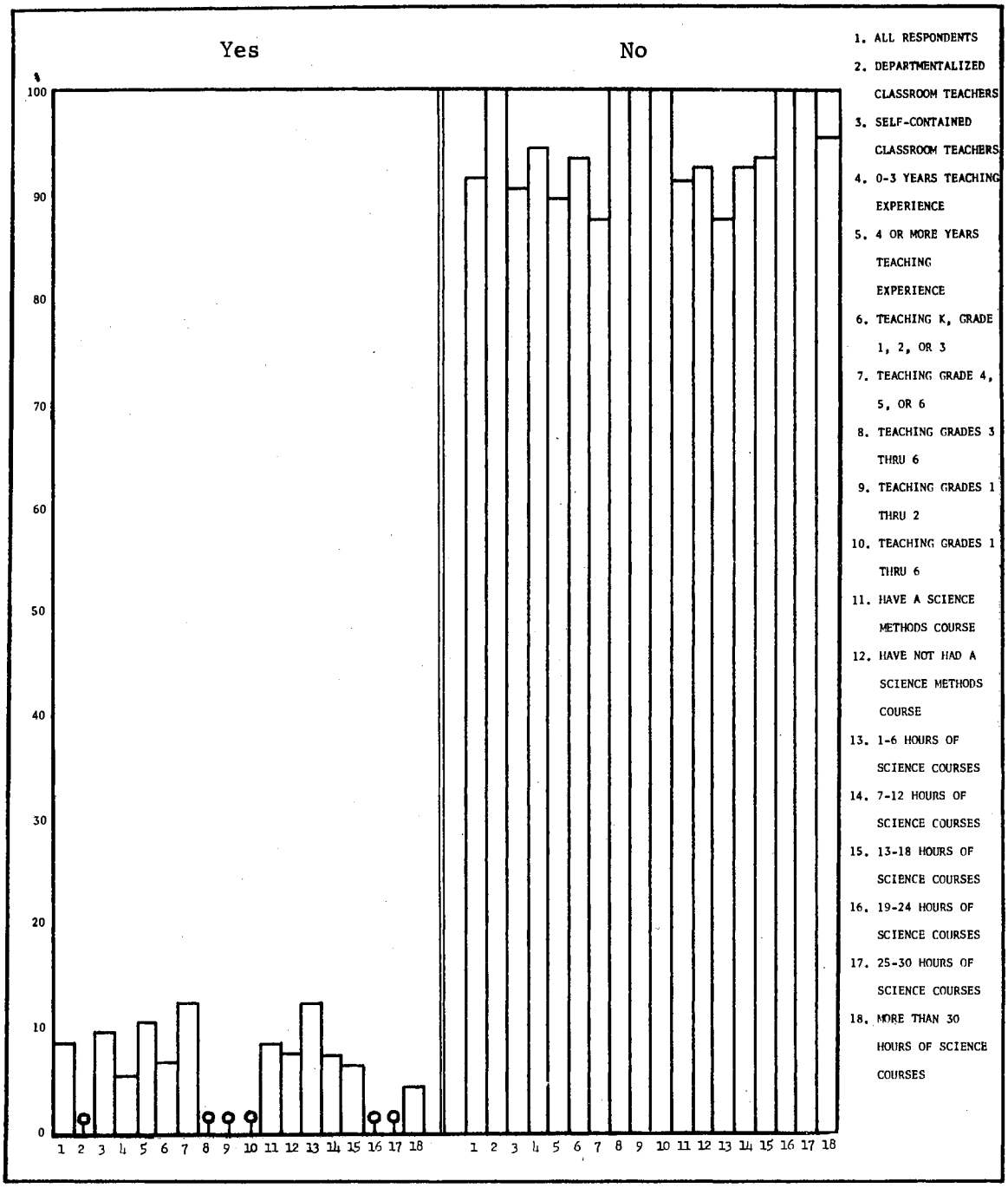

Figure 45. Teaching Science Disrupts Normal Classroom Activities

The investigator asked the teachers to respond to nine questions dealing with the availability and use of science equipment and materials.

The teachers were asked to respond to the statement that they used science textbooks in teaching science. Figure 46 reports this information and illustrates a positive response. The comparative analysis indicates that the differences that occur are in the degree of positive responses by the groups. The departmentalized classroom teachers, the experienced teachers, the intermediate grade teachers, and those teachers without a methods course indicate a higher degree of positive response than do their comparative groups. The differences that occur in the grade teaching other than those mentioned above are due to those categories established for the departmentalized teachers who indicate total agreement with the statement. The differences that occur in the number of hours of science course work indicate that the teachers with 1-6 and 7-12 hours show fewer positive responses. The teachers with 25-30 hours show a greater positive response than do the other groups in this category.

The teachers were asked to respond to the statement that they used additional science books or written materials in teaching science. Figure 47 indicates this response and reports a positive response. The comparative analysis indicates that the small differences that occur are in the degree of agreement and that there is little difference in the responses of the comparative groups.

The teachers were asked to respond to the statement that they make use of the science materials available in the library in their building. The responses called for were: yes, no, not available. In general, fewer than one-third of the teachers recorded that they were not available.

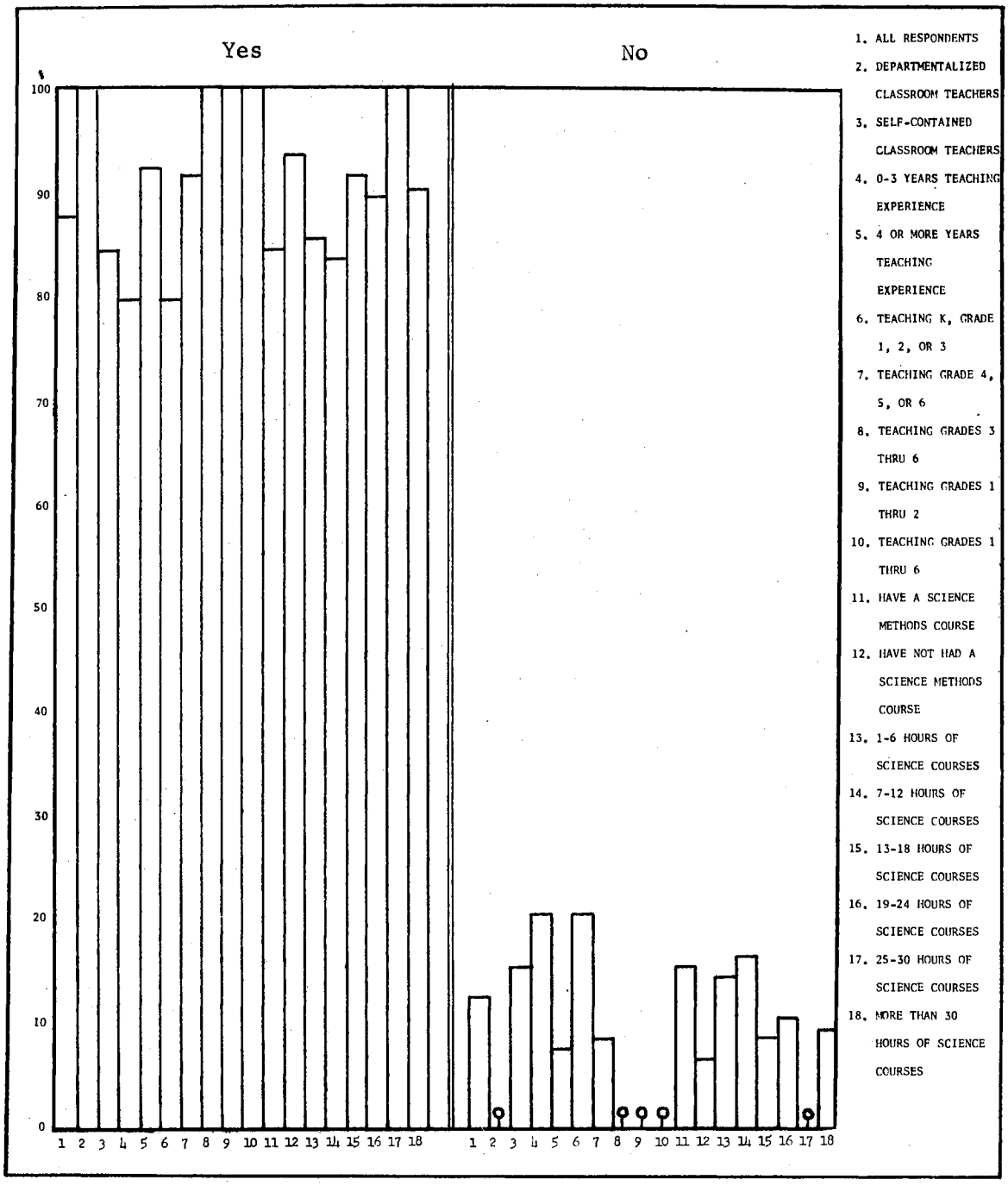

Figure 46. Teachers Use Science Textbooks in Teaching Science

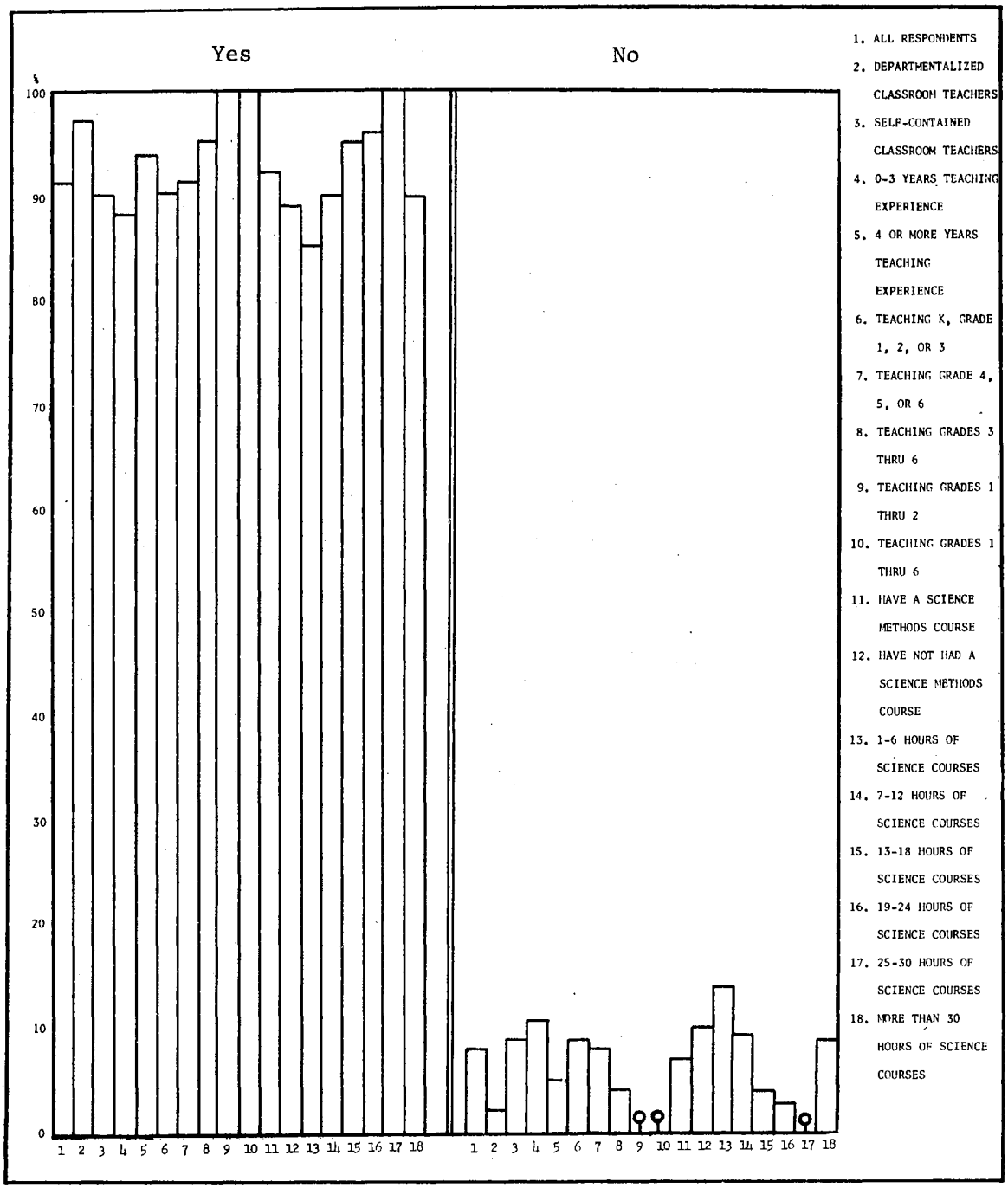

Figure 47. Teachers Use Additional Science Books or Written Materials in Teaching Science

A majority of these respondents were self-contained classroom teachers. There was little difference indicated in the grade that the self-contained classroom teachers were teaching. There were no differences based upon the years of teaching, the having or the not having a science methods course. A majority of the teachers indicating that materials were not available indicated that they had 7-12 hours of science course work.

In general, the response of those with materials available indicate that they agree with the statement. This information is provided in Figure 48. The comparative analysis illustrates that the differences in the responses are in the degree of agreement with the statement. The departmentalized teachers and the intermediate grade teachers indicate a much greater agreement with the statement. The more course work that the teachers have the greater is their agreement with the statement. The differences that occur in the grade teaching are due to the categories that have been established for the departmentalized classroom teachers. The teachers of grade 1 and 2 are undecided, and the teachers of grades 1-6 and 3-6 indicate greater agreement with the statement.

The teachers were asked to respond to the statement that they make use, where available, of local library films and/or filmstrips. The teachers were asked to respond in one of three ways, yes, no, not available. This information is provided in Figure 49 which indicates a positive reply. In general, fewer than one-fourth of the teachers stated that a local library with films and filmstrips was not available. A majority of these respondents were self-contained classroom teachers, teachers of the primary grades, teachers without a methods course, and have 13-18 hours of science course work.

The departmentalized classroom teachers indicate a higher degree

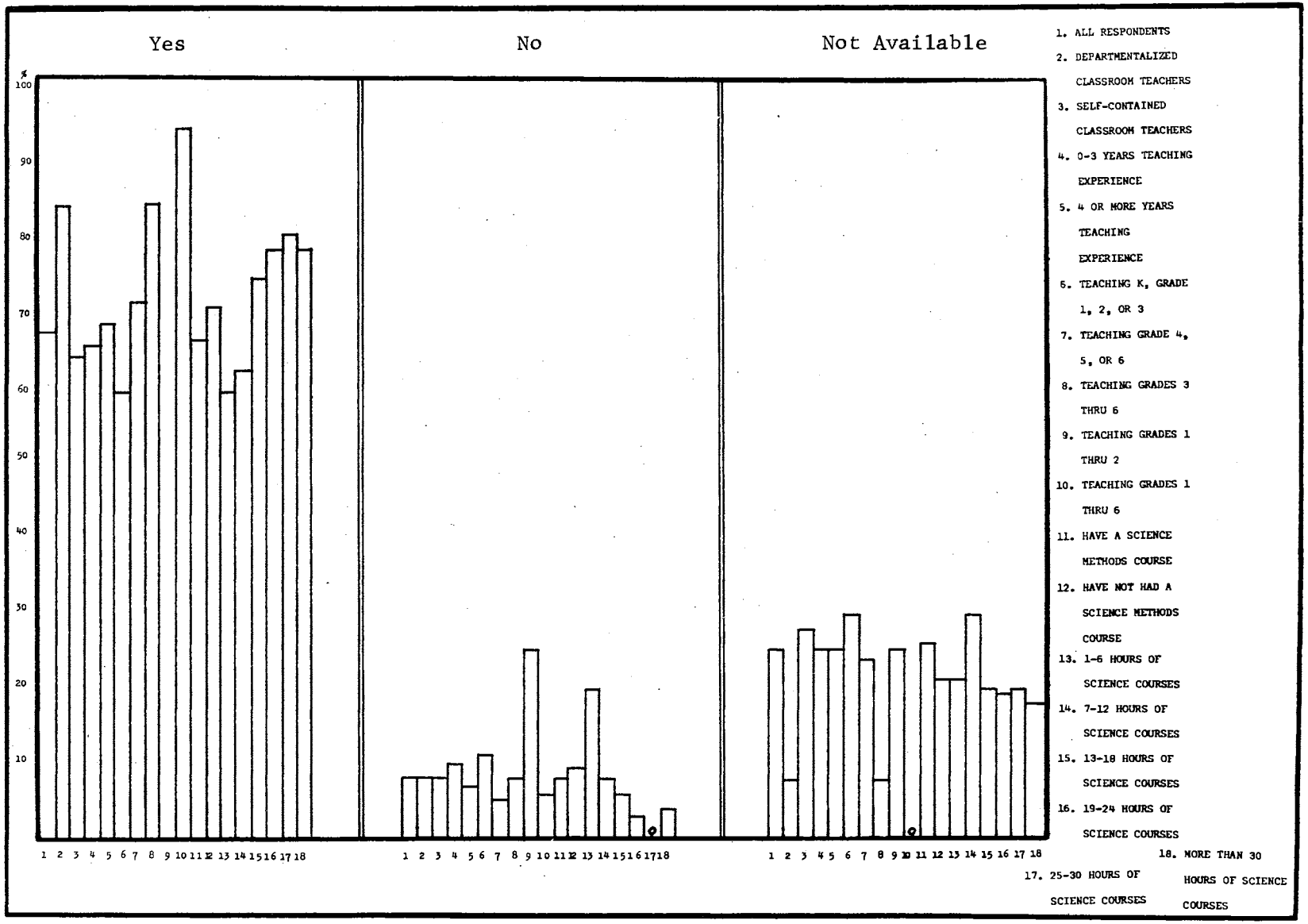

Figure 48. Teachers Make Use of Science Materials Available in the Library in Their Building

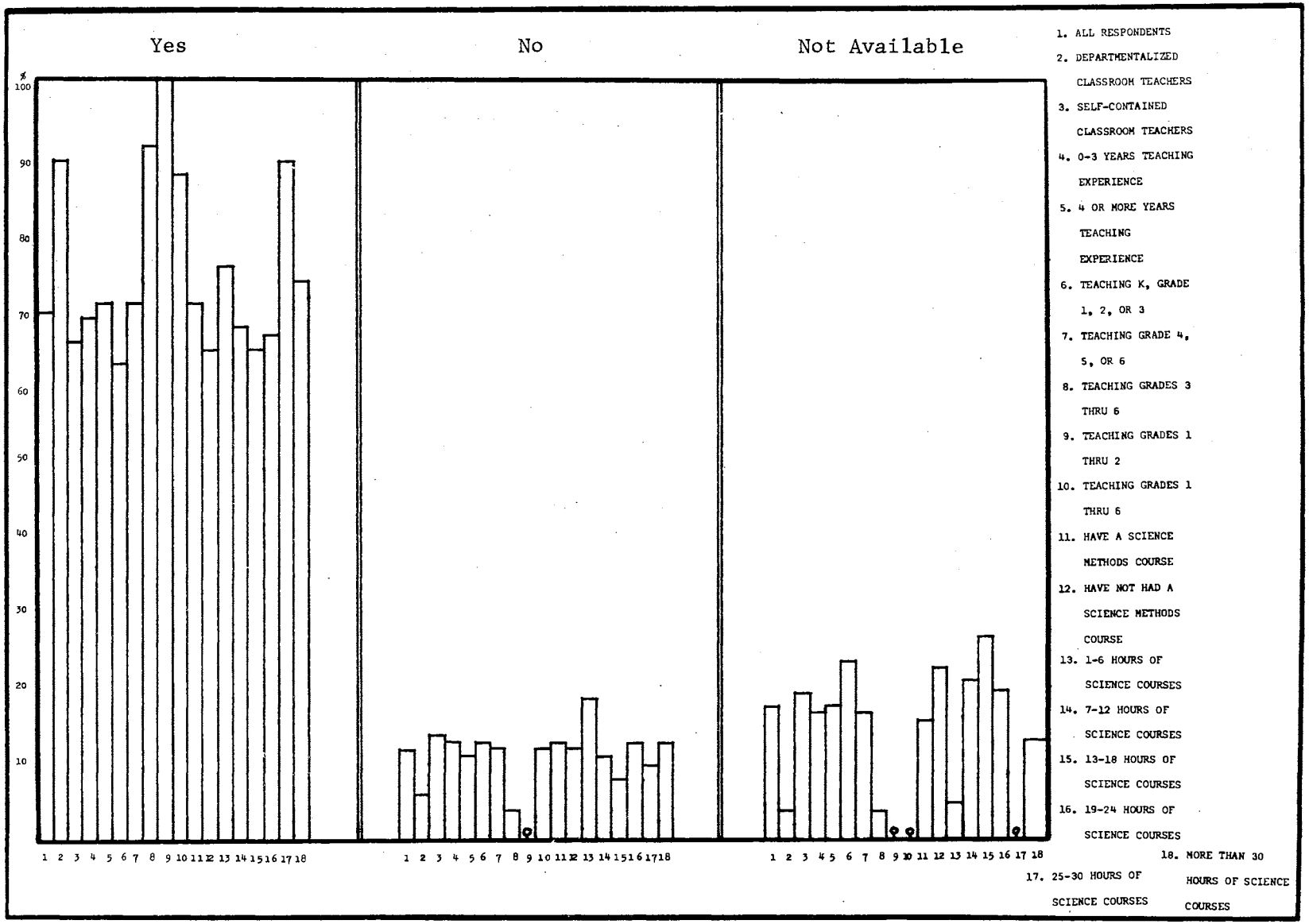

Figure 49. Teachers Make Use of Local Library With Films or Film Strips Available for Their Use

of agreement with the statement than do the self-contained classroom teachers. The differences that occur in the grade teaching are due to the categories established for the departmentalized classroom teachers. The teachers of all three groups indicate greater agreement with the statement than the others in their comparative group. The teachers with a methods course indicate greater agreement than do the teachers without a methods course. The teachers with 1-6 hours, 25-30 hours or more than 30 hours of science course work indicate greater agreement with the statement than do the other groups in this category.

The teachers were asked to respond to the statement that they make use of science films from the state department of education or commercial rental films in their science teaching. Figure 50 reports this information and illustrates a positive response. The comparative analysis indicates that in general the differences that occur among the groups are in the degree of the positive response. A noticeable exception is the group of teachers who teach grades 1 and 2. All of the teachers in this group disagree with the statement. The intermediate grade teachers, those teachers with more than 30 hours of science course work, and those teachers with a science methods course indicate a higher degree of agreement with the statement than do their comparative groups.

The teachers were asked to respond to the statement that they have science equipment in their school building. Figure 51 reports this information and illustrates a positive response. The comparative analysis illustrates that the only differences that occur are in the degree of agreement with the statement. The departmentalized classroom teachers, the experienced teachers, the intermediate grade teachers, the teachers with more than 30 hours of science course work, and the teachers of grades

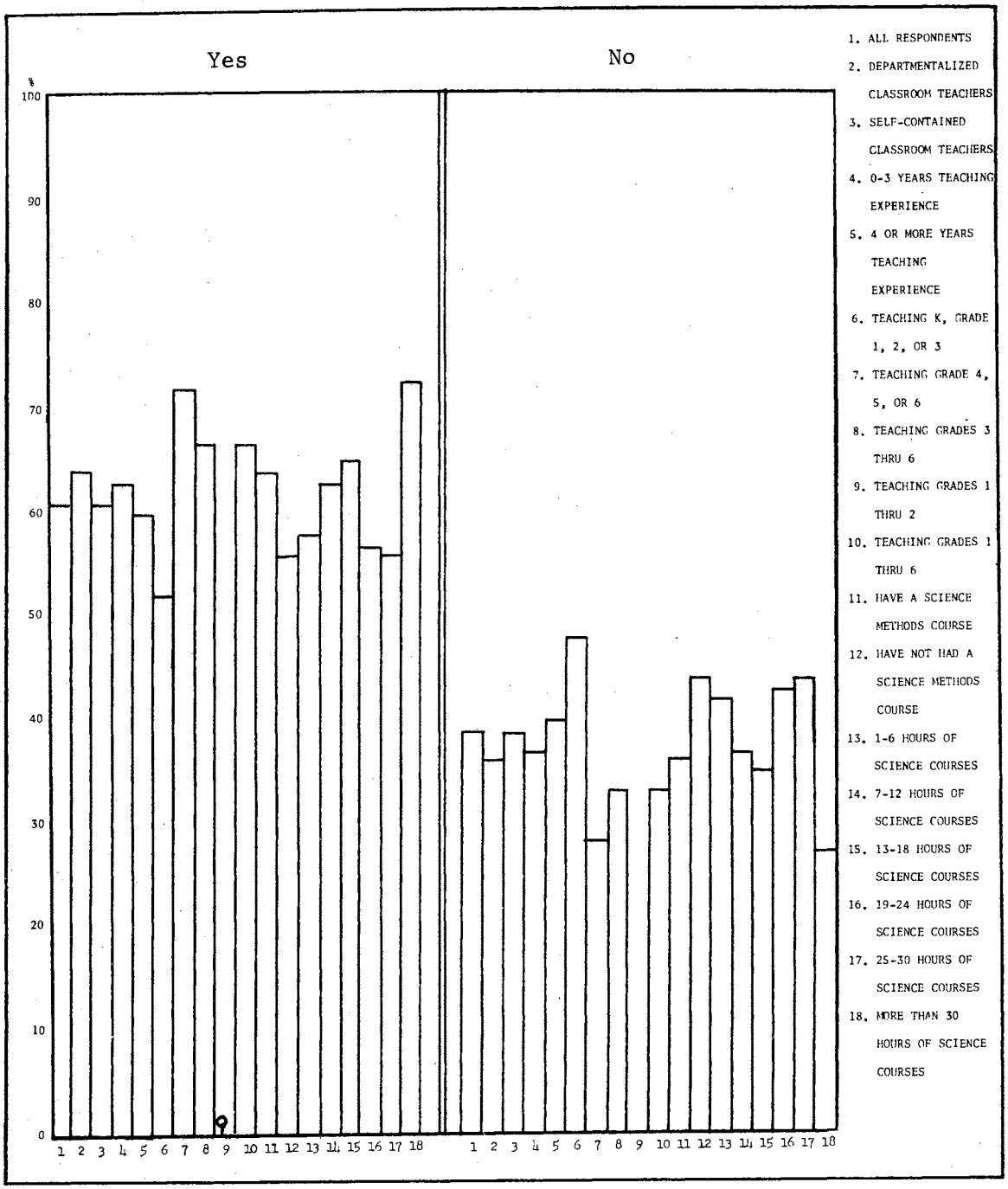

Figure 50. Teachers Make Use of Films From State Department or Science Rental Films in Science Teaching

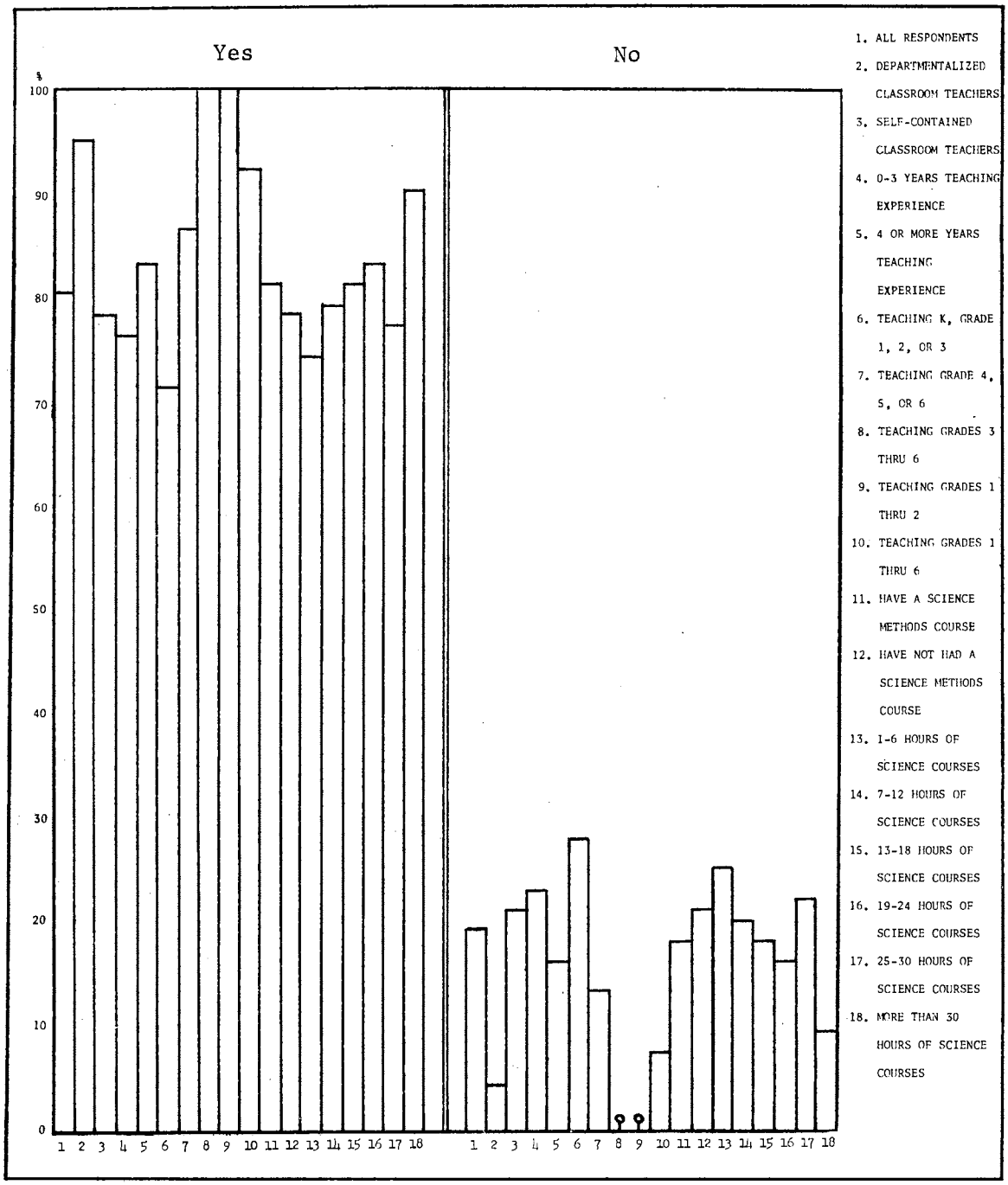

Figure 51. Teachers Have Science Equipment Available for Use in Their School Building

1-6, 1-2, and 3-6 indicate a higher degree of agreement with the statement than do their comparative groups.

The teachers were asked to respond to the statement that they have science equipment available for use in their schoolroom. Figure 52 reports this information and illustrates a positive response. The comparative analysis indicates that the differences that occur are in the degree of agreement with the statement. The departmentalized classroom teachers indicate a much higher degree of agreement with the statement than do the self-contained classroom teachers. The experienced teachers, the teachers of the intermediate grades, and the teachers with a methods course indicate a higher degree of agreement with the statement than do their respective groups. The other differences that occur in the grade teaching are due to the categories established for the departmentalized teachers. All groups indicate a greater response of agreement. The hours of science course work indicate that the more science hours the teachers have the greater their agreement with the exception of the group with 19-24 hours of science course work.

The teachers were asked to respond to the statement that because science equipment and materials are not provided for their class use, they keep demonstration and experimentation to a minimum. Figure 53 indicates their response and illustrates a negative response. The comparative analysis indicates that the departmentalized classroom teachers express greater disagreement with the statement than do the self-contained classroom teachers. The experienced teachers indicate more disagreement than do the inexperienced teachers. The intermediate grade teachers indicate more disagreement than do the primary grade teachers. The other disagreements are due to the groups established for the departmentalized

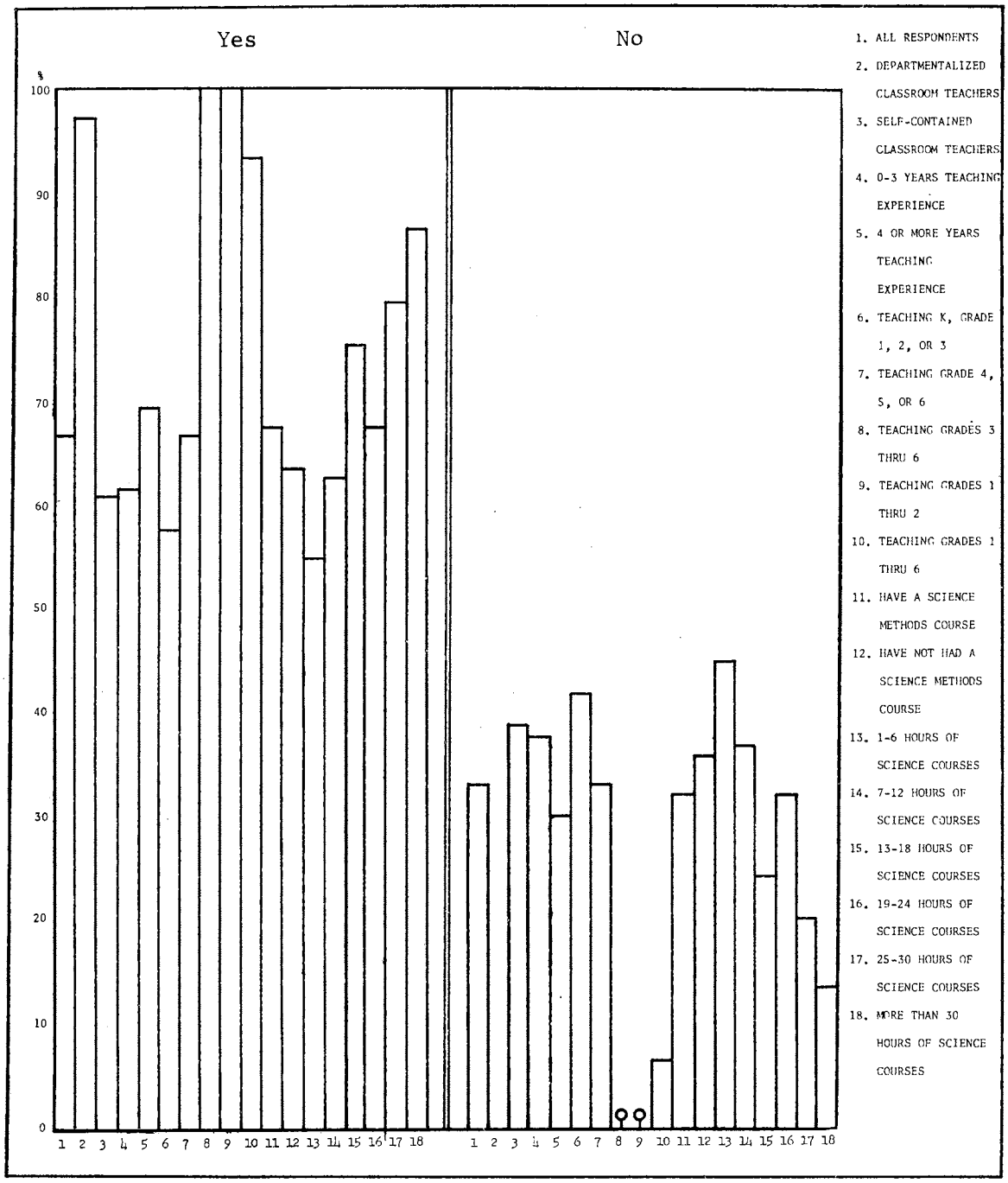

Figure 52. Teachers Have Science Equipment Available for Use in Their Classrooms

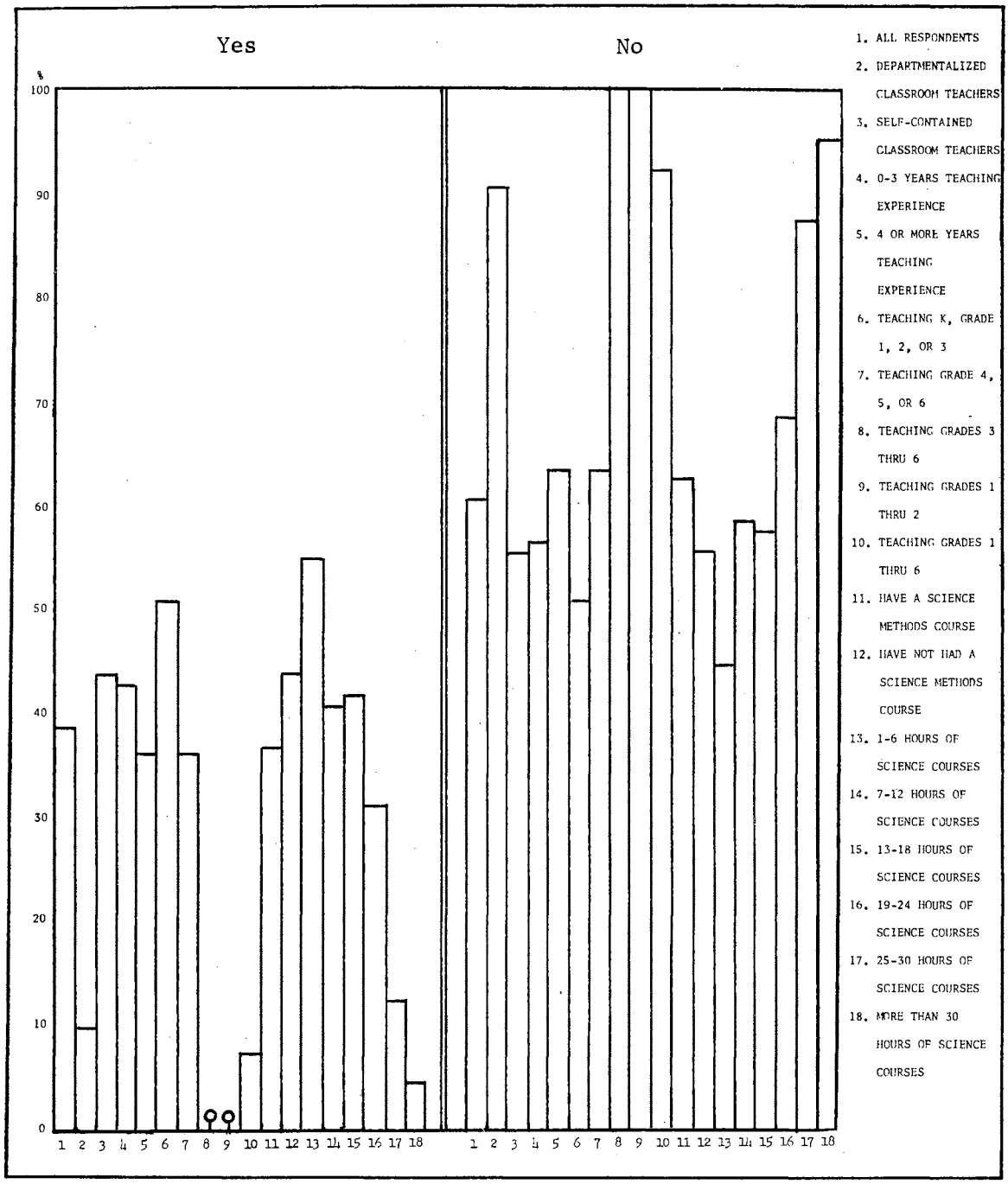

Figure 53. Teachers Keep Demonstration and Experimentation to a Minimum Because of Inadequate Science Equipment and Materials

classroom teachers. All groups indicate a greater disagreement with the statement. The teachers with a methods course indicate a higher degree of disagreement than do the teachers without a methods course. The course work responses indicate that those teachers with more course work exhibit a higher degree of disagreement than do the teachers with less course work.

The teachers were asked to respond to the statement that they would provide more experimentation and demonstration in their science classes if they were more familiar with the use of equipment. Figure 54 reports this information and indicates a positive response. The comparative analysis exhibits considerable variation among the groups. The departmentalized classroom teachers show a slight indication of a negative response. The self-contained classroom teachers indicate a positive response. The differences that occur in the grade teaching are due to the categories established for the departmentalized classroom teachers. All groups indicate a greater disagreement with the statement. The teachers with a science methods course indicate greater agreement than do the teachers without a methods course. With the exception of the teachers with 13-18 hours of science course work, the more course work the teachers had the more they disagree with the statement.

Responsibility for Designing and Controlling the Elementary School Science Program

The present emphasis upon science and the teaching of science has produced massive attempts to revise the science curriculum at all levels of our educational system. The investigator felt that the teachers should be asked to express their opinion of who should be responsible for designing and controlling the elementary school science program.

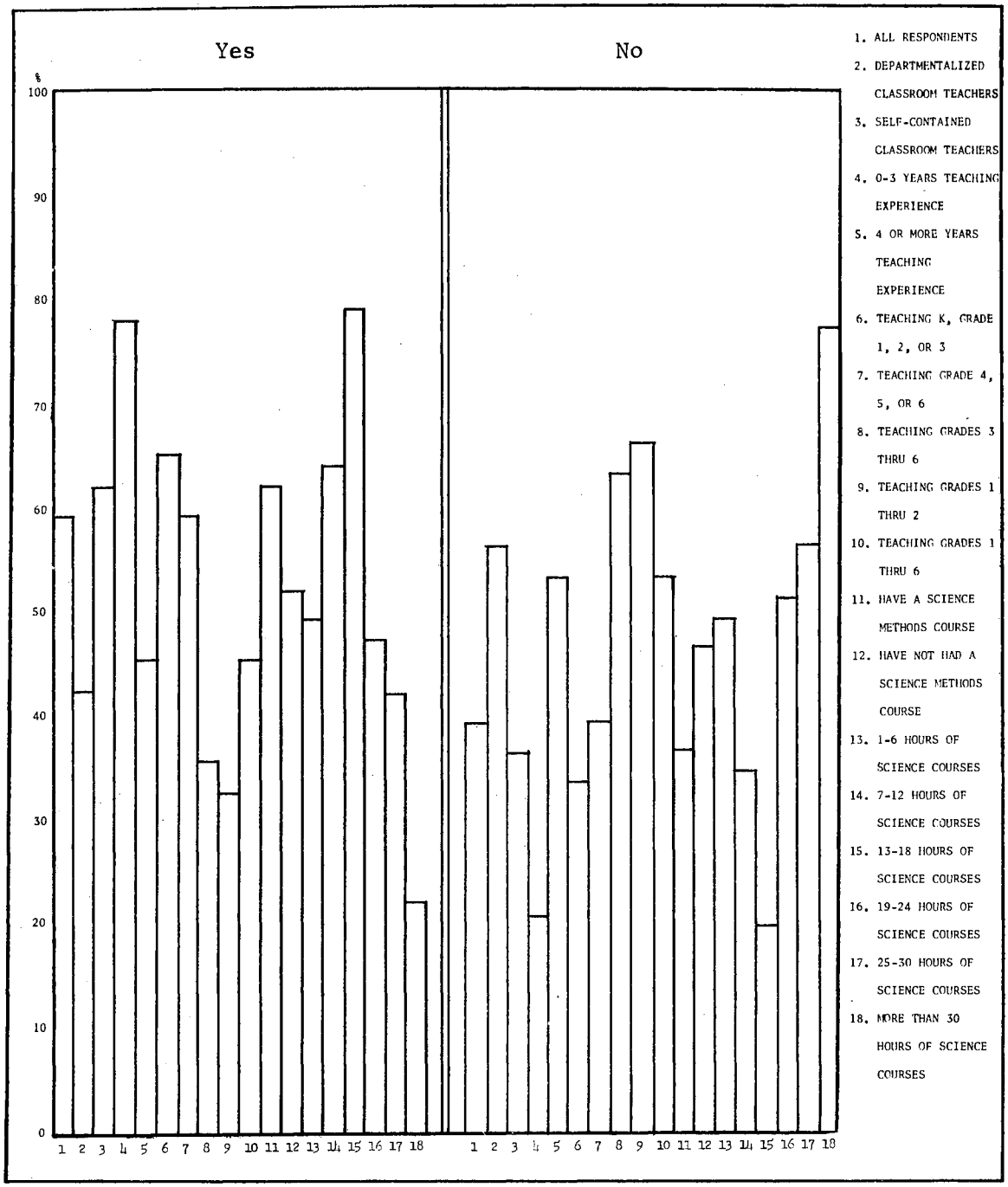

Figure 54. Teachers Would Provide More Experimentation and Demonstration if They Were More Familiar With the Use of the Equipment

The teachers were asked to respond to the statement that the science textbooks presently available are adequate and that there is no need for revision. Figure 55 reports this information and reflects a negative response. The comparative analysis indicates that the differences that occur among the groups are due primarily to the degree of negative response. The self-contained classroom teachers, the inexperienced teachers, and the teachers with a methods course indicate a higher degree of negative response to the statement than do their comparative groups. The differences that occur in the grade teaching are due to the categories established for the departmentalized classroom teachers. All groups indicate less disagreement. The course work responses indicate that the teachers with 13-18 hours and 25-30 hours report less disagreement with the statement than do the others in this group.

The teachers were asked to respond to the statement that wholesale revision of the conventional elementary school science course is necessary if a modern science curriculum is to be developed. The teachers indicate a positive response. This information is illustrated in Figure 56. The comparative analysis indicates considerable variation in the responses of the comparative groups. The departmentalized classroom teachers disagree with the statement, but the self-contained classroom teachers agree with the statement. The inexperienced teachers exhibit a much higher degree of agreement with the statement than do the experienced teachers. The primary grade teachers indicate greater agreement than do the intermediate grade teachers. The other differences in the grade teaching are due to the categories established for the departmentalized classroom teachers. All groups indicate greater disagreement with the statement. Those teachers with a methods course indicate stronger agreement than do

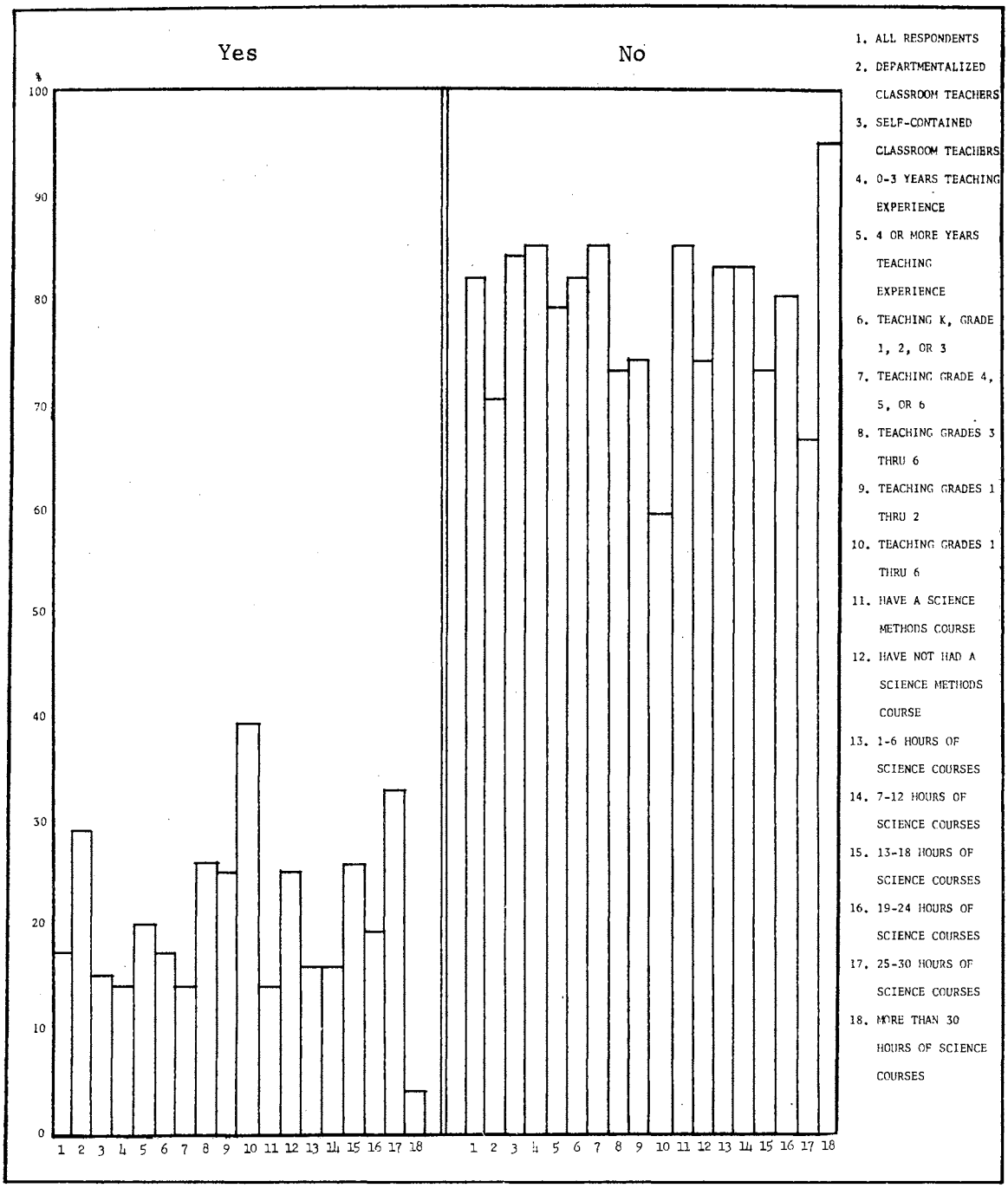

Figure 55. There is No Need for Revision of Available Science Textbooks

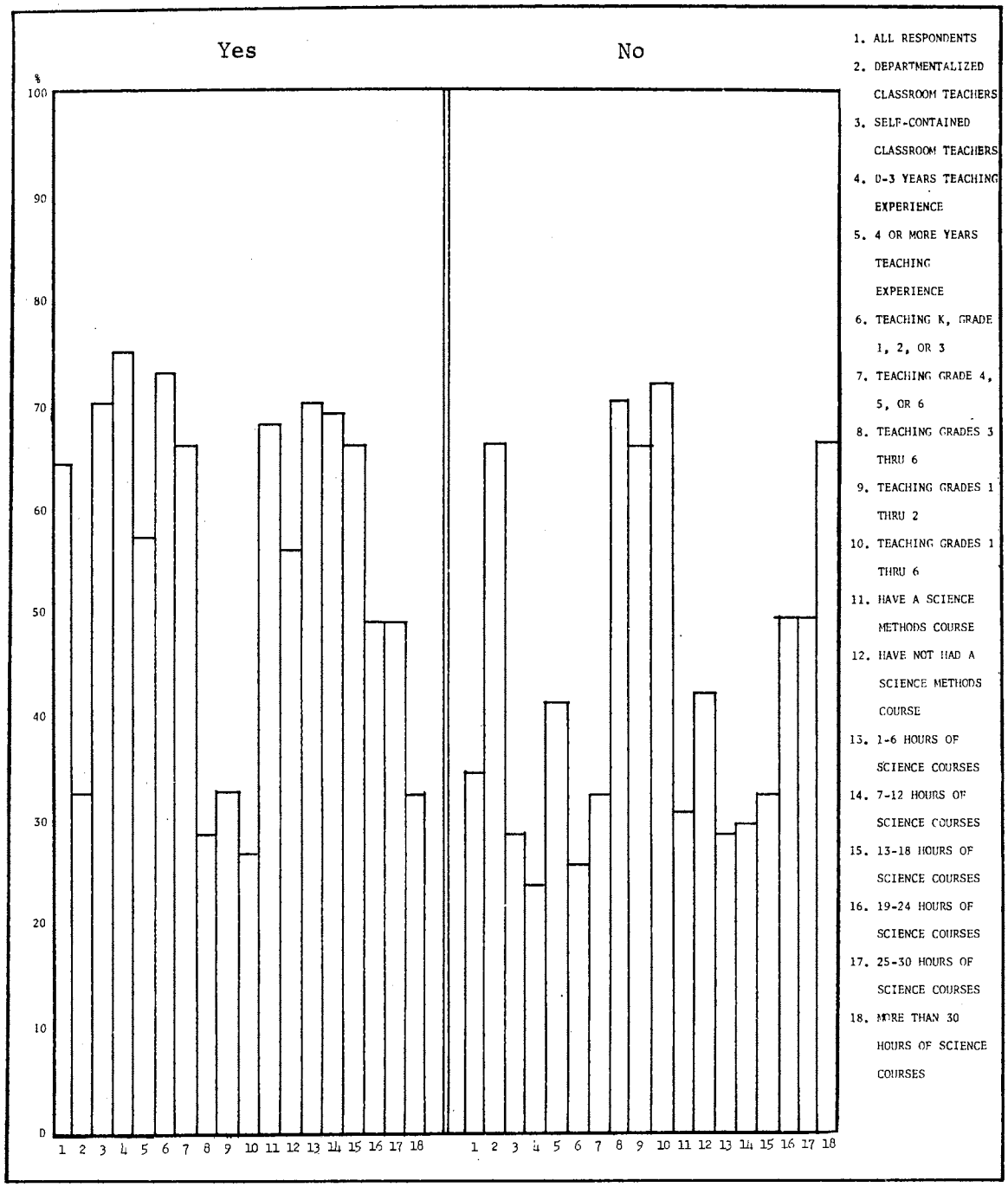

Figure 56. Wholesale Revision of Conventional Textbooks Is Necessary

the teachers who do not have a methods course. The teachers with less course work indicate more agreement with the statement; the group with 19-24 hours or 25-30 hours are undecided; and the teachers with more than 30 hours exhibit a negative response.

The teachers were asked to respond to the statement that scientists as well as elementary school teachers should be responsible for designing and controlling the elementary school science program. Figure 57 reports this information and records a positive response. The comparative analysis indicates that the differences that occur among the groups are in the degree of positive response. The differences that occur in grade teaching are due primarily to the categories established for the departmentalized classroom teachers. The teachers of grades 1-2 indicate total agreement. The teachers with 13-18 hours, 25-30 hours and more than 30 hours of science course work indicate a smaller degree of agreement than do the other groups in this category.

The teachers were asked to respond to the statement that designing and controlling the elementary science program should be left to the elementary school teachers as they are more familiar with the capabilities of their students. Figure 58 presents this information and reports a positive response. The comparative analysis indicates some differences of opinion among the comparative groups. The more experienced teachers exhibit a positive response; the inexperienced teachers exhibit a negative response. The differences in grade teaching are due to the categories established for the departmentalized classroom teachers. Teachers of grades 1-6 are undecided; teachers of grades 3-6 are in disagreement; and teachers of grades 1-2 are in agreement with the statement. Teachers with a methods course disagree with the statement; teachers who have no

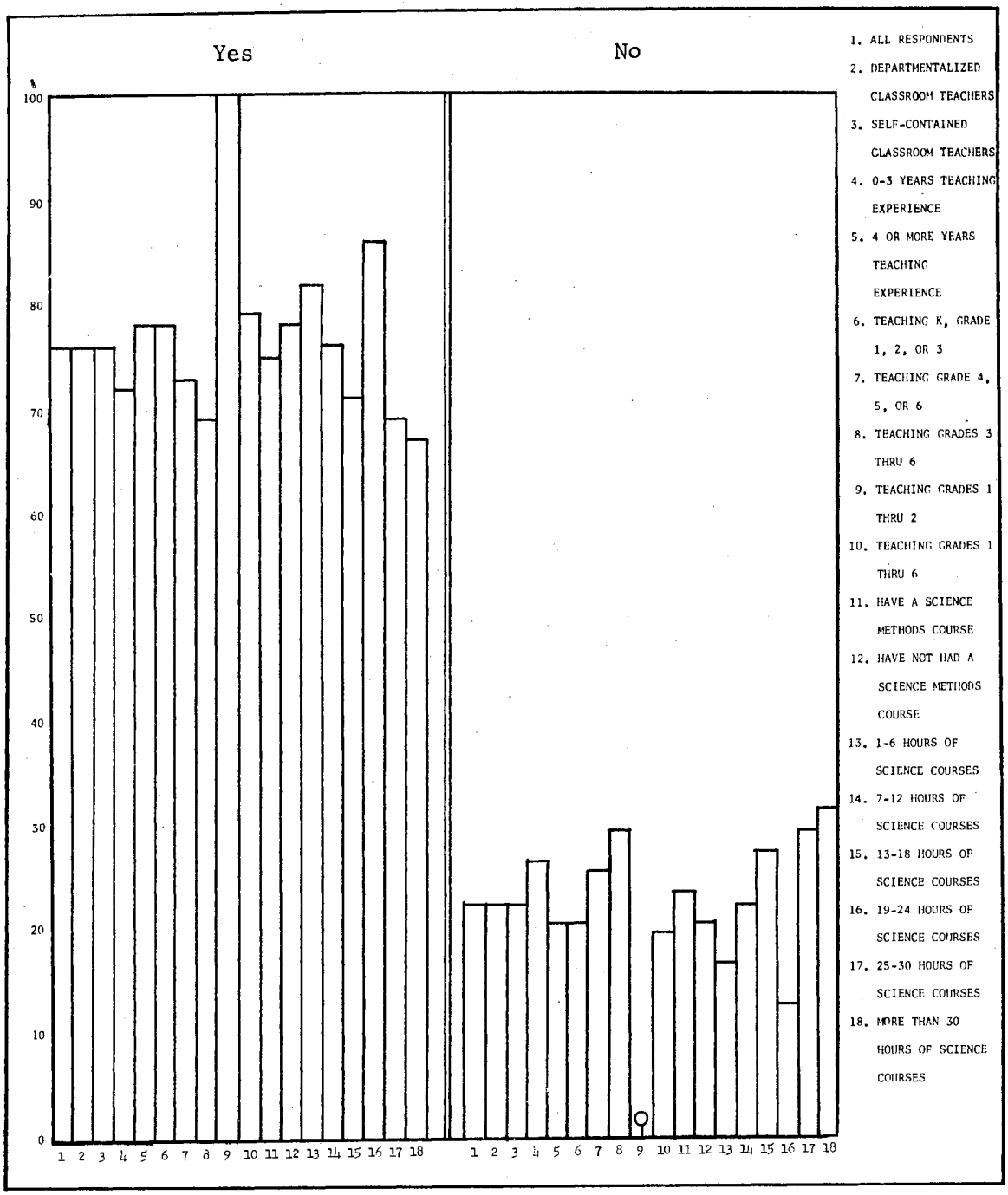

Figure 57. Scientists and Elementary School Teachers Should Be Responsible for Designing and Controlling the Elementary School Science Program

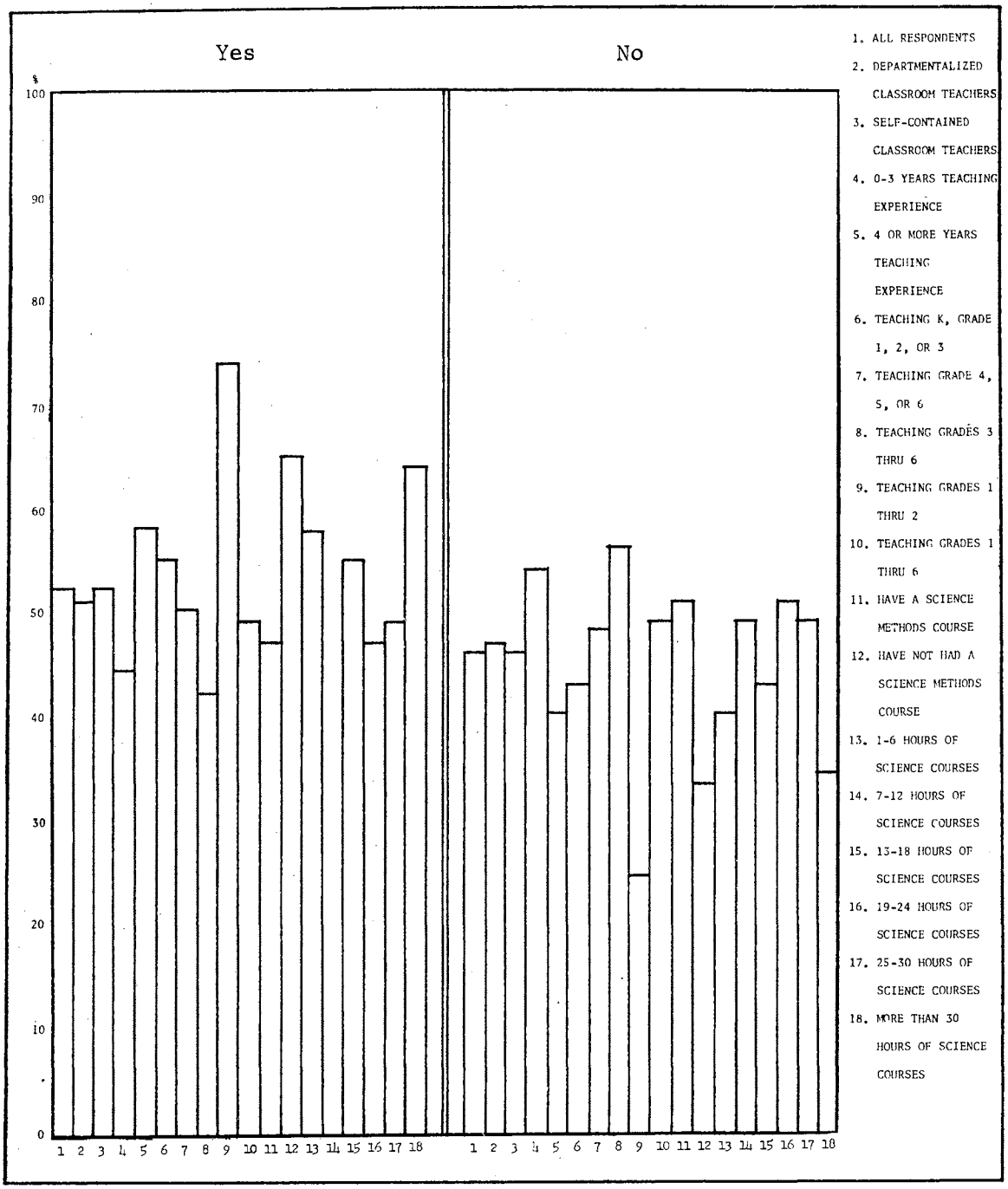

Figure 58. Elementary Teachers Should Be Responsible for Designing and Controlling the Elementary School Science Program

methods course agree. The teachers with 7-12 hours and 25-30 hours of science course work are undecided; teachers with 1-6 hours, 13-18 hours and more than 30 hours of science course work agree; and teachers with 19-24 hours of science course work disagree with the statement.

After a consideration of these factors, the investigator felt that valuable information might be provided by a consideration of the opinions of the elementary school teachers concerning the contributions that have been made and that should be made by their science courses, by science workshops or institute experience, by science supervisors, and by science methods courses in preparing them for teaching science.

Contributions of Science Courses to Teaching Elementary Science

The number of hours of science course work were divided into the following categories: (1) 1-6 hours, (2) 7-12 hours, (3) 13-18 hours, (4) 19-24 hours, (5) 25-30 hours, and (6) more than 30 hours. Figure 59 reports this information and illustrates that more of the teachers have 7-12 hours of science course work than any other category of hours. For the purpose of making the comparative analysis more immediately meaningful, the investigator arbitrarily separated the science course work into two orders, (1) teachers with fewer course hours (including teachers with 1-6, 7-12, and 13-18 hours) and (2) teachers with more course hours (including teachers with 19-24, 25-30, and more than 30 hours), in reporting the differences that occur among the prescribed groups. As a result, for example, the departmentalized classroom teachers would indicate more course work than the self-contained classroom teachers. There is little difference indicated in the number of years of teaching experience. Both of these groups indicate fewer science course hours. The inexperienced

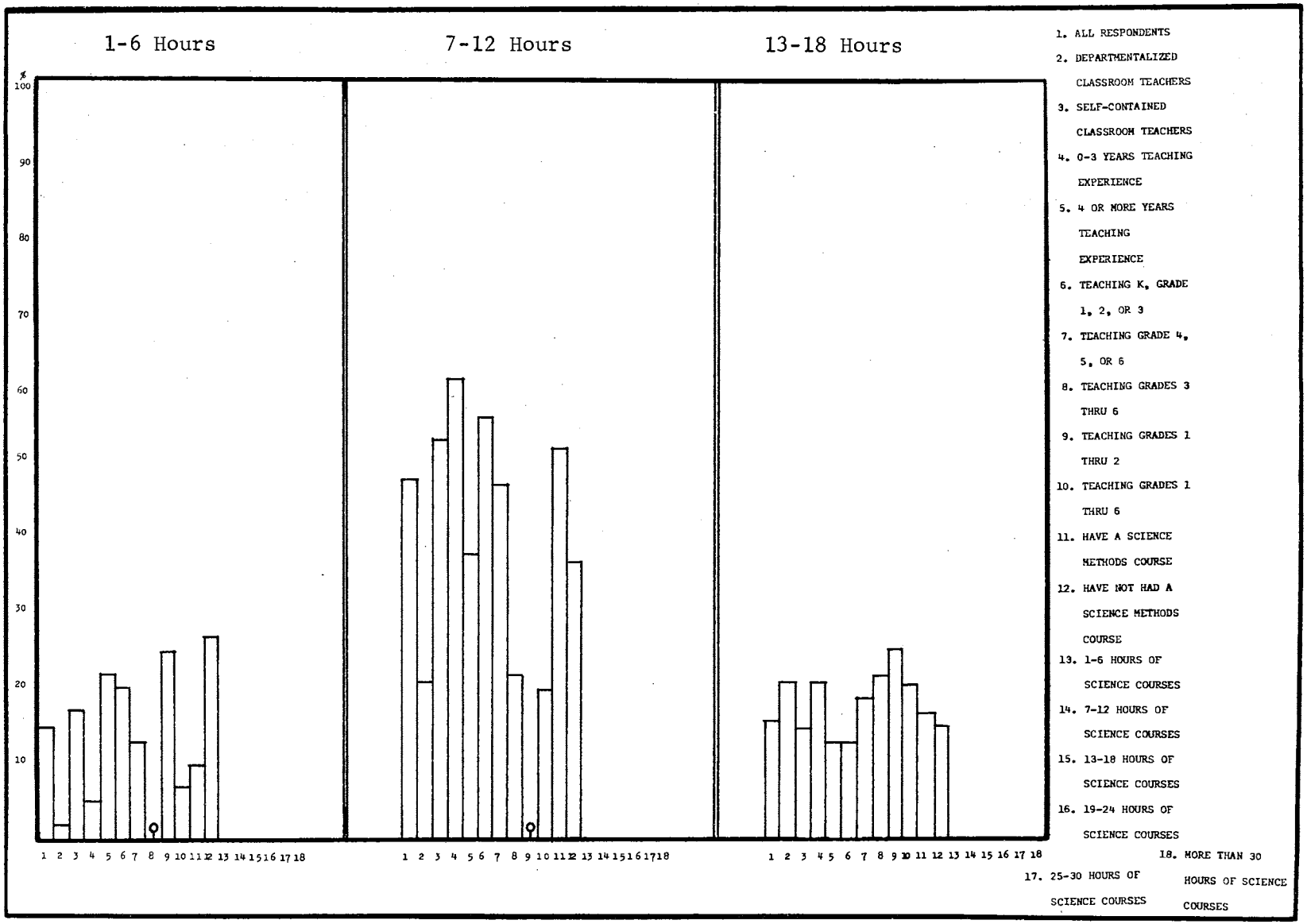

Figure 59. Hours of Science Course Work

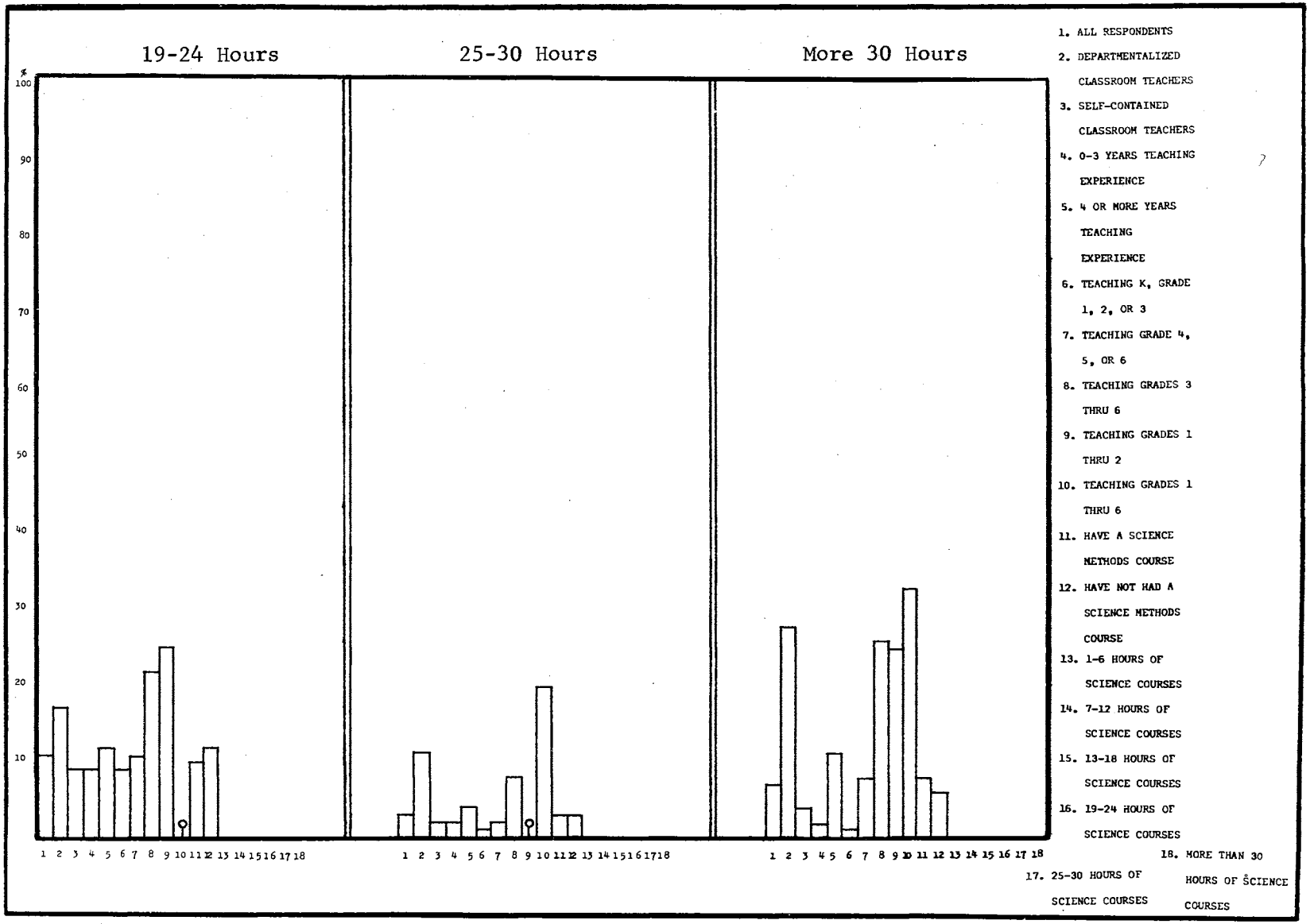

Figure 59. (continued)

teachers show a larger number in this category than do the experienced teachers. The primary grade teachers indicate fewer course hours than do the intermediate teachers. The teachers who teach grades 3-6 and 1-6 indicate more course work, and the teachers who teach grades 1 and 2 indicate an equal distribution. There is no difference between the group of teachers with a methods course and the group of teachers without a methods course. They both indicate less course work.

The teachers were asked to supply what they thought that science courses should provide and what they did provide by a yes or no response to these predicates: (1) provide assistance in planning and organizing science teaching, (2) provide subject matter content for science teaching, (3) provide an understanding of experimentation and demonstration for science teaching, (4) provide a feeling of security in science teaching, (5) provide an idea of what should be taught at my grade level, (6) provide a greater interest in science teaching, (7) provide units and materials necessary for science teaching, and (8) provide methods and techniques necessary to teach science.

The teachers indicate that science courses should provide assistance in planning and organizing science teaching. This information is reported in Figure 60. The comparative analysis shows general agreement with the statement by all groups except on the matter of the degree of agreement. The departmentalized classroom teachers, the experienced teachers, and the teachers with a methods course show more agreement with the statement than do their comparative groups. The differences that are illustrated in the grade teaching are due to the categories established for the departmentalized classroom teachers. The teachers of grades 1-2 and 1-6 indicate greater agreement than the teachers of grades 3-6. The teachers

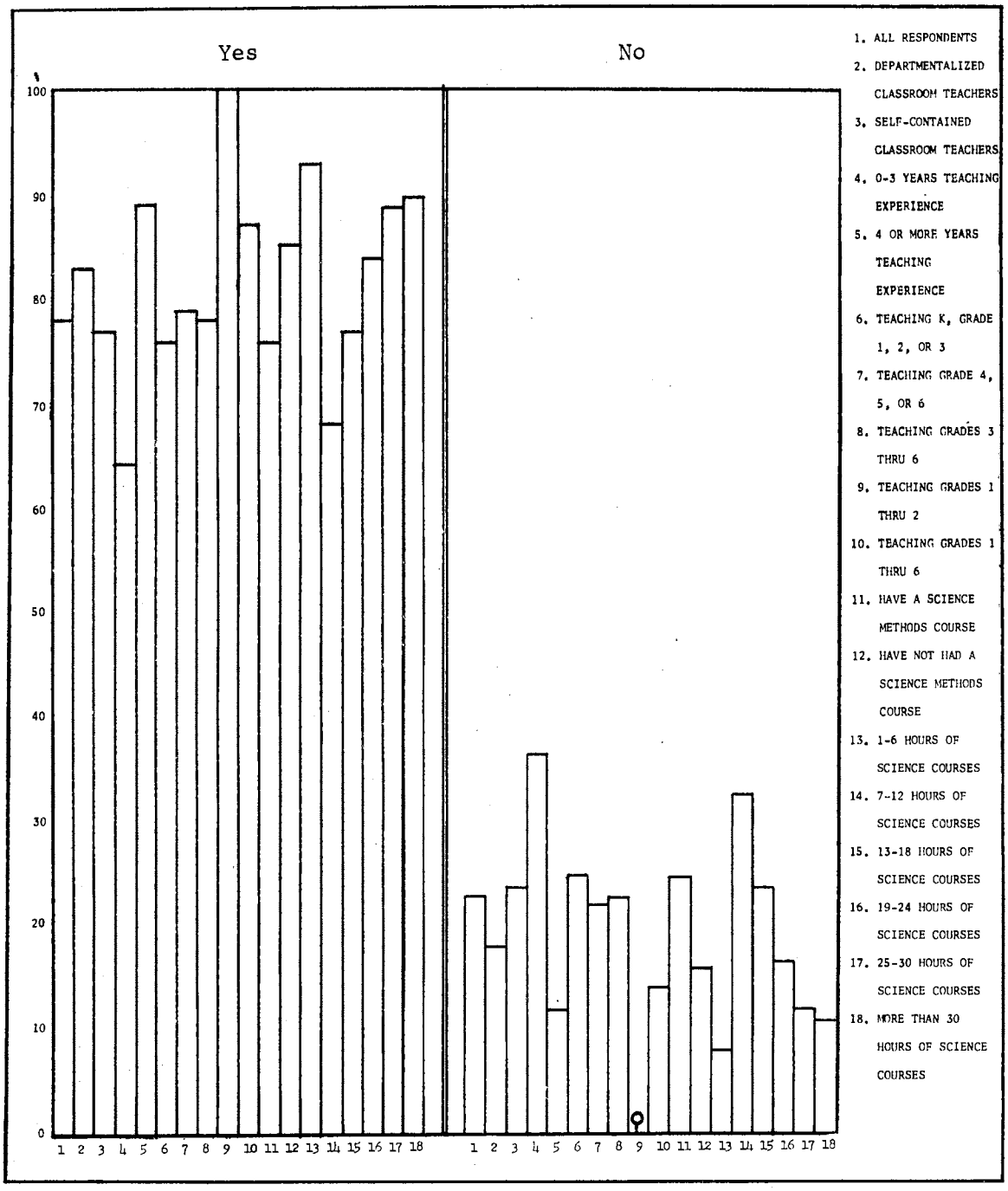

Figure 60. Science Courses Should Provide Assistance in Planning and Organizing Science Teaching

with 1-6 hours of science course work indicate the greatest agreement with the statement; the teachers with 25-30 or more than 30 hours indicated the next highest degree of agreement.

The teachers indicate a slight disagreement with the statement that their science courses did probide assistance in planning and organizing science teaching. This information is reported in Figure 61. The comparative analysis indicates some variation among the groups. The departmentalized classroom teachers, the inexperienced teachers, and the teachers without a methods course exhibit a greater degree of disagreement than do their comparative groups. The primary grade teachers disagree with the statement, but the intermediate grade teachers agree slightly with the statement. The other differences that occur in the grade teaching are due to the categories established for the departmentalized classroom teachers. All groups indicate greater agreement than do their comparative groups. The teachers with 1-6 hours, 25-30 hours and more than 30 hours of science course work agree with the statement; the teachers with 7-12, 13-18 and 19-24 hours of science course work disagree with the statement.

The teachers indicate that science courses should provide subject-matter content for science teaching. This information is presented in Figure 62. The comparative analysis shows that the groups vary only in a slight degree of positive agreement with the statement.

The teachers indicate that their science courses did provide subject-matter content for science teaching. This information is presented in Figure 63. The comparative analysis indicates general agreement with this statement except for some variation in the degree of agreement. The departmentalized classroom teachers, the intermediate grade teachers, the

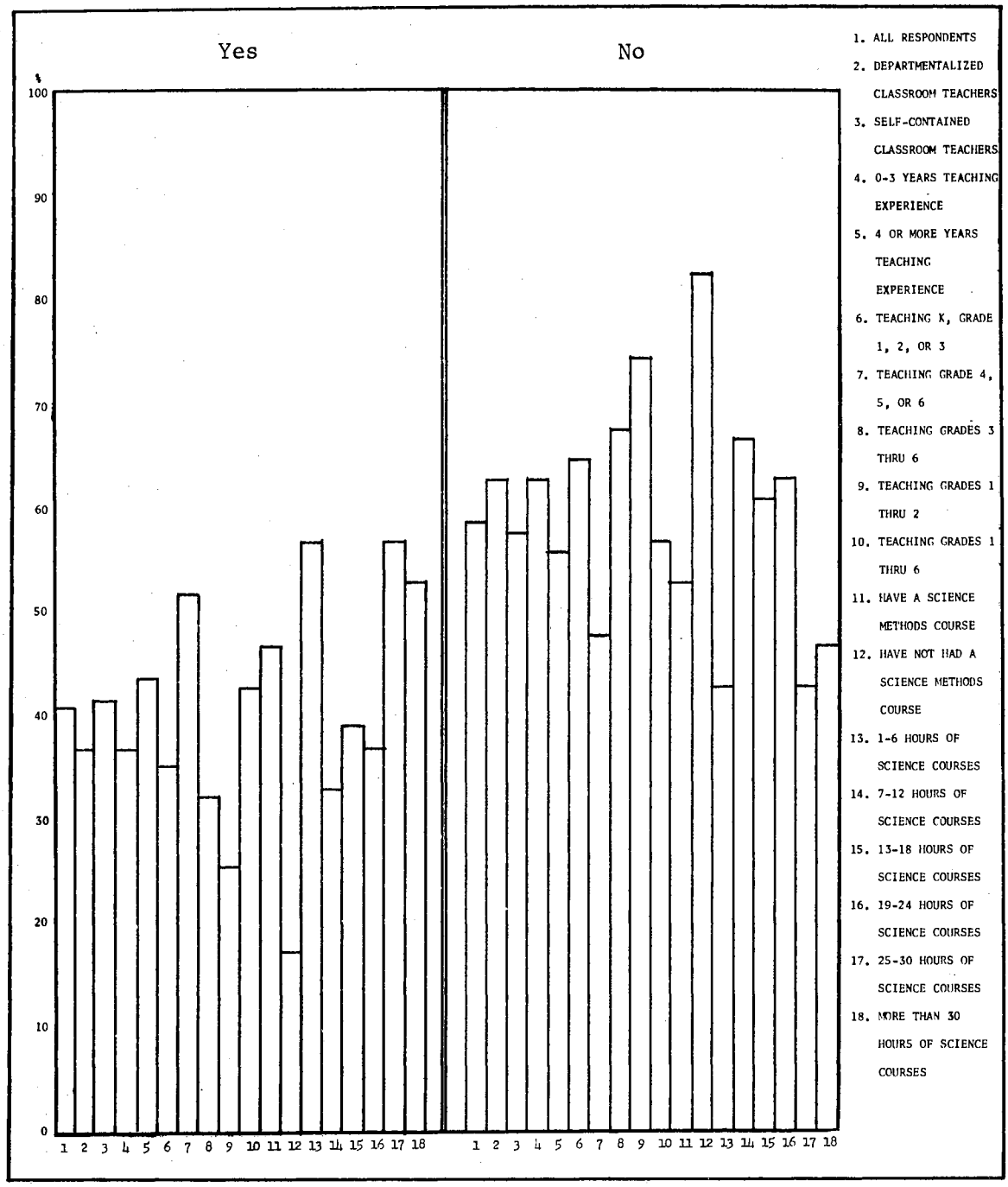

Figure 61. Science Courses Did Provide Assistance in Planning and Organizing Science Teaching

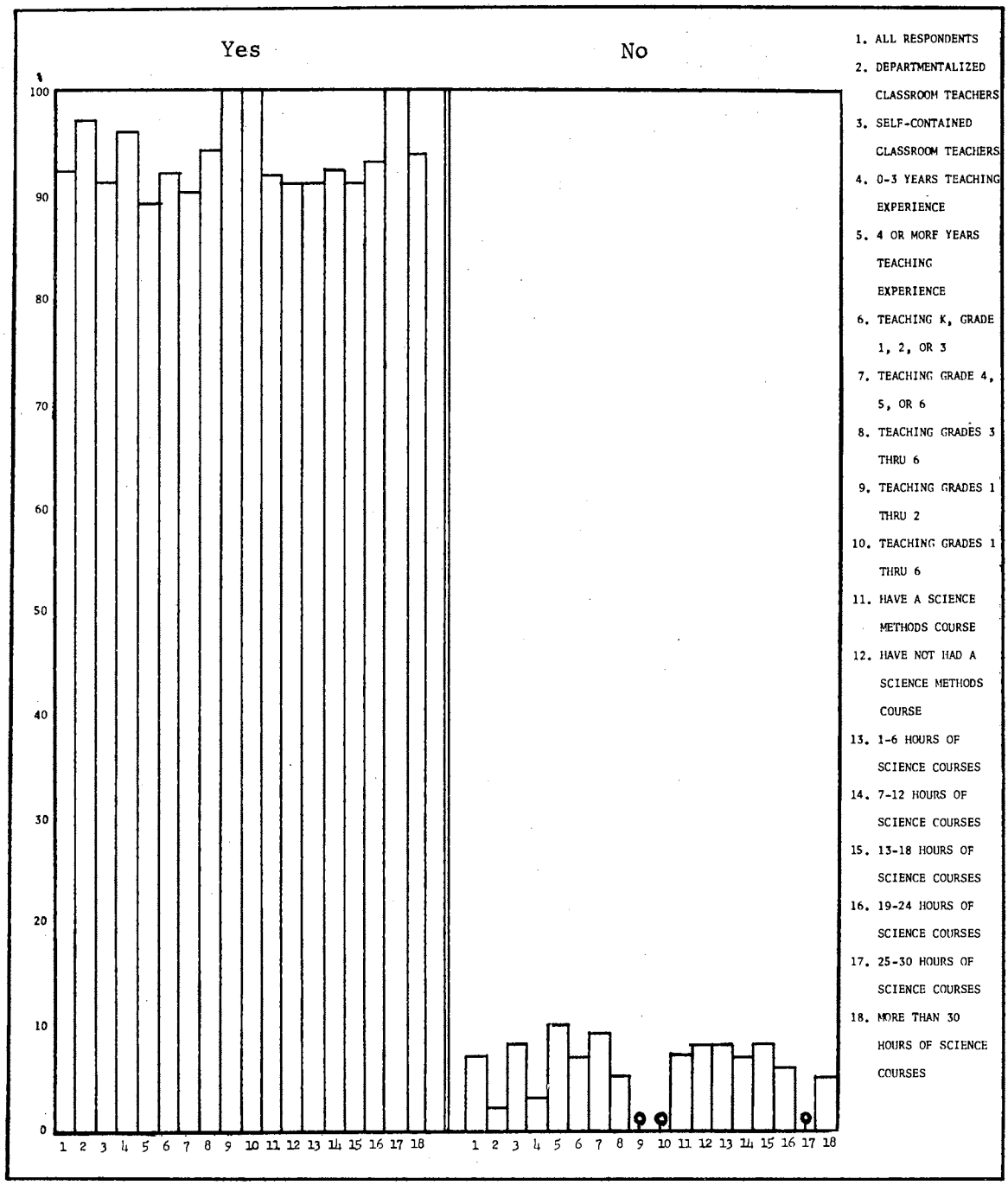

Figure 62. Science Courses Should Provide Subject Matter Content For Science Teaching

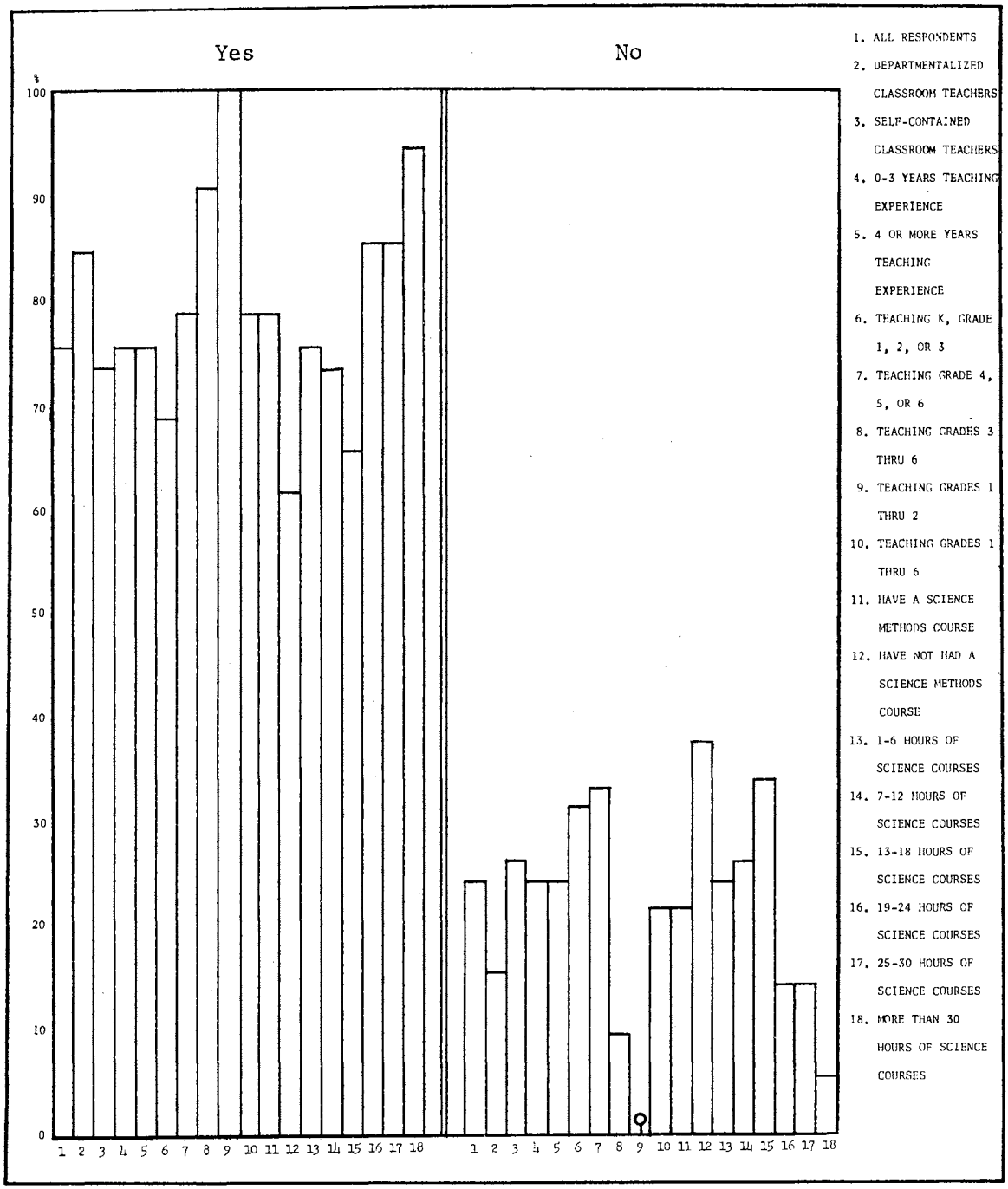

Figure 63. Science Courses Did Provide Subject Matter Content for Science Teaching

teachers of grades 3-6, 1-2, and 1-6, the teachers with a methods course and the teachers with more science course hours indicate a greater degree of agreement with the statement than do the other groups.

The teachers indicate that their science courses should provide an understanding of experimentation and demonstration. This information is reported in Figure 64. The comparative analysis shows that the groups vary only in a slight degree in their agreement with the statement.

The teachers indicate that their science courses did provide an understanding of experimentation and demonstration. This information is reported in Figure 65. The comparative analysis indicates some variation among the groups. The self-contained classroom teachers, the inexperienced teachers, and the intermediate grade teachers report a greater agreement than do their comparative groups. The teachers with a methods course agree with the statement, but the teachers without a methods course disagree with the statement. The teachers with 25-30 hours of science course work disagree with the statement, but the other comparative groups in this category agree with the statement. The teachers of grades 3-6 are undecided and; teachers of grades 1-6 disagree; and teachers of grades 3-6 agree with the statement.

The teachers indicate that science courses should provide a feeling of security in science teaching. This information is provided in Figure 66. The comparative analysis indicates that the groups vary only in degree of agreement with the statement. The departmentalized classroom teachers, the experienced teachers, and the teachers with no methods course indicate a greater degree of agreement than do their comparative groups. The differences that occur in the grade teaching are due to the categories established for the departmentalized teachers which indicate

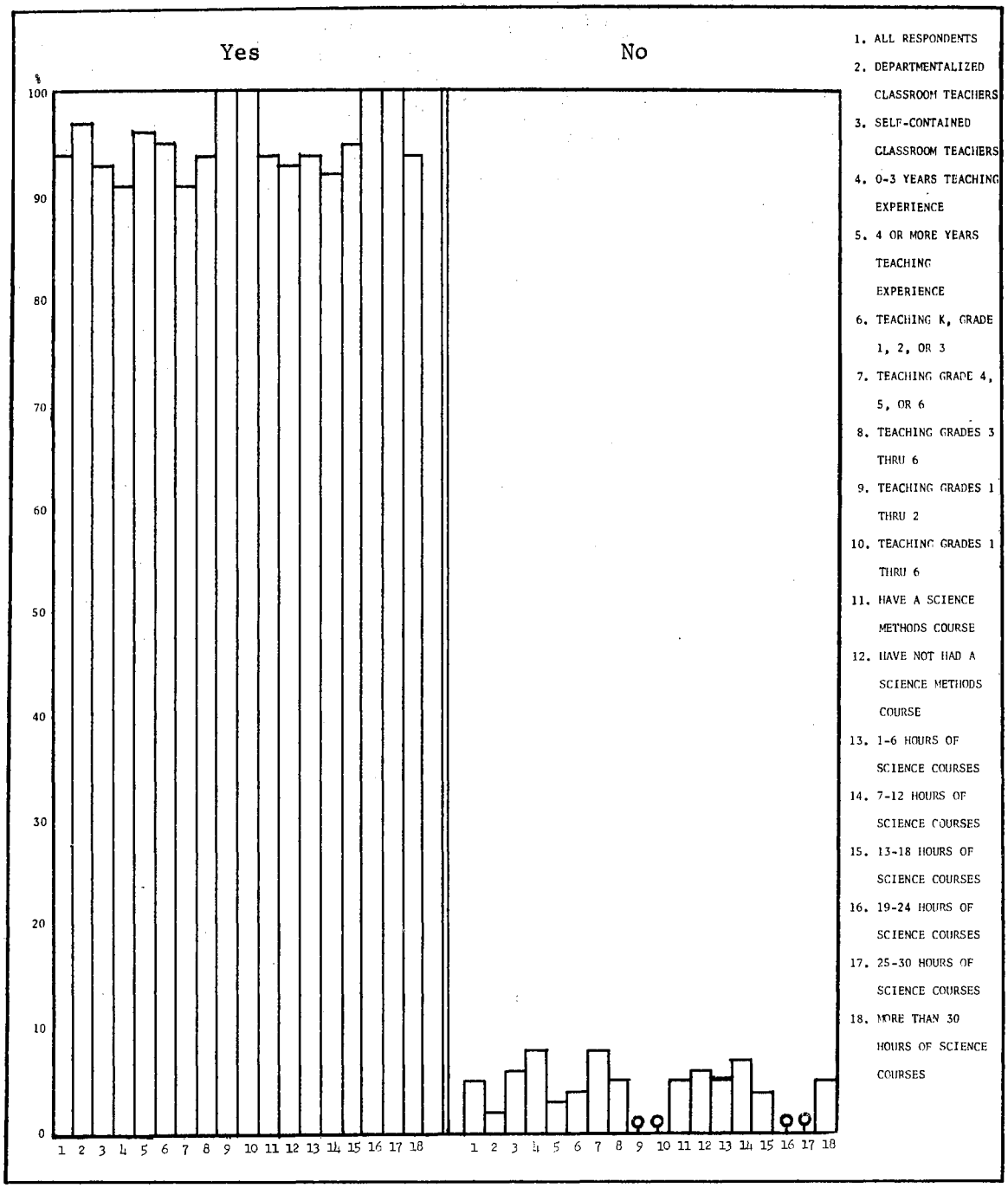

Figure 64. Science Courses Should Provide an Understanding of Experimentation and Demonstrations

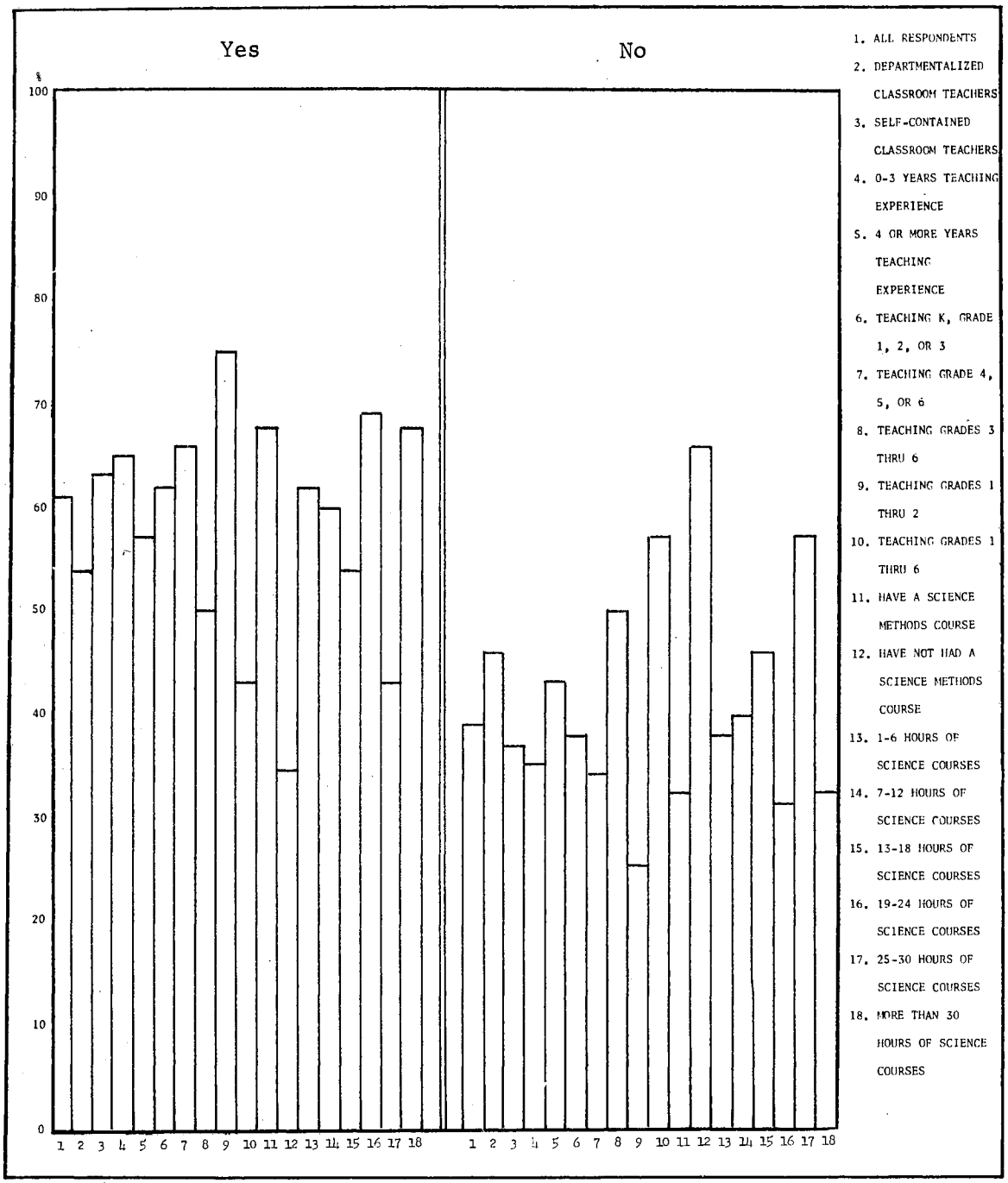

Figure 65. Science Courses Did Provide an Understanding of Experimentation and Demonstration

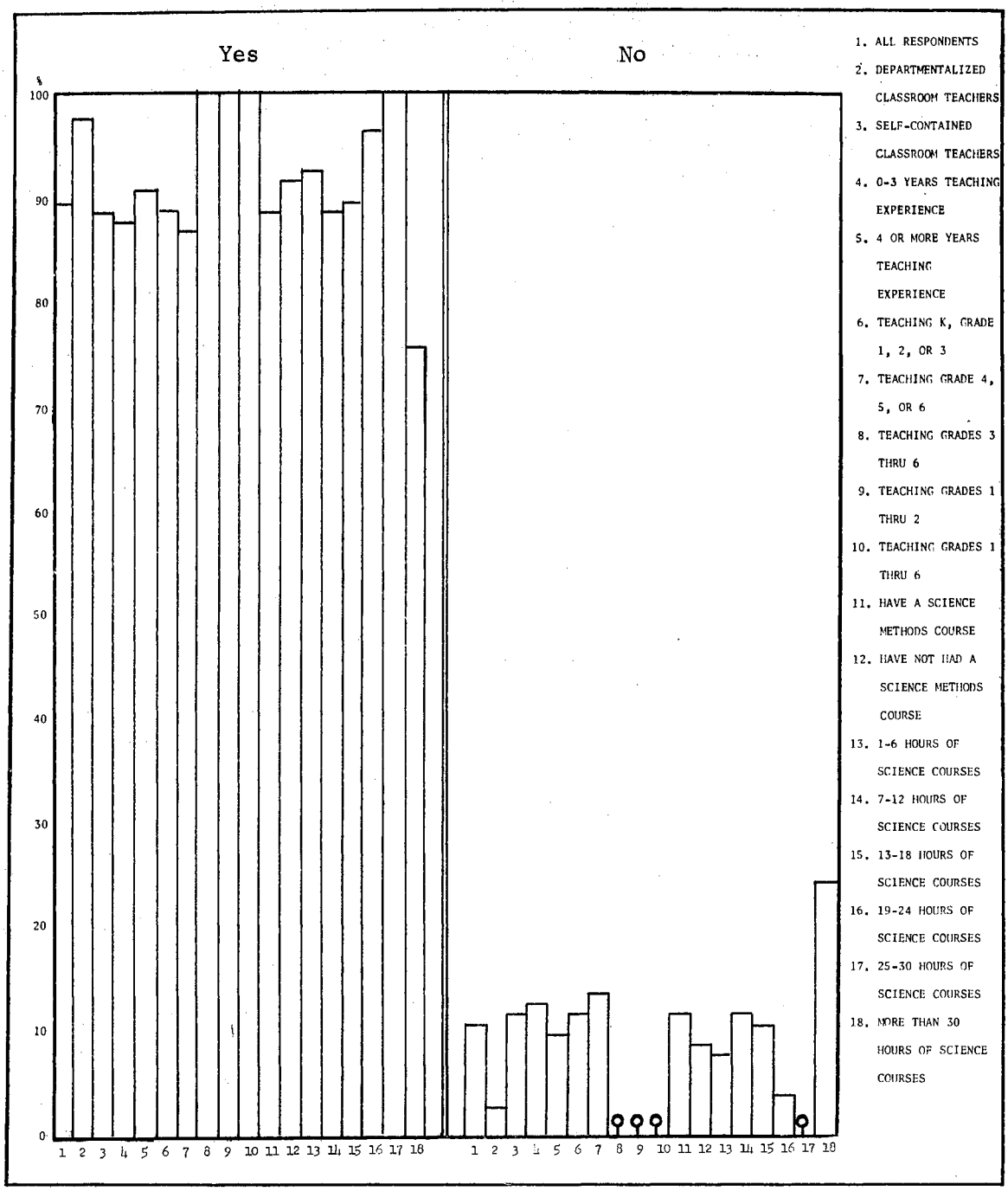

Figure 66. Science Courses Should Provide a Feeling of Security in Teaching Science

total agreement with the statement. The teachers with 7-12 hours and more than 30 hours exhibit a smaller amount of agreement than do the other groups in this category.

As illustrated in Figure 67, the teachers respond with slight agreement to the statement that their science courses did provide a feeling of security. The comprative analysis indicates some variation among the groups. The departmentalized teachers respond with agreement to the statement, and the self-contained classroom teachers respond with a slight degree of disagreement. The teachers of grades 3-6 exhibit strong agreement. The primary grade teachers record a negative response; the intermediate grade teachers record a positive response. The teachers with a methods course indicate a greater degree of agreement than do the teachers without a methods course. The teachers with 24-30 hours of science course work exhibit the greatest degree of agreement with the statement, and the teachers with 1-6 and 7-12 hours exhibit a negative response.

As illustrated in Figure 68, the teachers feel that science courses should provide an idea of what should be taught at various grade levels. The comparative analysis indicates that the differences that occur among the groups are in the degree of agreement with the statement. The departmentalized classroom teachers, the experienced teachers, the primary grade teachers, the teachers with a methods course and the teachers with 1-6 hours, 25-30 hours and more than 30 hours of science course work record a greater degree of agreement with the statement. The teachers of grades 1-2 indicate total agreement.

The teachers thought that their science courses did not provide an idea of what should be taught at various grade levels. This information

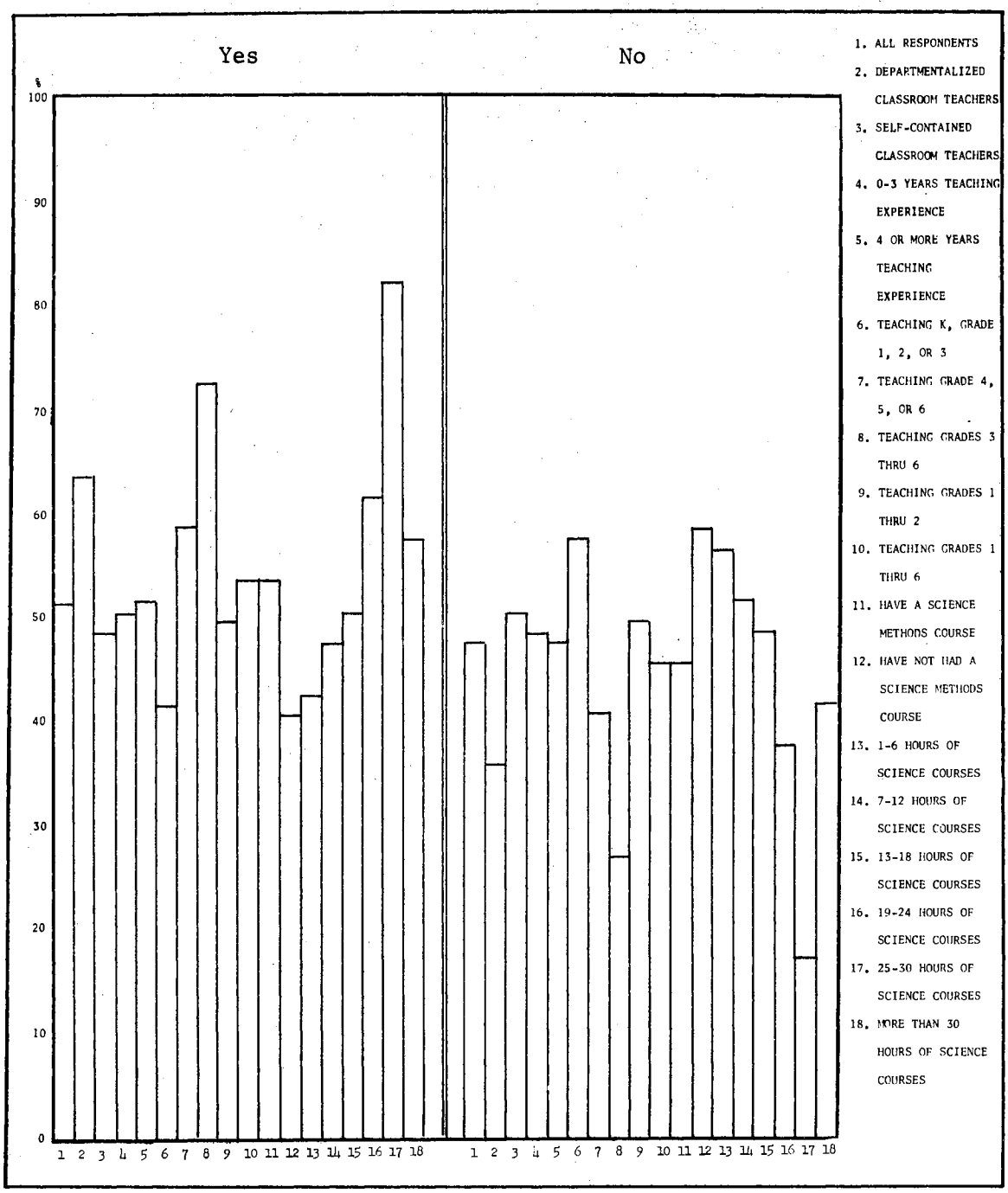

Figure 67. Science Courses Did Provide a Feeling of Security in Teaching Science

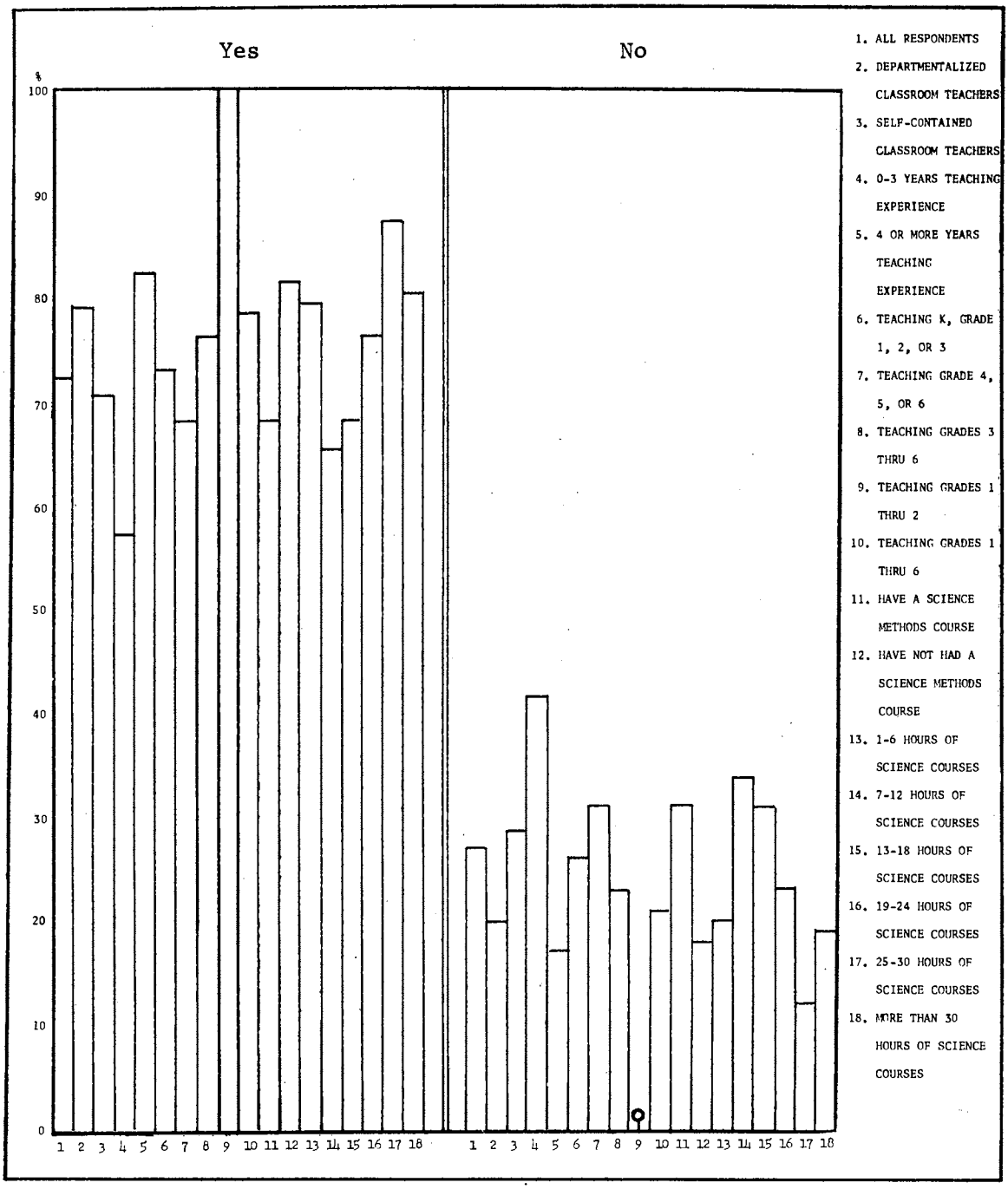

Figure 68. Science Courses Should Provide an Idea of What Should Be Taught at Various Grade Levels

is presented in Figure 69. The experienced teachers, the teachers with no methods course and the teachers with 13-18 hours of science course work exhibit the greatest disagreement with the statement. There are no other significant differences shown among the groups.

The teachers indicate in Figure 70 that science courses should provide a greater interest in science teaching. The comparative analysis shows that the groups vary only in a slight degree of agreement with the statement.

The teachers indicate in Figure 71 that their science courses did provide a greater interest in science teaching. The comparative analysis indicates general agreement with this statement. The only difference is in the degree of agreement. The departmentalized classroom teachers, the experienced teachers, the intermediate grade teachers, the teachers with a methods course and the teachers with 1-6, 19-24, and 25-30 hours of science course work indicate a greater agreement with the statement than do their comparative groups. Teachers of grades 1 and 2 are in total agreement.

The teachers indicate that science courses should provide units and materials for science teaching. This information is reported in Figure 72. The comparative analysis indicates a general agreement with the statement. The only difference is in the degree of agreement. The experienced teachers, the primary grade teachers and the teachers with 1-6, 13-18, and 25-30 hours of science course work are in greater agreement with the statement than are their comparative groups. Teachers of grades 1 and 2 are in total agreement.

The teachers indicate in Figure 73 that their science courses did provide units and materials for science teaching. The comparative

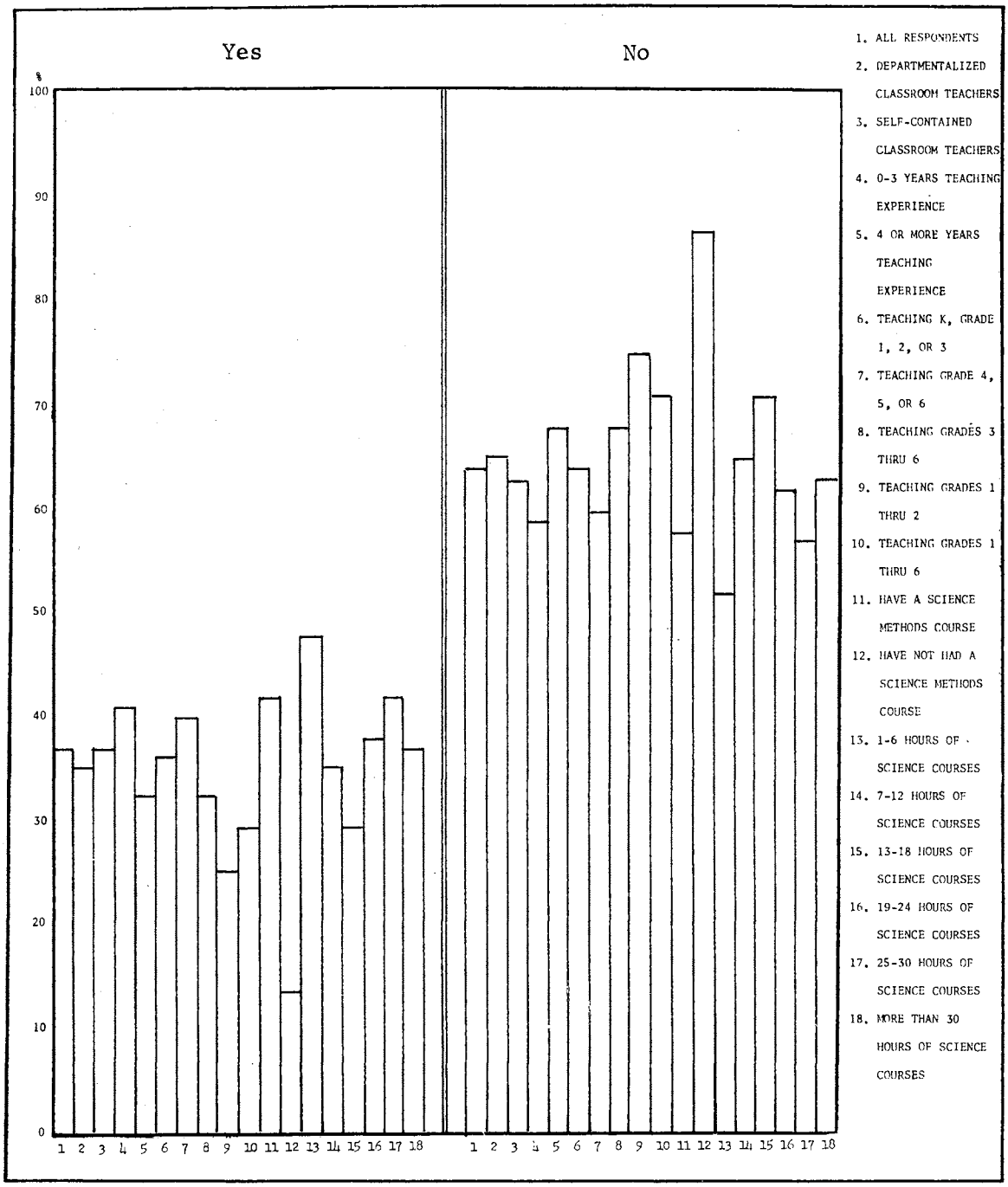

Figure 69. Science Courses Did Provide an Idea of What Should Be Taught at Various Grade Levels

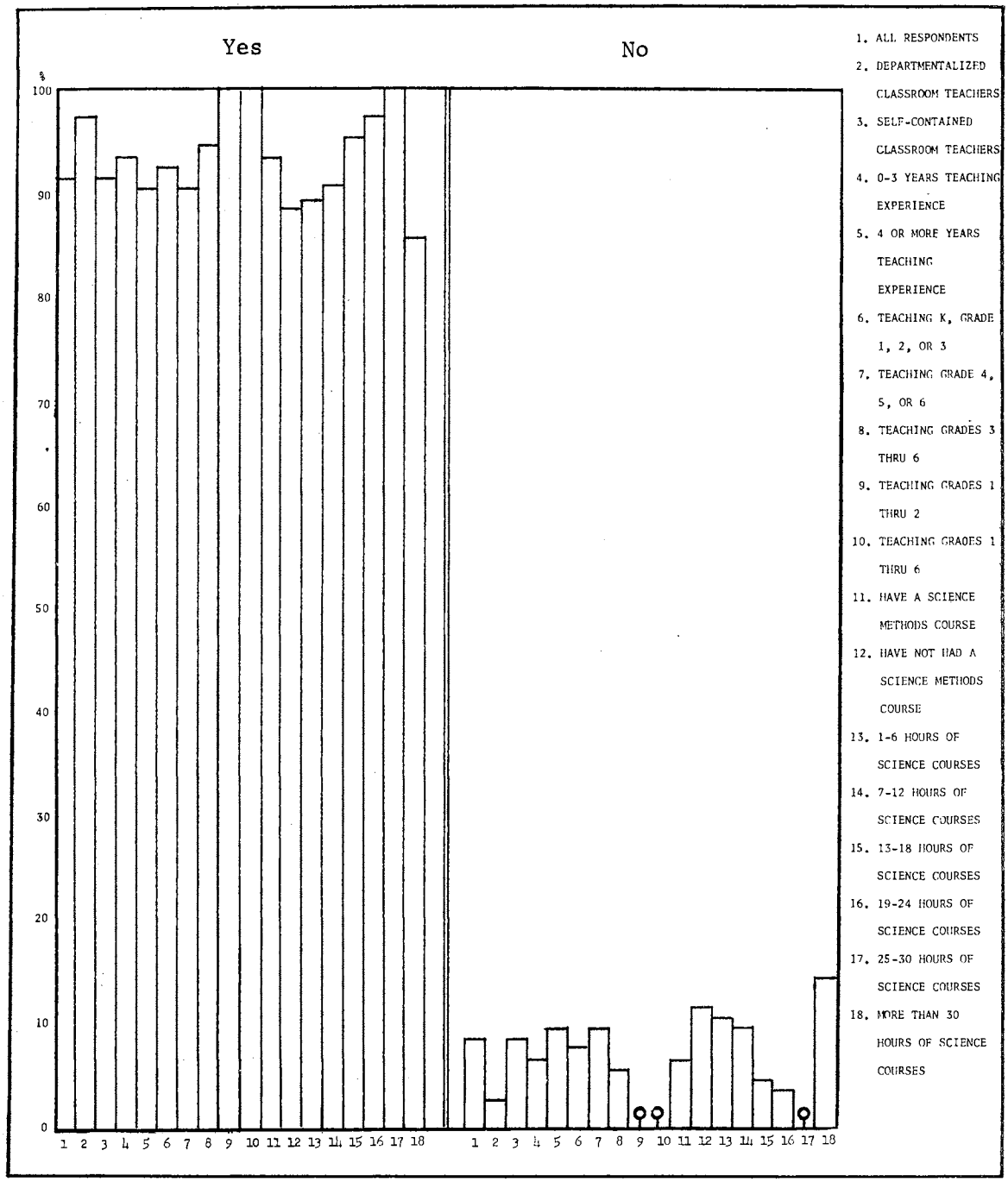

Figure 70. Science Courses Should Provide a Greater Interest in Teaching Science

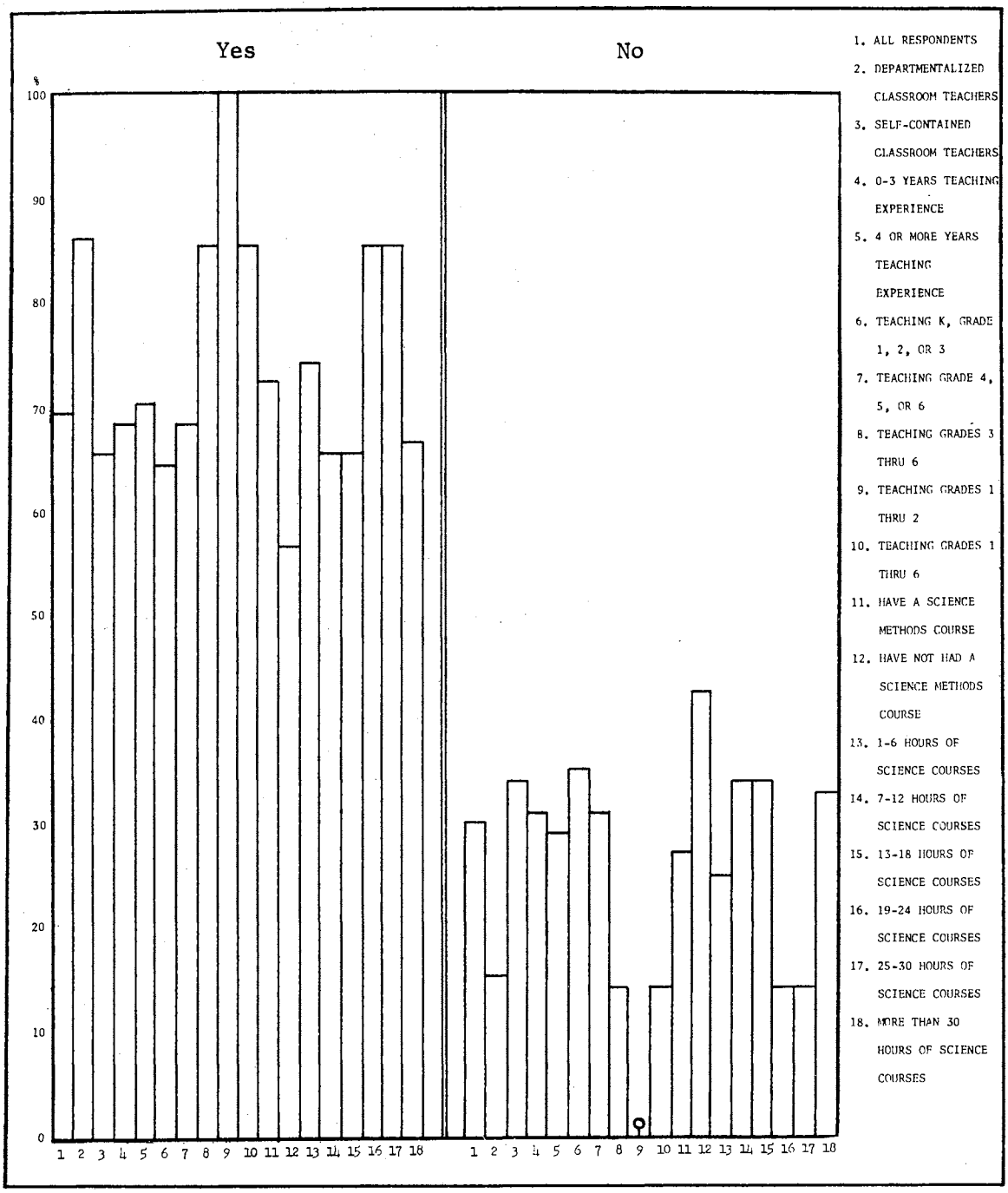

Figure 71. Science Courses Did Provide a Greater Interest in Teaching Science

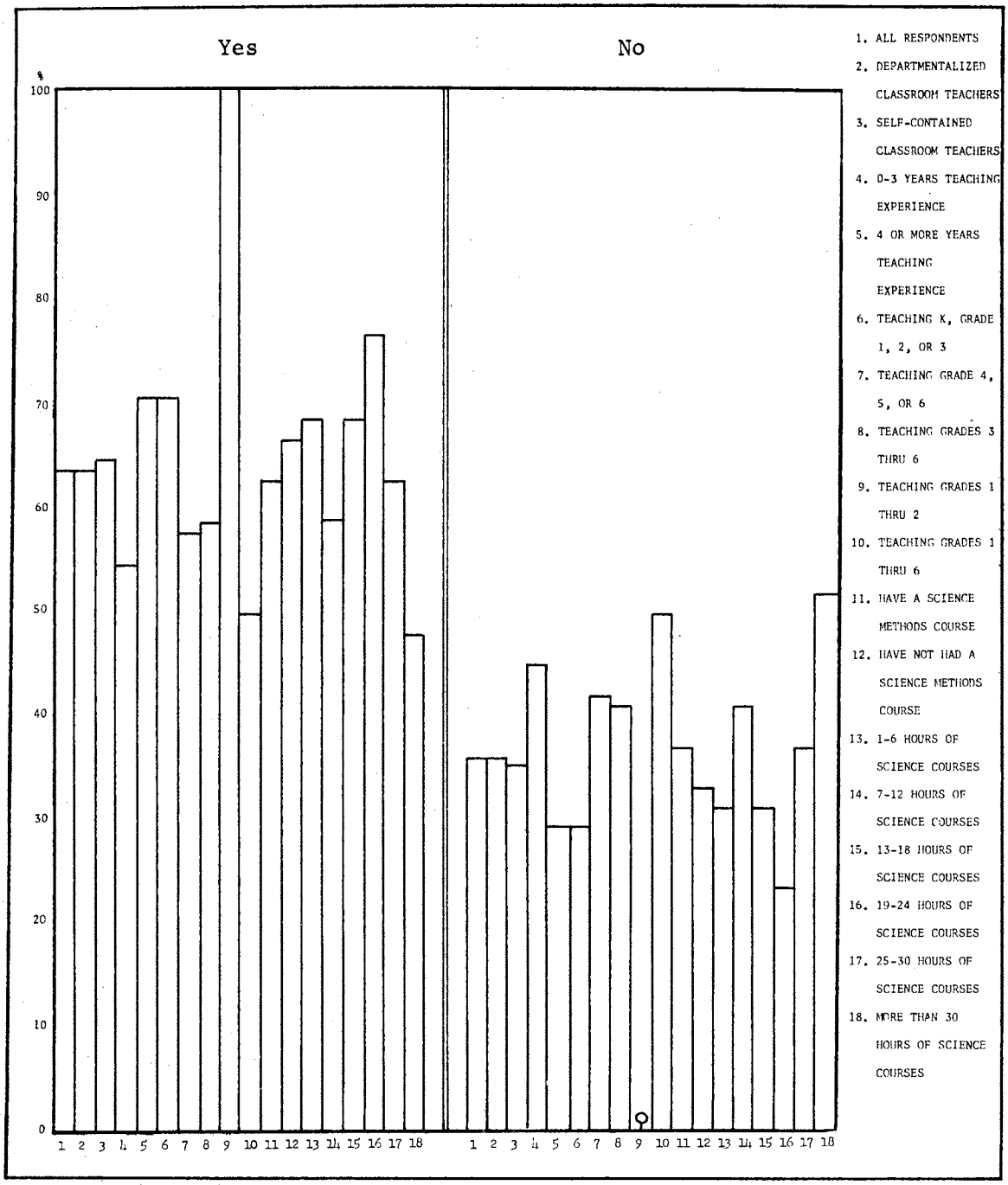

Figure 72. Science Courses Should Provide Units and Materials for Teaching Science

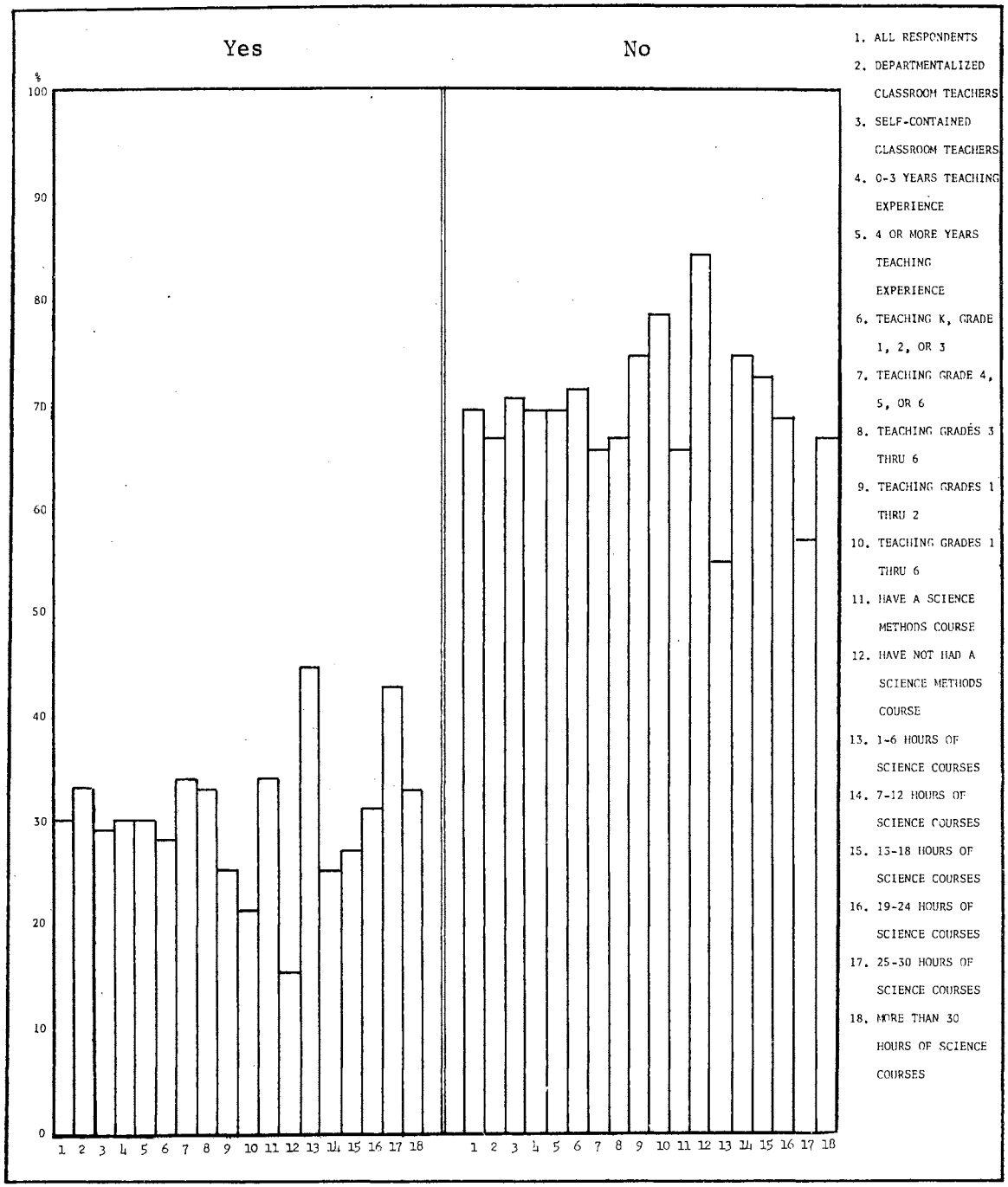

Figure 73. Science Courses Did Provide Units and Materials for Teaching Science

analysis indicates a general disagreement with the statement except on the matter of the degree of disagreement. The self-contained classroom teachers, the primary grade teachers, the teachers without a methods course and the teachers with 7-12 and 13-18 hours of science course work indicate greater disagreement with the statement than do their comparative groups. The teachers of grades 3-6 indicate a smaller amount of disagreement.

The teachers indicate that science courses should provide methods and techniques for science teaching. This information is illustrated in Figure 74. The comparative analysis indicates a general agreement with the statement. The sole difference is in the degree of agreement. The departmentalized classroom teachers, the experienced teachers and the teachers without a methods course indicate greater agreement than do their comparative groups. The teachers of grades 1 and 2 exhibit greater agreement than their comparative groups. The teachers with 7-12 and 13-18 hours indicate a smaller amount of agreement than do the other groups in this category.

The teachers indicate in Figure 75 that their science courses did not provide methods and techniques for science teaching. However, the degree of disagreement is slight. The only significant differences that appear in the comparative analysis are the teachers who teach grades 1-2 and the teachers with more than 30 hours of science course work. These groups agree with the statement. The teachers who have not had a science methods course indicate greater disagreement than do the teachers with a methods course.

The teachers were asked to respond to the statement that science subject-matter course should provide instruction in the care, use and

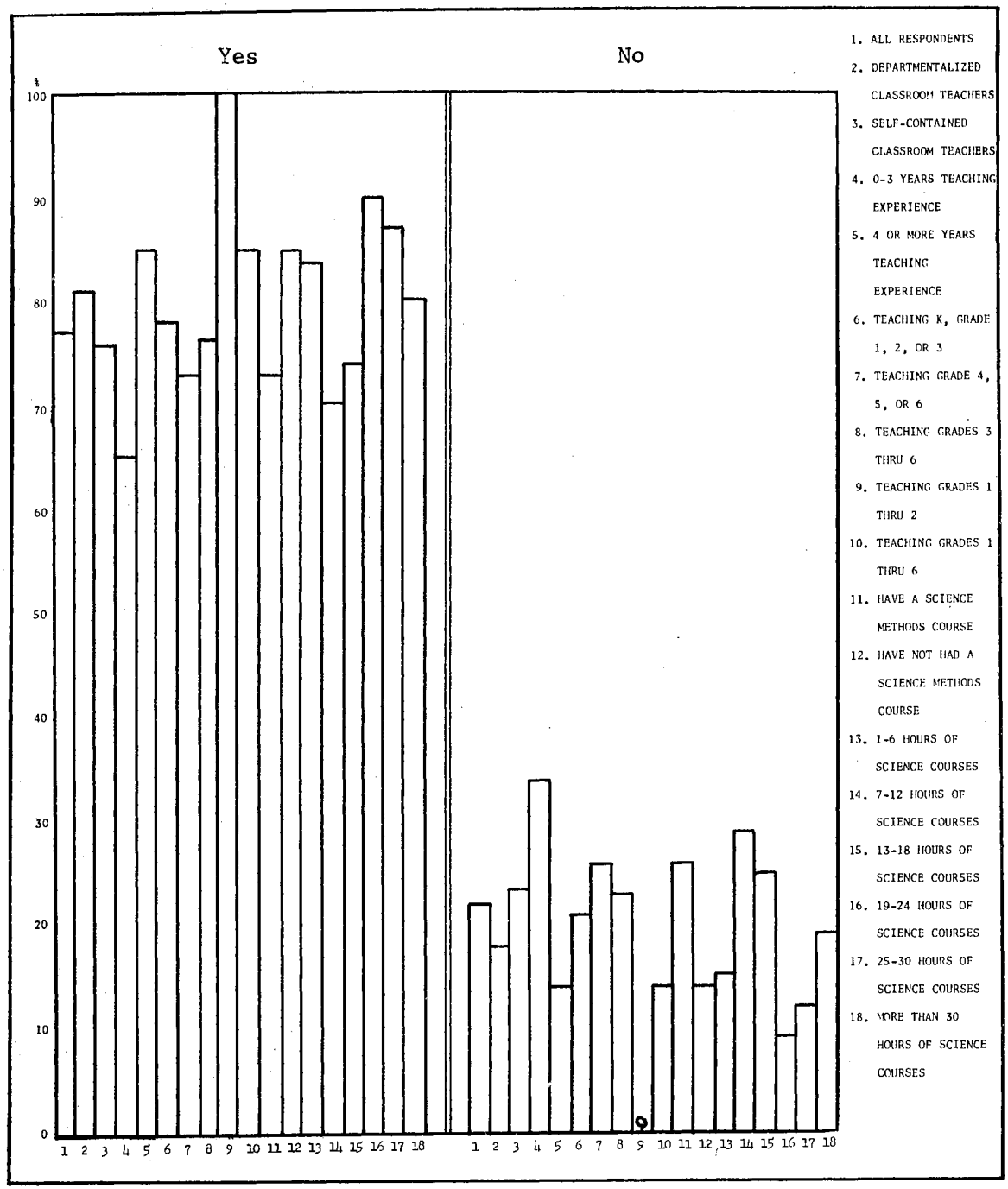

Figure 74. Science Courses Should Provide Methods and Techniques for Teaching Science

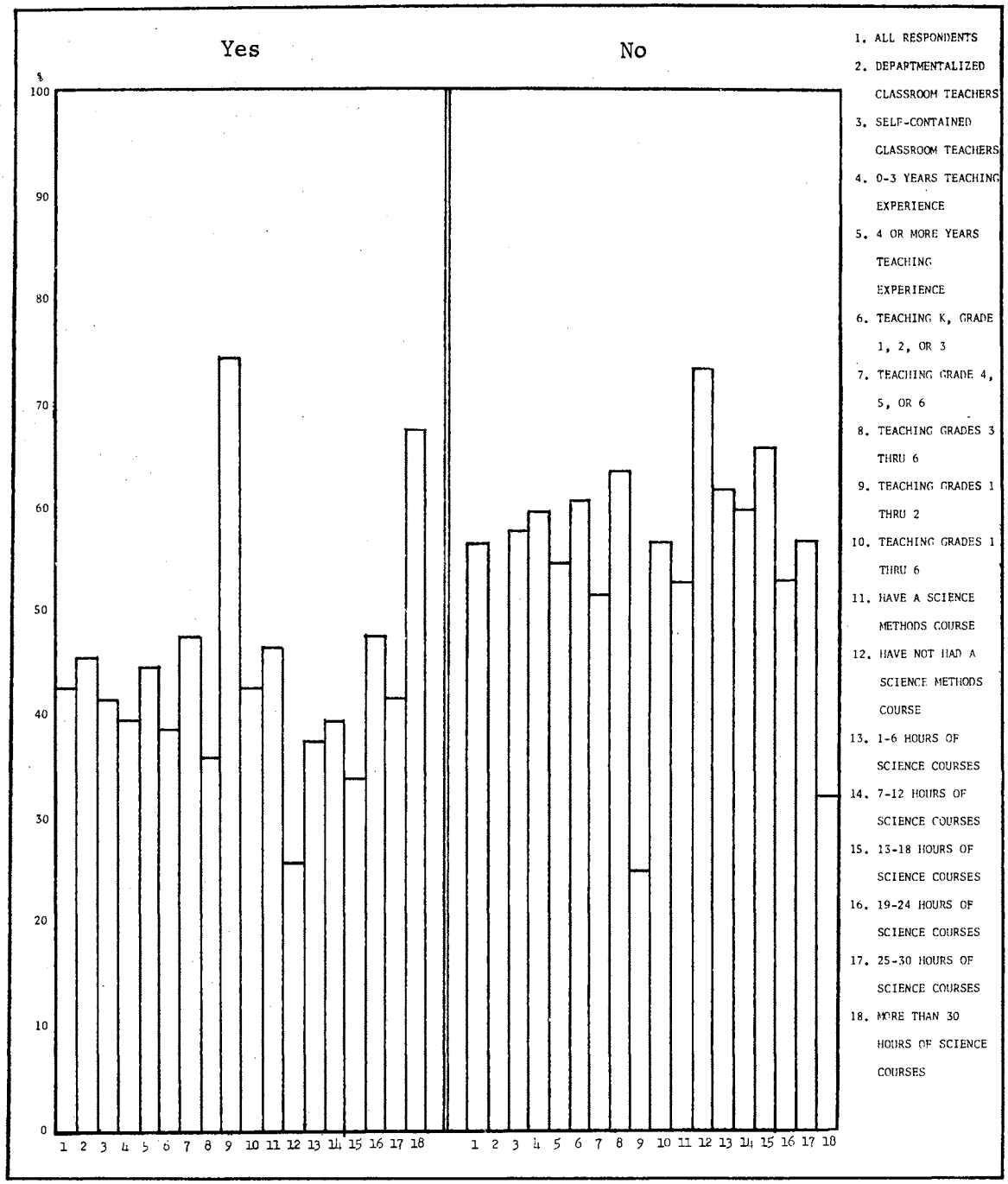

Figure 75. Science Courses Did Provide Methods and Techniques for Teaching Science

construction of science equipment. This information is presented in Figure 76 and indicates a positive response. The comparative analysis indicates that, in general, there is agreement with the statement by all the groups. The differences that occur are in the degree of agreement with the statement. The experienced teachers indicate greater agreement than the inexperienced teachers. The teachers of grades 1-2, and 1-6 indicate greater agreement than their comparative groups. The teachers with 1-6 and 25-30 hours of science course work indicate greater agreement with the statement than do the members of this category.

Contributions of Science Workshops to Teaching Elementary Science

The teachers were asked to report their participation in a science workshop or institute by a yes or no response. This information is provided in Figure 77. Figure 77 illustrates a slight negative response. The comparative analysis indicates considerable variation among the comparative groups. The departmentalized classroom teachers, the experienced teachers and the teachers with no methods course indicate a positive response; their comparative groups indicate a negative response. The primary and intermediate grade teachers of the self-contained classroom teaching group indicate a negative response, but the categories in grade teaching established for the departmentalized classroom teachers all indicate an agreement with the statement. The teachers with a smaller amount of science course work indicate a negative response; those teachers with more science course work indicate a positive response.

The teachers who had a workshop or institute were asked to report on the recentness of their in-service institute or workshop. The categories presented for indication were: (1) prior to the last 3 years, (2) during

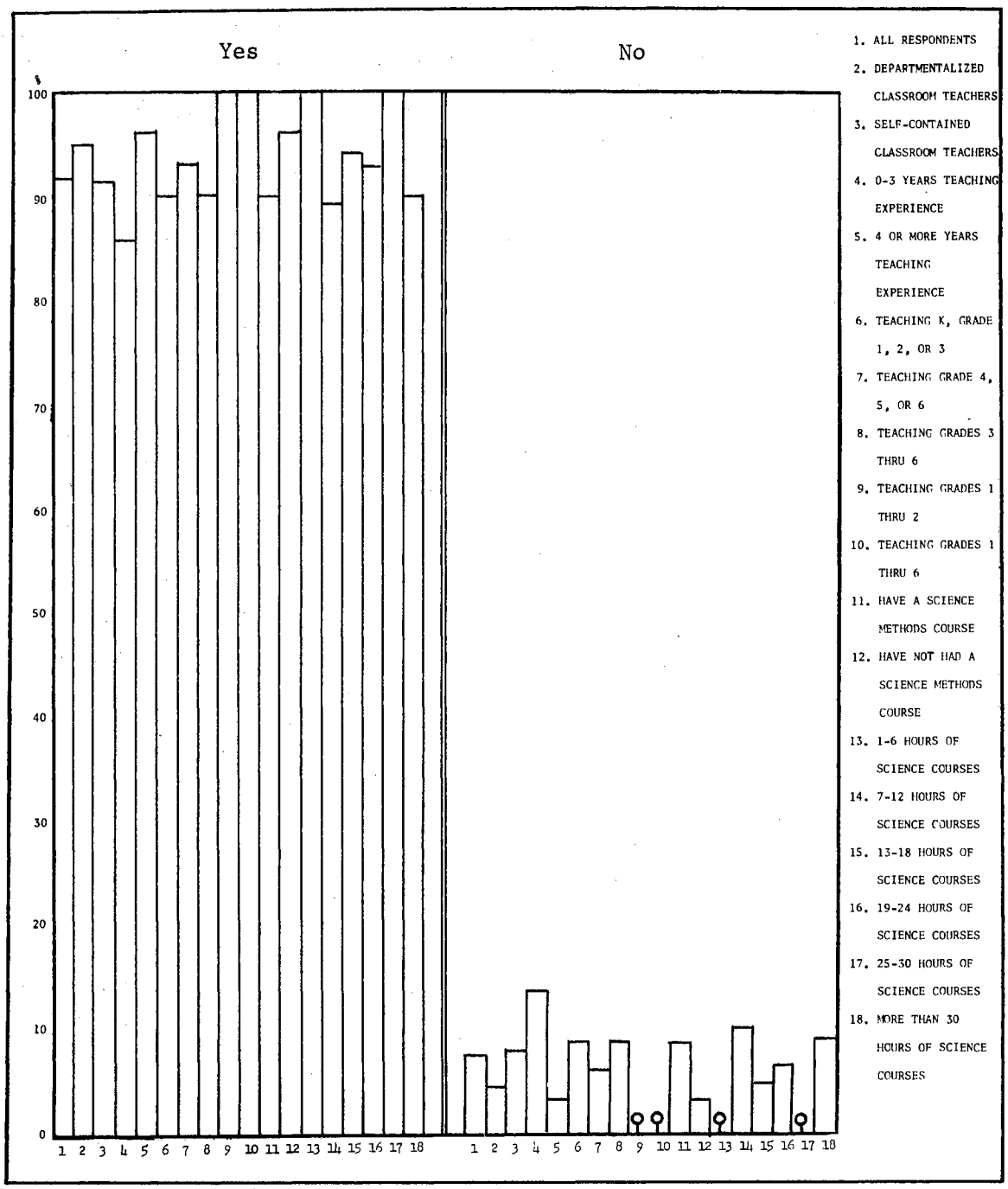

Figure 76. Science Courses Should Provide Instruction in the Care, Use and Construction of Science Equipment

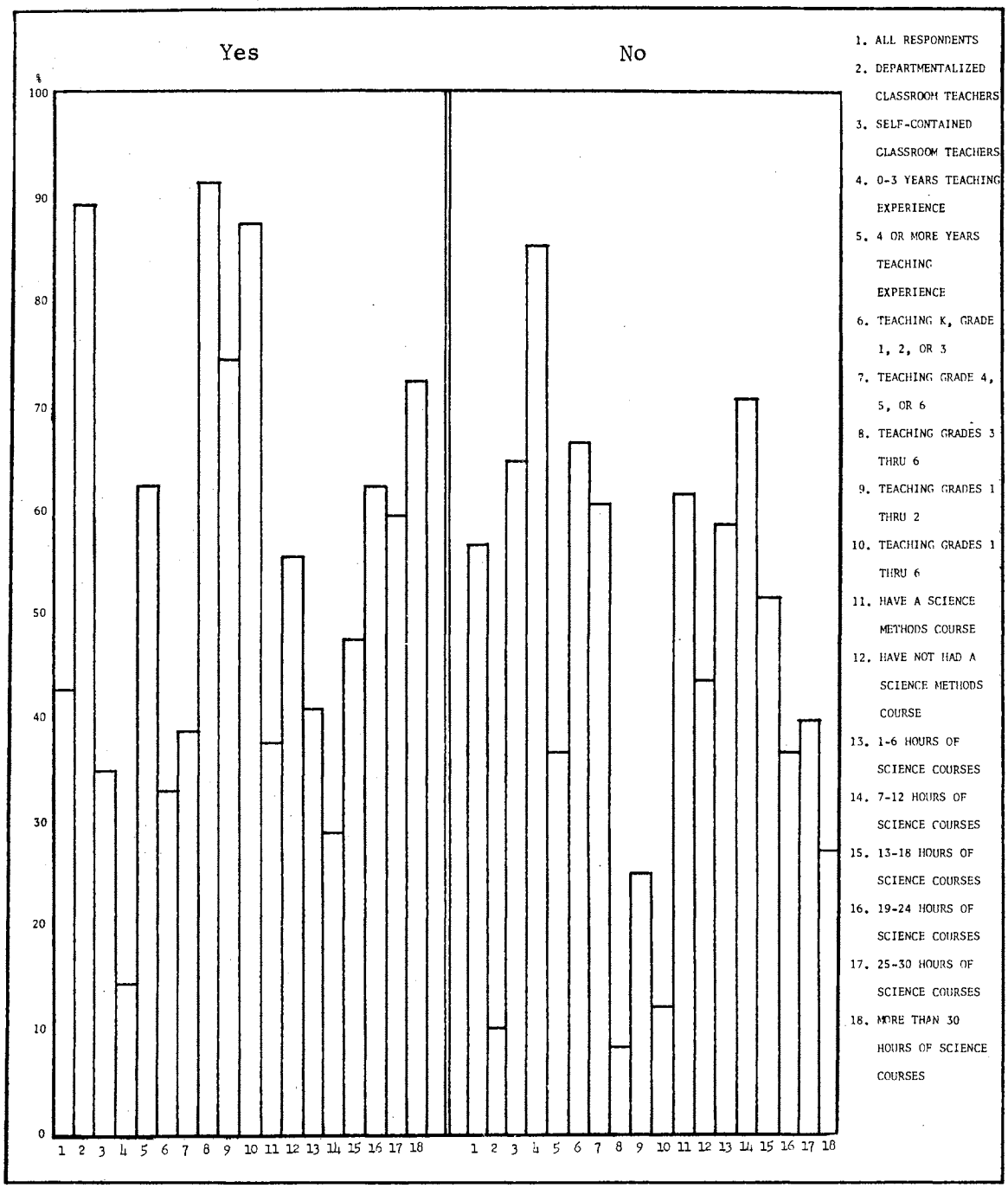

Figure 77. Teachers Who Have Participated in a Science Workshop or Institute

the last three years, or (3) both. This information is provided in Figure 78 which illustrates that most of the teachers had attended an institute or workshop during the last three years. The comparative analysis indicates that the only noticeable differences in the groups' responses are in the departmentalized classroom teachers who teach grades 1-2 and 1-6. The teachers of grades 1-2 indicate that their workshops or institutes were taken prior to the last three years. The teachers of grades 1-6 indicate an equal distribution of teachers who had workshops or institutes during the last three years and both.

The teachers were asked to respond to the statement that after participating in a workshop or institute they had increased the time that they devoted to teaching science. This information is provided in Figure 79 which illustrates that most of the teachers report that this statement does not apply to them. This is due to the fact that most of the teachers indicated that they had not taken a science institute or workshop. Among those teachers who did have a science workshop or institute, there was an equal distribution of agreement and disagreement. The comparative analysis indicates very little clear-cut evidence of whether the teachers did or did not provide more time after participating in the workshop or institute. The departmentalized classroom teachers indicate to a slight degree that they did increase the time devoted to science teaching. The self-contained classroom teachers indicate a slight negative response. The inexperienced teachers indicate a negative response, and the experienced teachers indicate a slight positive response. The differences that occur in the grade teaching indicate that the primary grade teachers are undecided; the intermediate grade teachers indicate a negative response; the departmentalized classroom teachers of

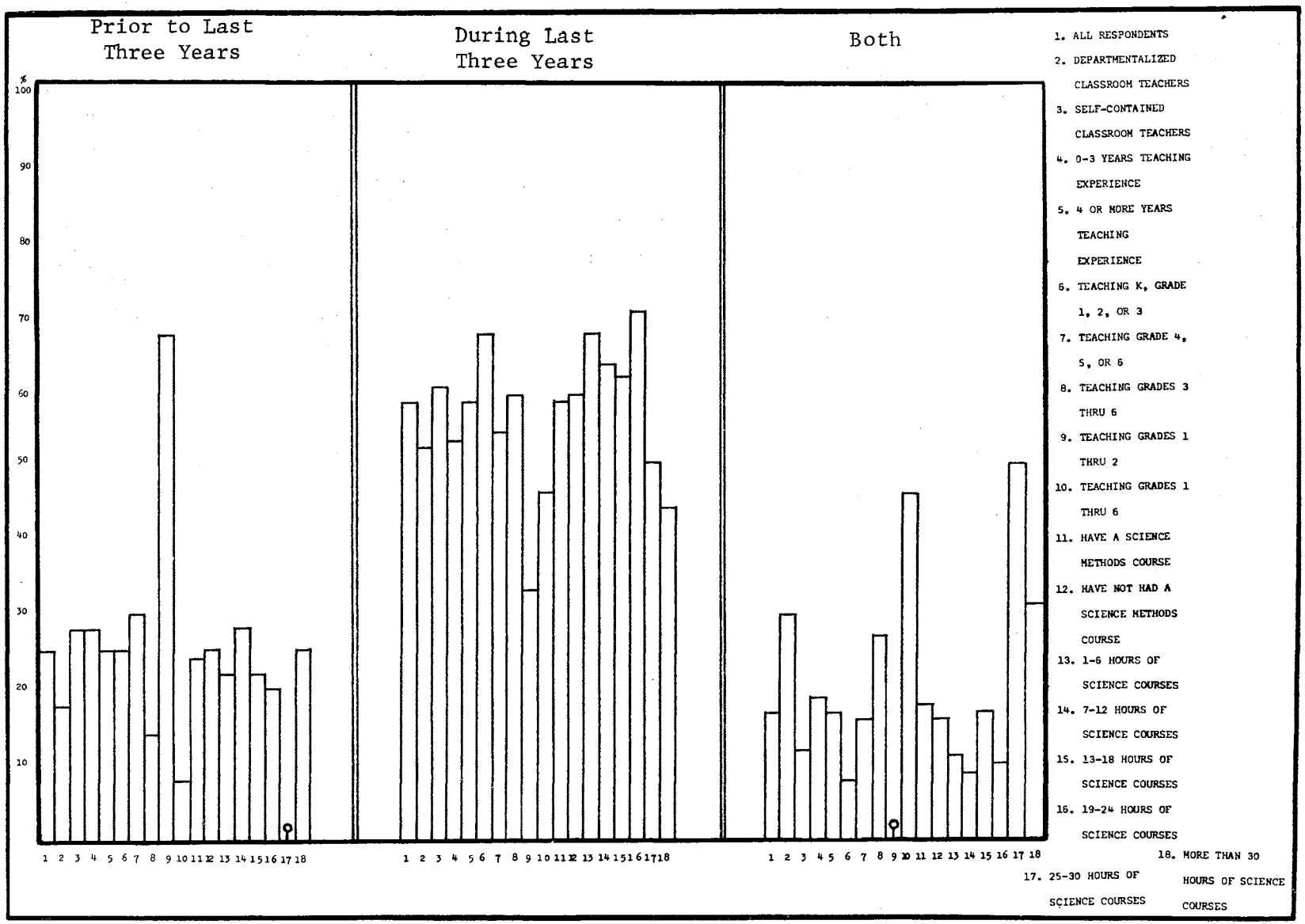

Figure 78. Recentness of In-Service Institute or Workshop

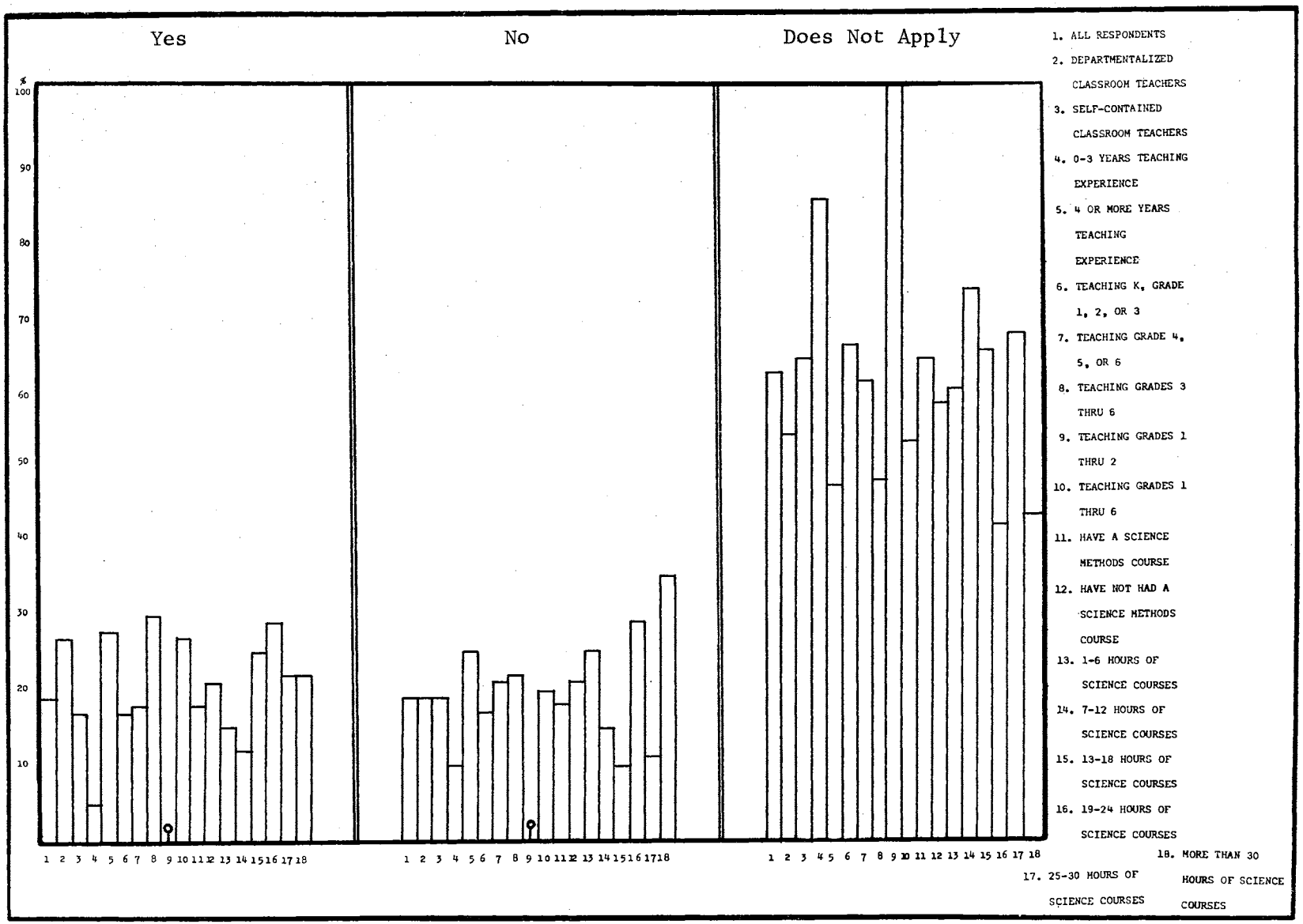

Figure 79. Workshop or Institute Influenced the Time Devoted to Teaching Science

grades 3-6 and 1-6 indicate a positive response. Teachers with and without a science methods course are undecided. The teachers with 1-6, 7-12 and more than 30 hours of science course work indicate a negative response; teachers with 13-18 and 25-30 hours indicate a positive response; and the teachers with 19-24 hours are undecided.

The teachers were asked to respond to the statement that they would be interested in participating in an in-service workshop or institute for elementary science teachers. Figure 80 reports this information and shows a positive response to the statement. The comparative analysis indicates that the differences that occur among the groups are in the degree of agreement with the statement. The departmentalized classroom teachers, the inexperienced teachers, the teachers of the primary grades, and the teachers with a methods course indicate a greater degree of agreement than do their comparative groups. The other differences that occur in the grade teaching are due to the categories established for the departmentalized classroom teachers. The teachers of grades 1-6 indicate greater agreement than the other members of this category. The teachers with 1-6 hours and 25-30 hours of science course work indicate a smaller degree of agreement than do the others in this group.

By means of the eight unfinished statements, the teachers were asked to express opinions on the science workshops or institutes. Everyone was asked to report what a science workshop or institute should provide. Only those teachers who had a science workshop or institute were asked to report what their science workshop or institute did provide.

The teachers indicate that a science institute or workshop should provide assistance in planning and organizing. This information is reported in Figure 81. The comparative analysis shows that the groups vary

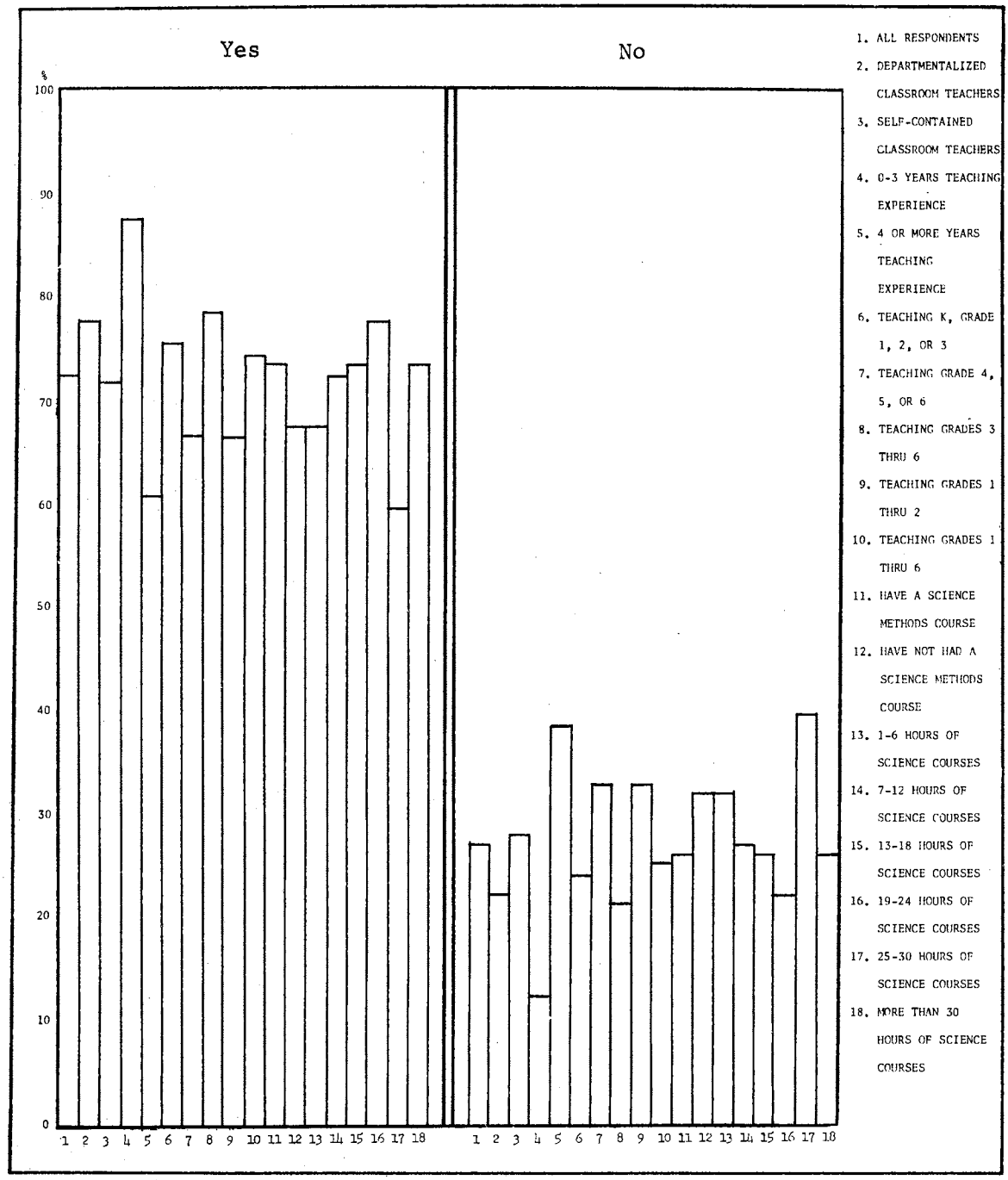

Figure 80. Interest in Participation in a Workshop or Institute

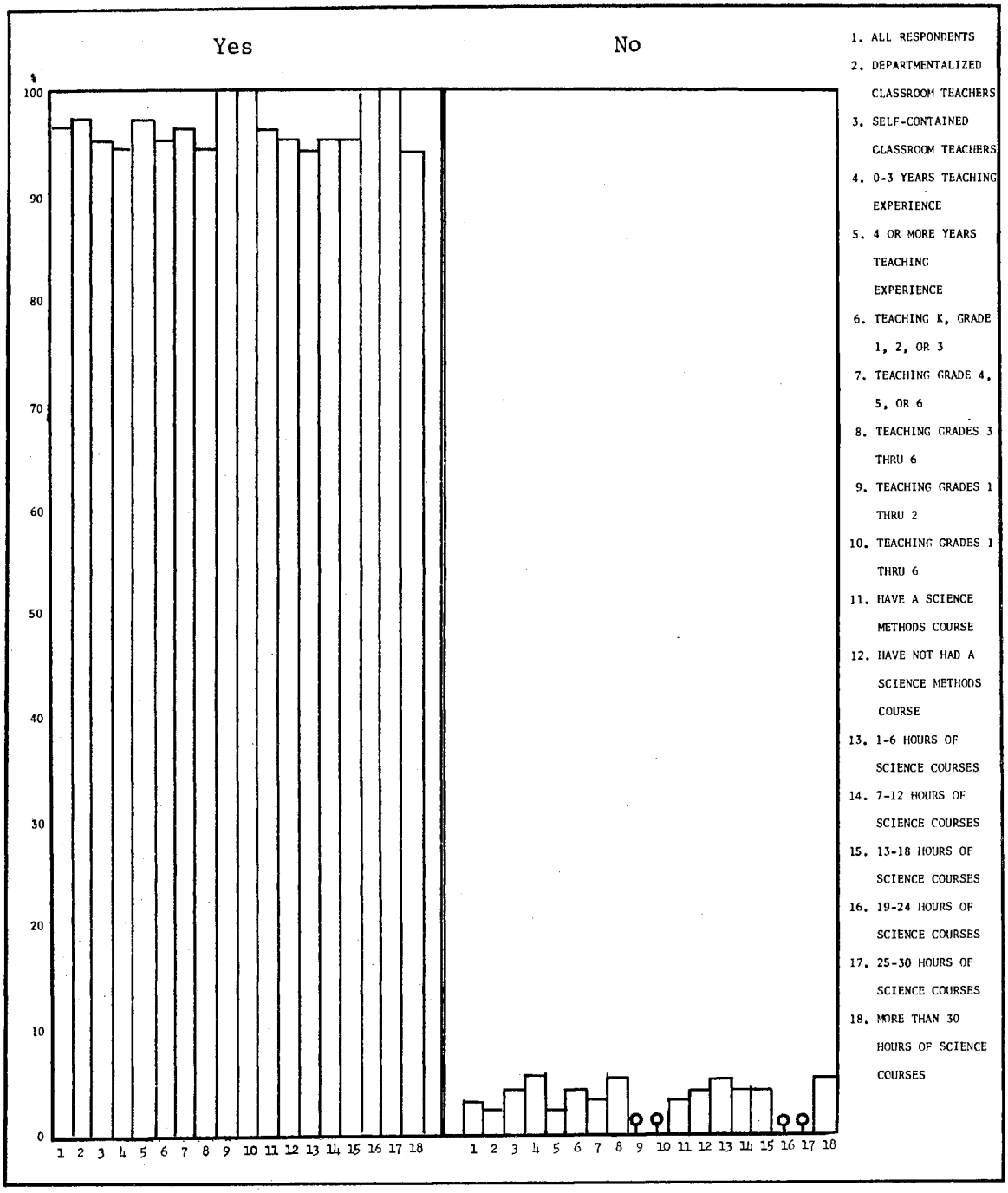

Figure 81. Workshop or Institute Should Provide Assistance in Planning and Organizing

only in a slight degree of agreement with the statement.

The teachers indicate that their science institute or workshop did provide assistance in planning and organizing. This information is reported in Figure 82. The comparative analysis shows that the only difference that occurs in the groups is the degree of agreement with the statement. The departmentalized classroom teachers, the experienced teachers, the primary grade teachers, the teachers without a methods course and the teachers with 13-18 hours of science course work indicate greater agreement with the statement than do their comparative groups. The teachers of grades 1-2 indicate the smallest amount of agreement.

The teachers indicate in Figure 83 that a science workshop or institute should provide subject-matter content. The comparative analysis shows that all groups are in agreement with the statement. The degree of agreement is the only exception. The departmentalized classroom teachers, the experienced teachers, the teachers of the primary grades, the teachers without a methods course and the teachers with 1-6, 13-18, and more than 30 hours of science course work indicate greater agreement than do their comparative groups. The teachers of grades 1-2 indicate a smaller amount of agreement than the others in this category.

The teachers indicate in Figure 84 that their science workshop or institute did provide subject-matter content. The comparative analysis indicates that all groups are in agreement with the statement except on the matter of the degree of agreement. The self-contained classroom teachers, the experienced teachers, the primary grade teachers and the teachers with a methods course indicate a greater agreement than do their comparative groups. The teachers of grades 1-2 and the teachers with 19-24 and 25-30 hours of science course work indicate a smaller agreement

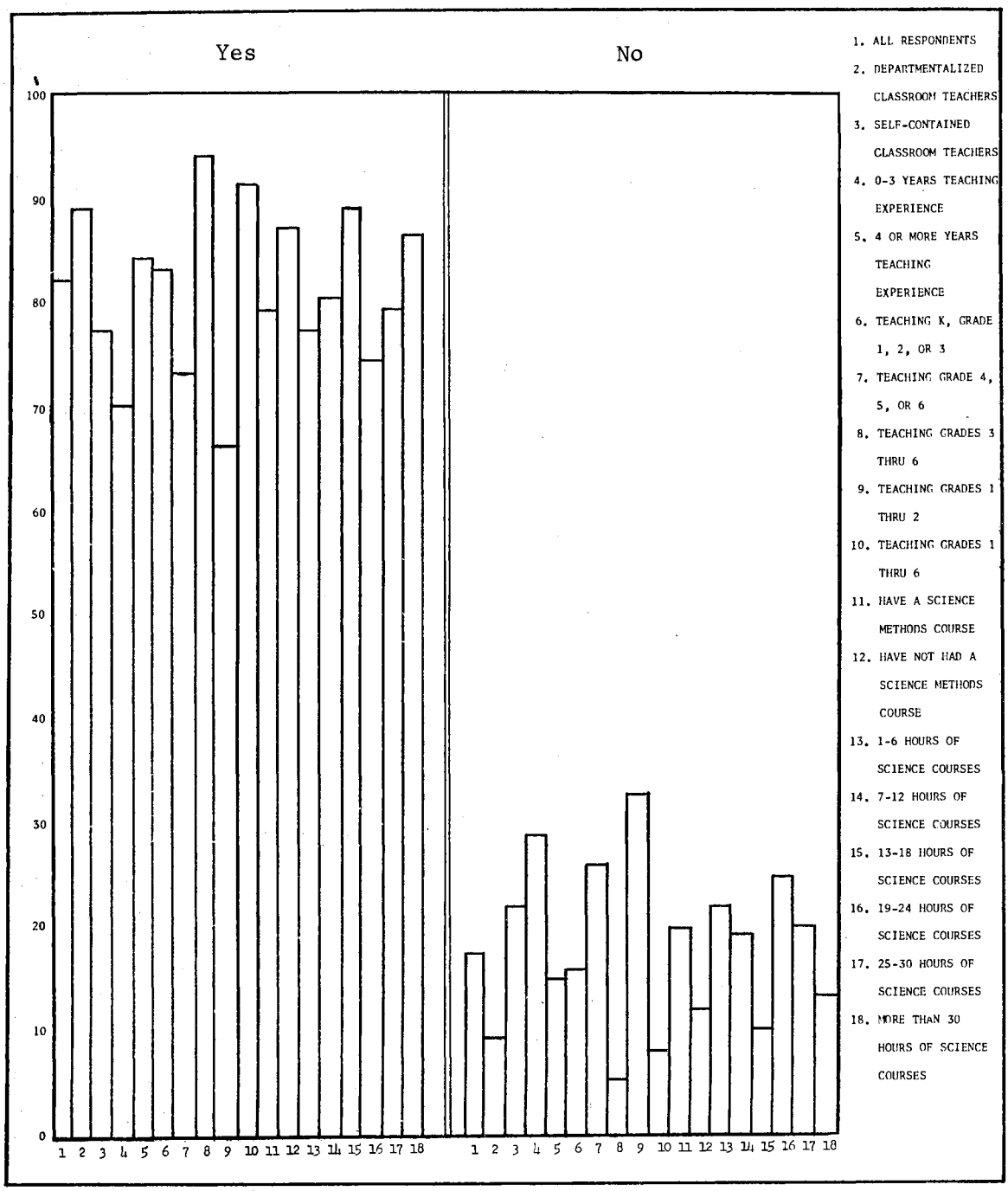

Figure 82. Workshop or Institute Did Provide Assistance in Planning and Organizing

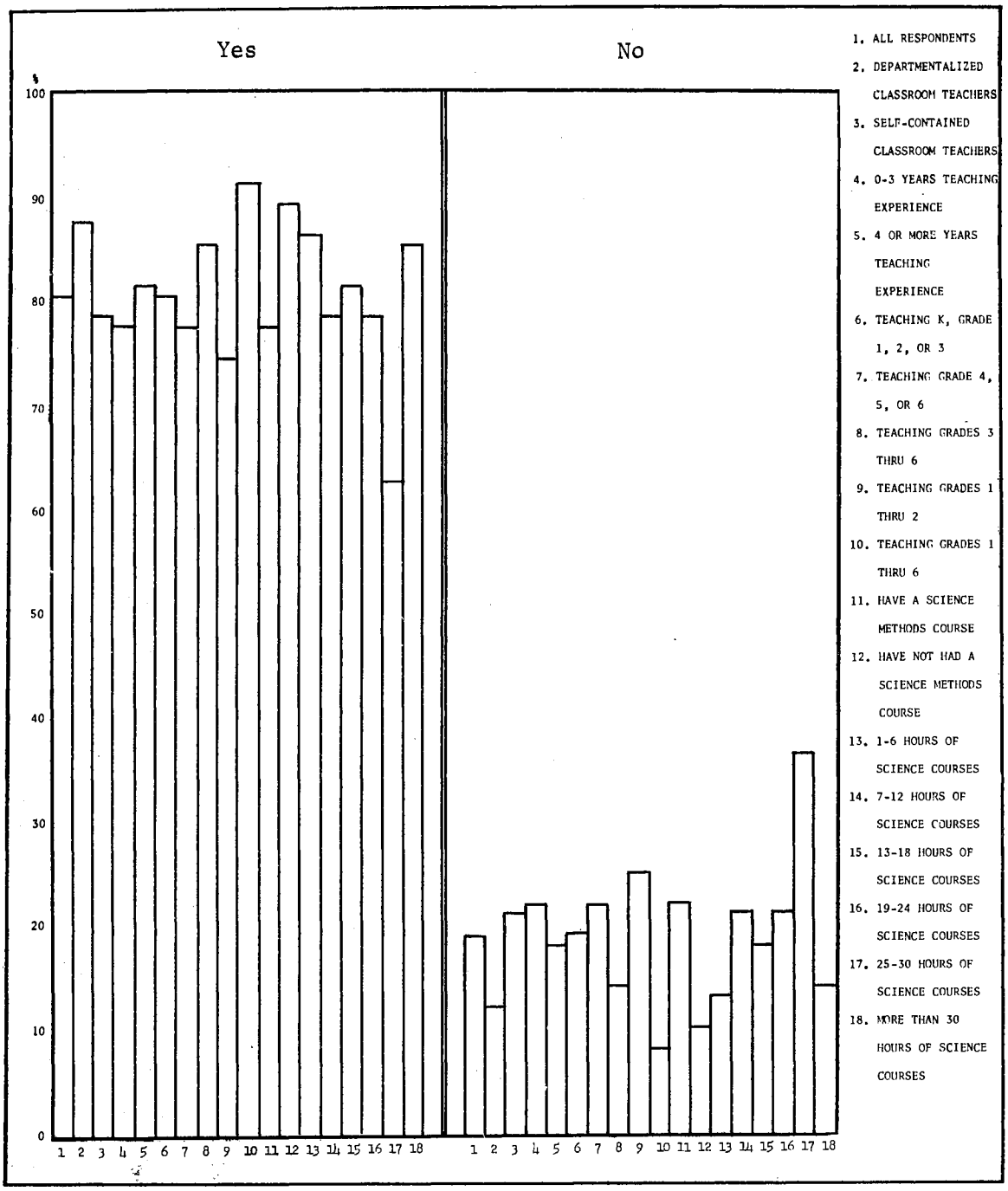

Figure 83. Workshop or Institute Should Provide Subject Matter Content

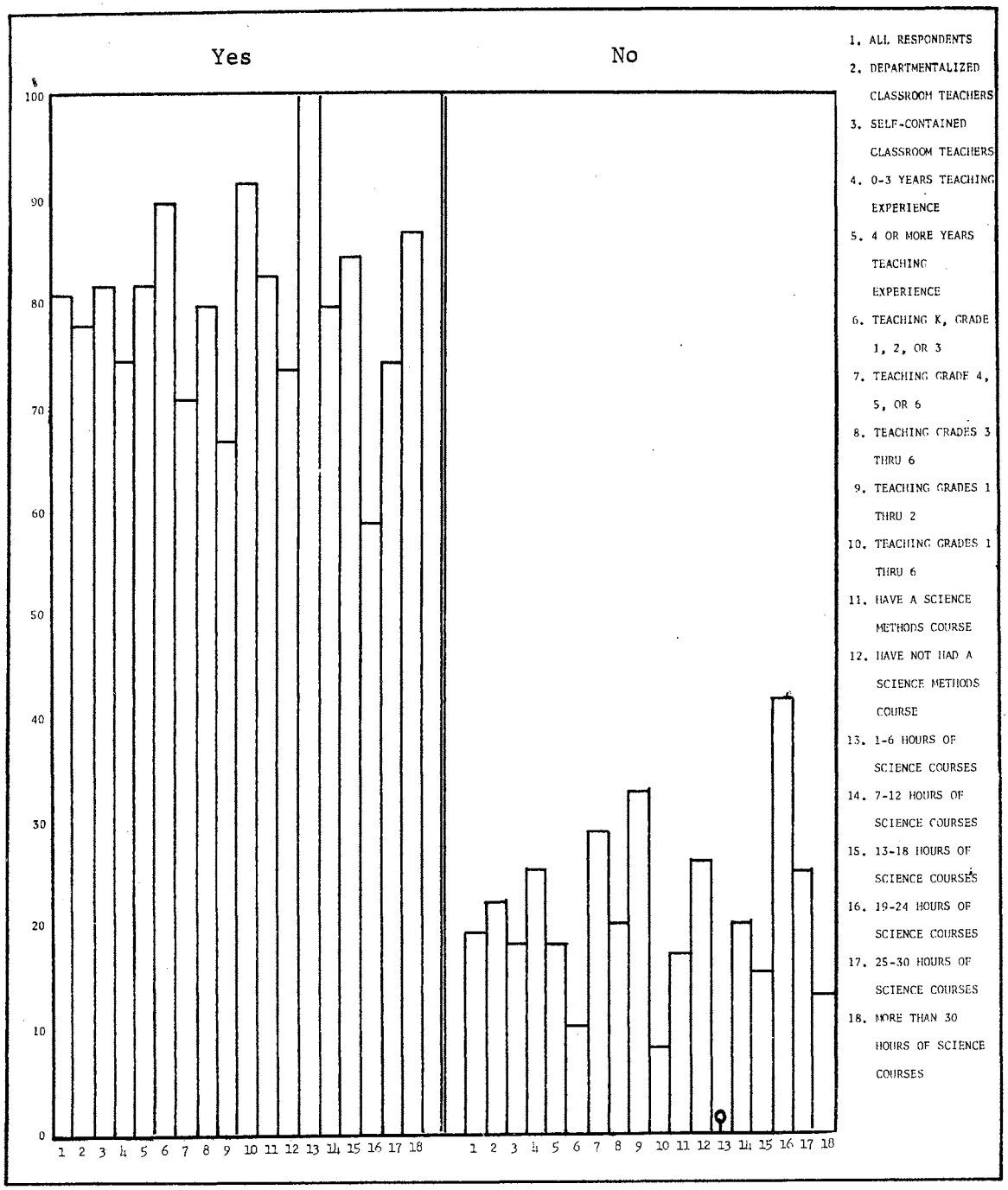

Figure 84. Workshop or Institute Did Provide Subject Matter Content

than do the other groups in these categories.

The teachers indicate that a science workshop or institute should provide an understanding of experimentation and demonstration. This information is reported in Figure 85. The comparative analysis shows that the groups in general vary only in a slight degree of positive response. The exception is the group of teachers with more than 30 hours of science course work who indicate a smaller degree of agreement than do their comparative groups.

The teachers indicate in Figure 86 that their science workshop or institute did provide an understanding of experimentation and demonstration. The comparative analysis shows that there is some variation among the comparative groups. The self-contained classroom teachers and the primary grade teachers indicate greater agreement than do their comparative groups. The departmentalized classroom teachers who teach grades 1-2 indicate disagreement with the statement. The teachers with 19-24 and more than 30 hours of science course work indicate a smaller agreement with the statement than do their comparative groups.

The teachers indicate that a science workshop or institute should provide a feeling of security in science teaching. This information is illustrated in Figure 87. The comparative analysis indicates that the groups differ only in the degree of agreement with the statement. The departmentalized classroom teachers and the experienced teachers indicate a greater agreement with the statement than do their comparative groups. The teachers of grades 3-6 indicate a smaller amount of agreement than do their comparative groups. The teachers with 1-6 hours of science course work indicate greater agreement than do their comparative groups.

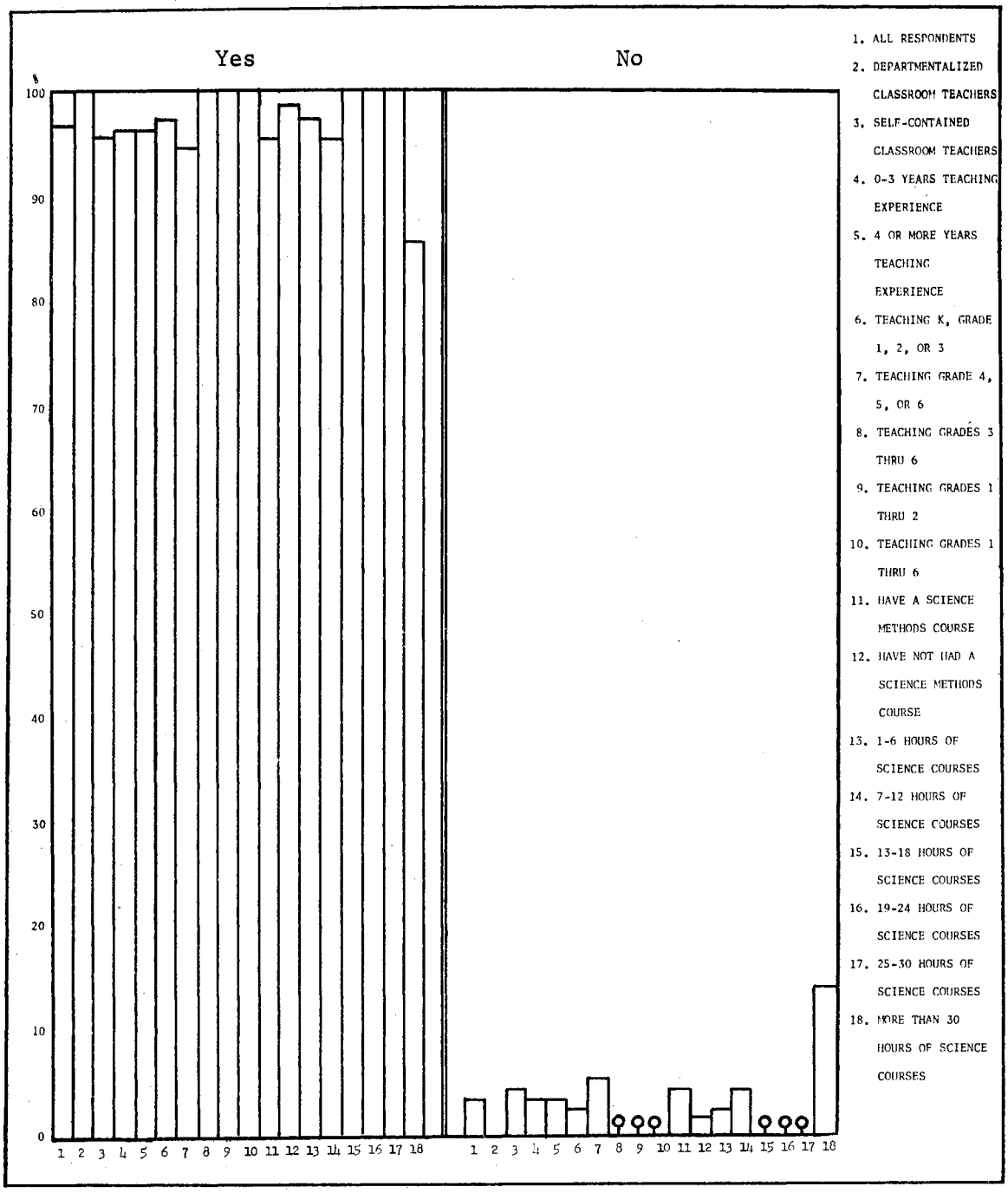

Figure 85. Workshop or Institute Should Provide an Understanding of Experimentation and Demonstration

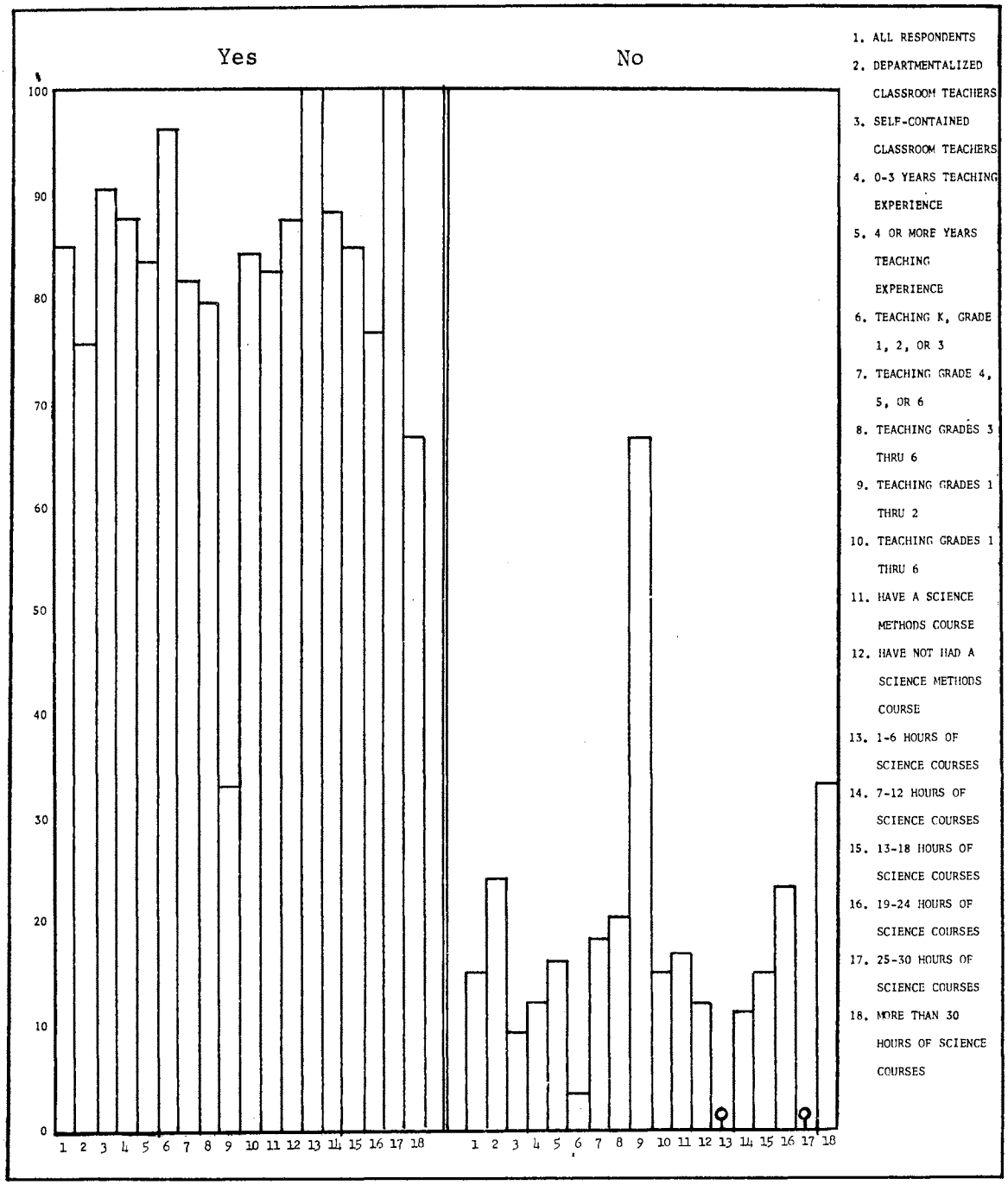

Figure 86. Workshop or Institute Did Provide an Understanding of Experimentation and Demonstration

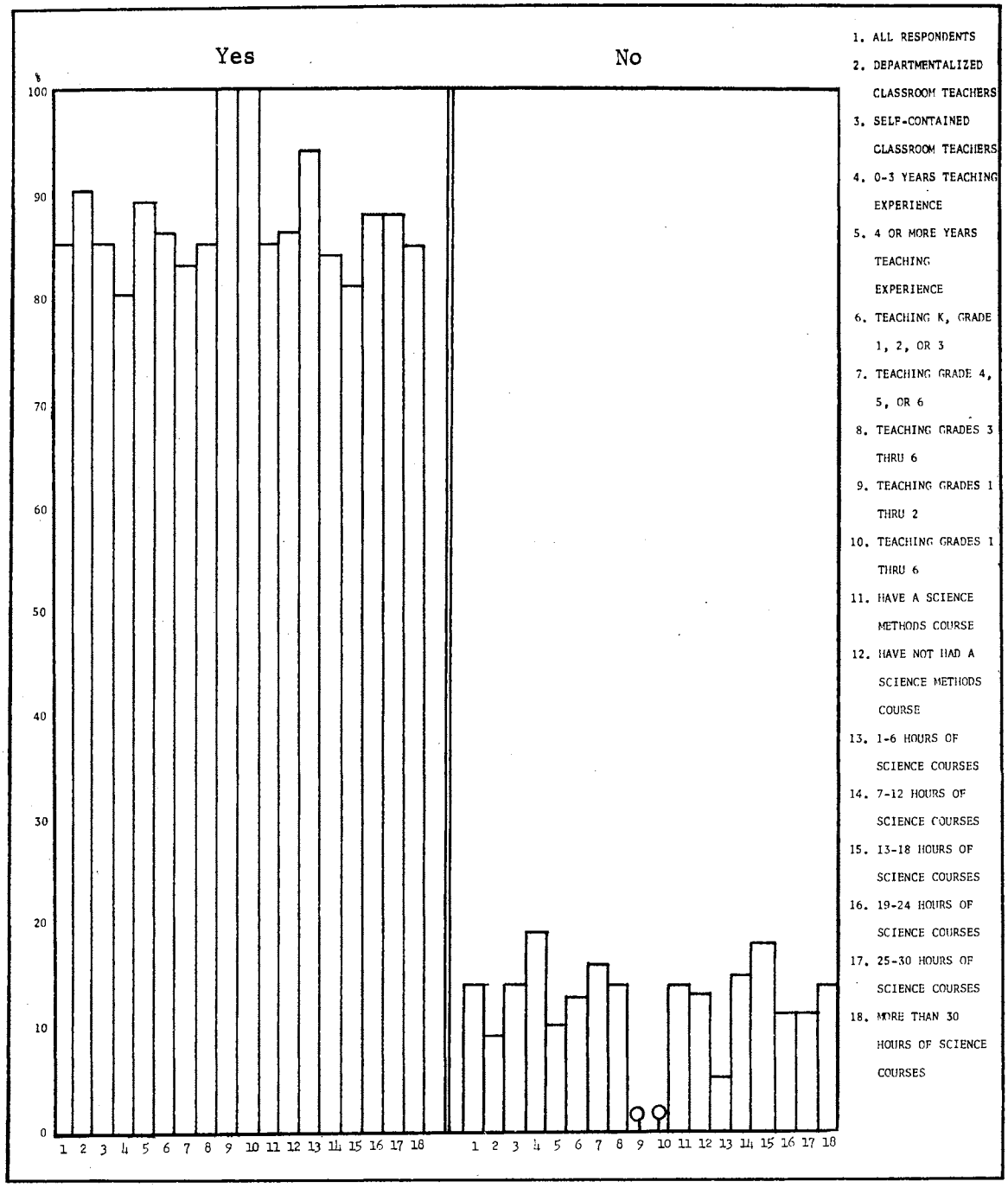

Figure 87. Workshop or Institute Should Provide a Feeling of Security in Teaching Science

The teachers indicate that their science workshop or institute did provide a feeling of security in science teaching. This information is illustrated in Figure 88. The comparative analysis indicates that the groups differ only in the degree of agreement with the statement. The primary grade teachers indicate a greater degree of agreement than do the intermediate grade teachers. Teachers of grades 1-2 are in total agreement. The teachers with methods course and the teachers with 1-6 hours of science course work indicate greater agreement than do their comparative groups.

The teachers indicate that a science workshop or institute should provide an idea of what should be taught at various grade levels. This information is reported in Figure 89. The comparative analysis indicates that the groups differ only in the degree of agreement with the statement. The departmentalized classroom teachers, the experienced teachers, the primary grade teachers, the teachers with no methods course, and the teachers with 19-24 hours of science course work indicate a greater agreement than do their comparative groups.

The teachers indicate that their workshop or institute did provide an idea of what should be taught at various grade levels. This information is provided in Figure 90. The comparative analysis indicates that the groups differ only in the degree of agreement with the statement. The departmentalized classroom teachers, the experienced teachers, the primary grade teachers, the teachers without a methods course and the teachers with 1-6 hours of science course work indicate a greater agreement with the statement than do their comparative groups.

The teachers indicate that a science workshop or institute should provide a greater interest in science teaching. This information is

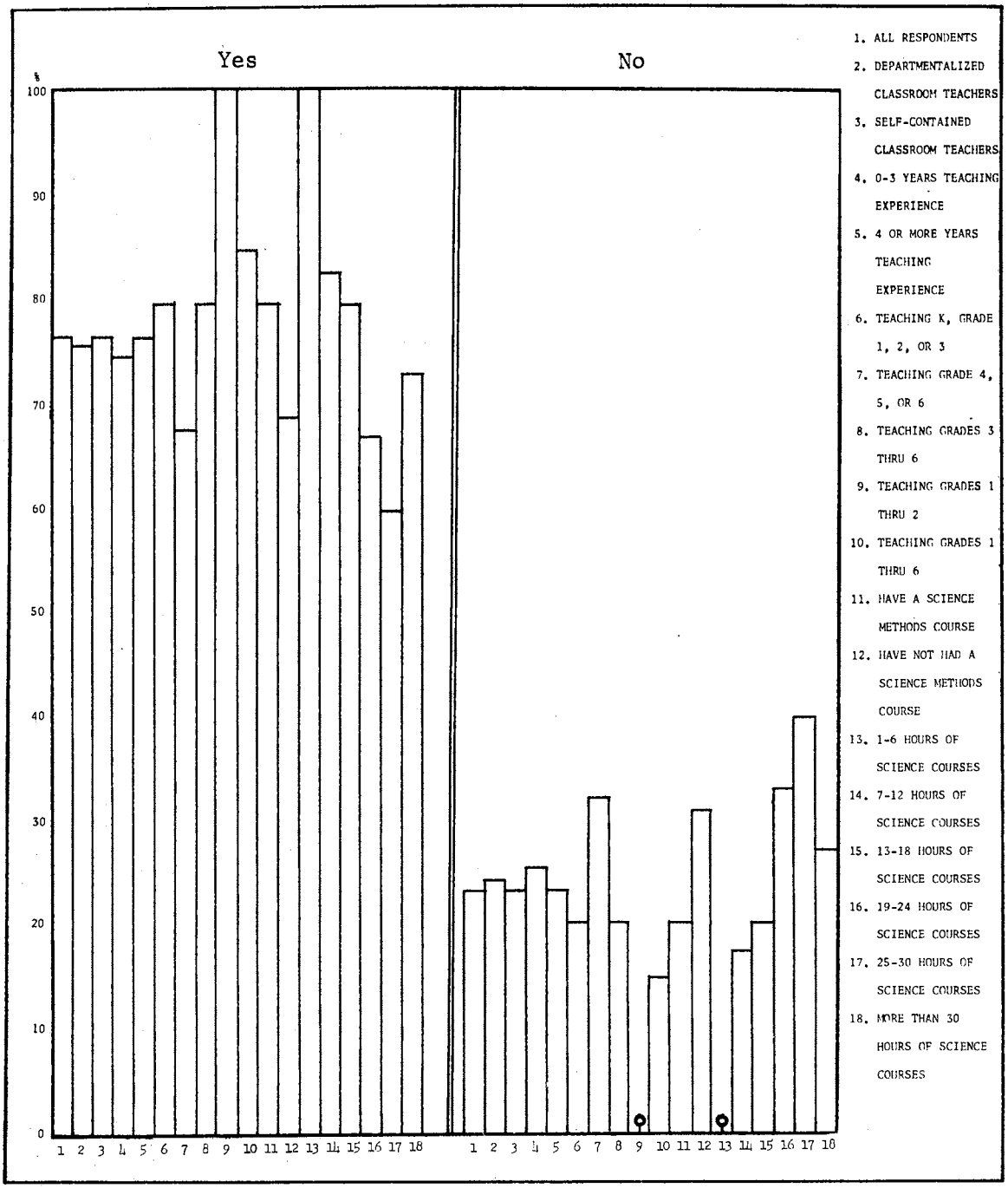

Figure 88. Workshop or Institute Did Provide a Feeling of Security in Teaching Science

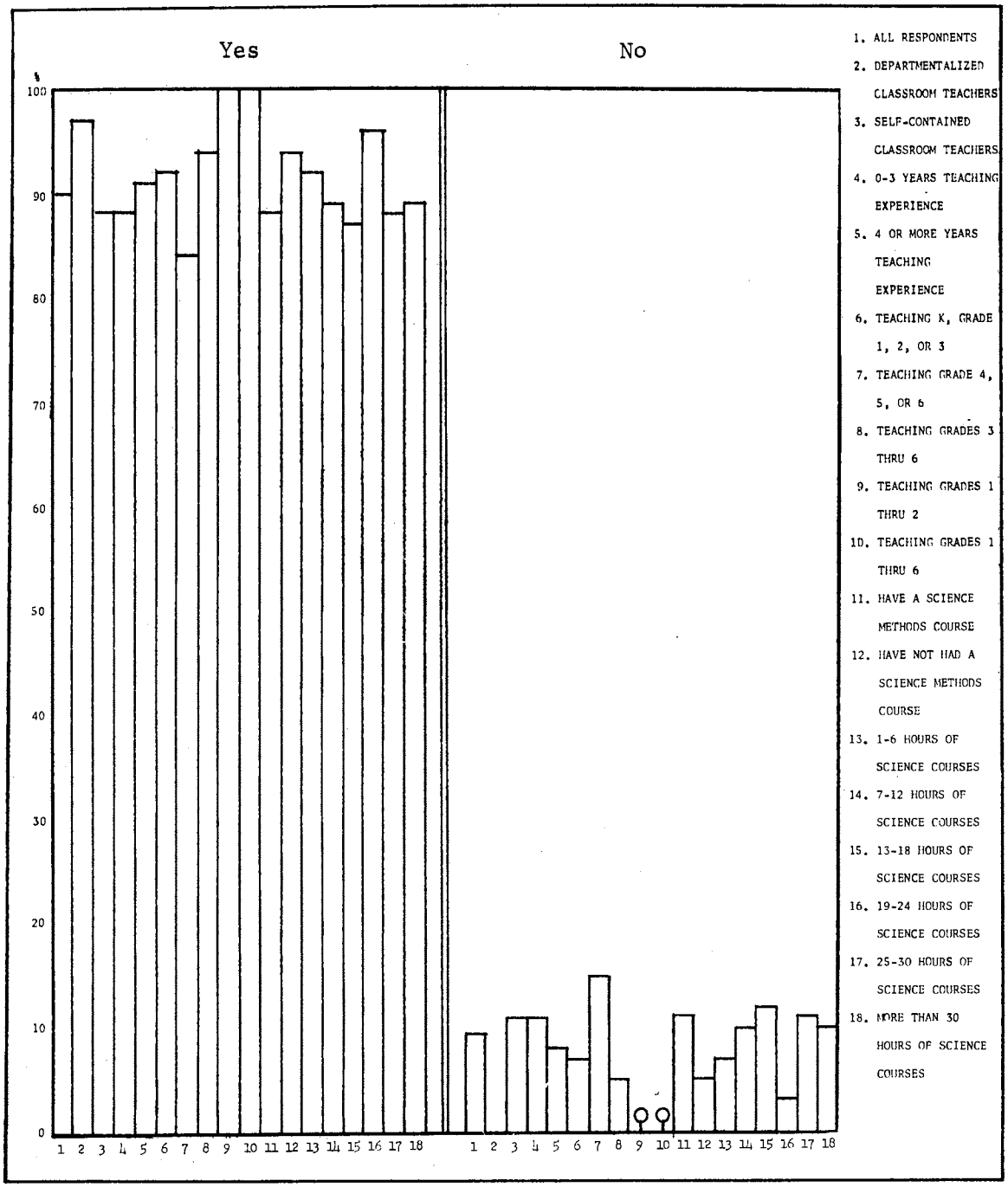

Figure 89. Workshop or Institute Should Provide an Idea of What Should Be Taught at Various Grade Levels

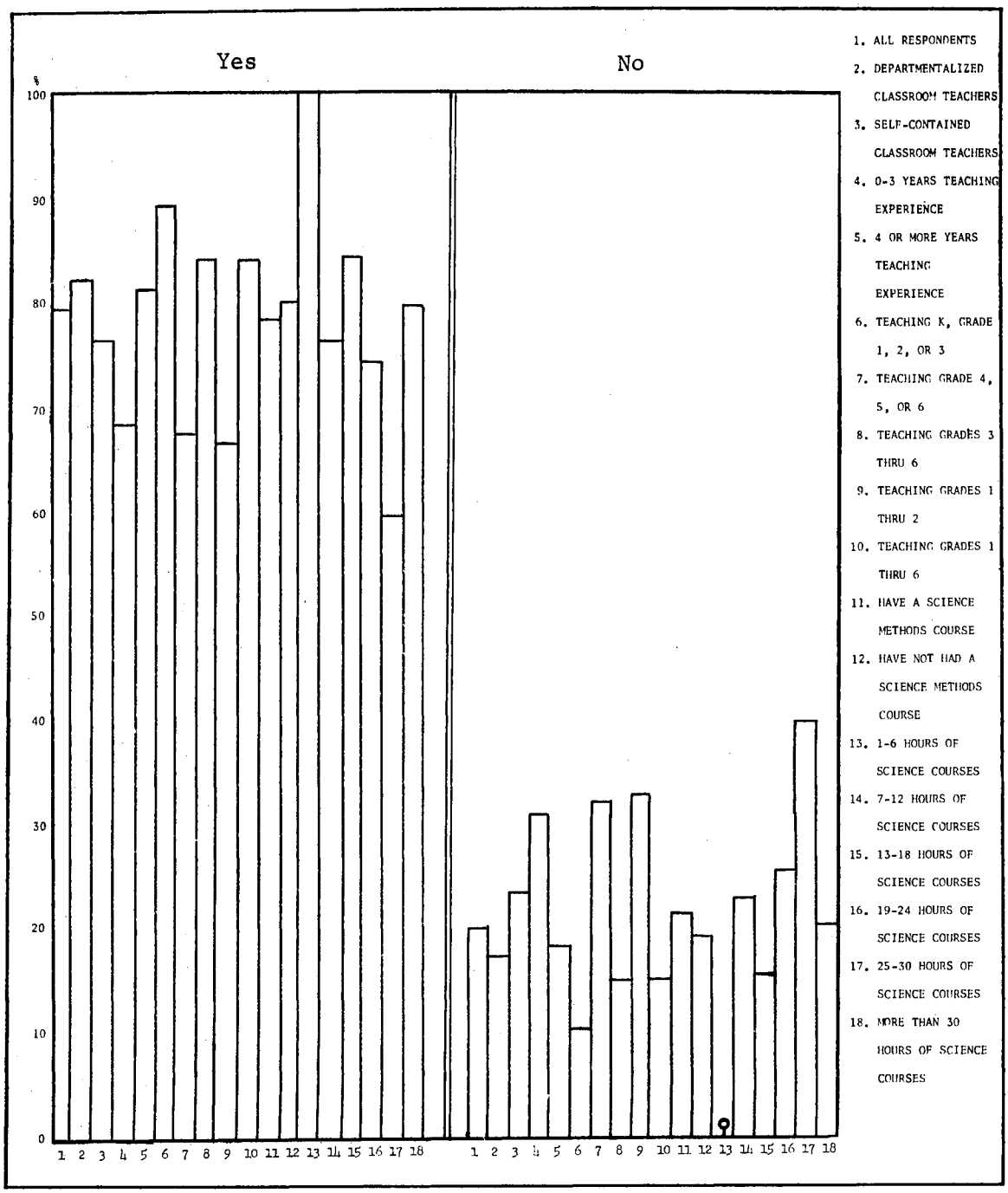

Figure 90. Workshop or Institute Did Provide an Idea of What Should Be Taught at Various Grade Levels

reported in Figure 91. The comparative analysis shows that the groups in general vary only in a slight degree of positive response. The exceptions are the teachers who teach grades 3-6 and the teachers with 19-24 hours of science course work who indicate a smaller degree of positive response than do their comparative groups.

The teachers indicate that their science workshop or institute did provide a greater interest in science teaching. This information is reported in Figure 92. The comparative analysis indicates that the groups agree with the statement and vary only in the degree of response. The intermediate grade teachers indicate a greater agreement than do the primary grade teachers. The teachers of grades 3-6 and the teachers with 19-24 hours of science course work indicate smaller agreement with the statement than do their comparative groups.

The teachers indicate a science workshop or institute should provide units and materials necessary to teach science. This information is provided in Figure 93. The comparative analysis indicates that in general the groups agree with the statement. The only difference is in degree of agreement. The departmentalized classroom teachers, the experienced teachers, the primary grade teachers and the teachers of grades 3-6, teachers with a methods course, and teachers with 1-6 hours of science work indicate greater agreement than do their comparative groups.

The teachers indicate that their science workshop or institute did provide units and materials necessary to teach science. This information is reported in Figure 94. The comparative analysis indicates that the groups agree with the statement. The only difference is in the degree of agreement. The departmentalized classroom teachers, the experienced teachers, the primary grade teachers and teachers of grades 1-2, teachers

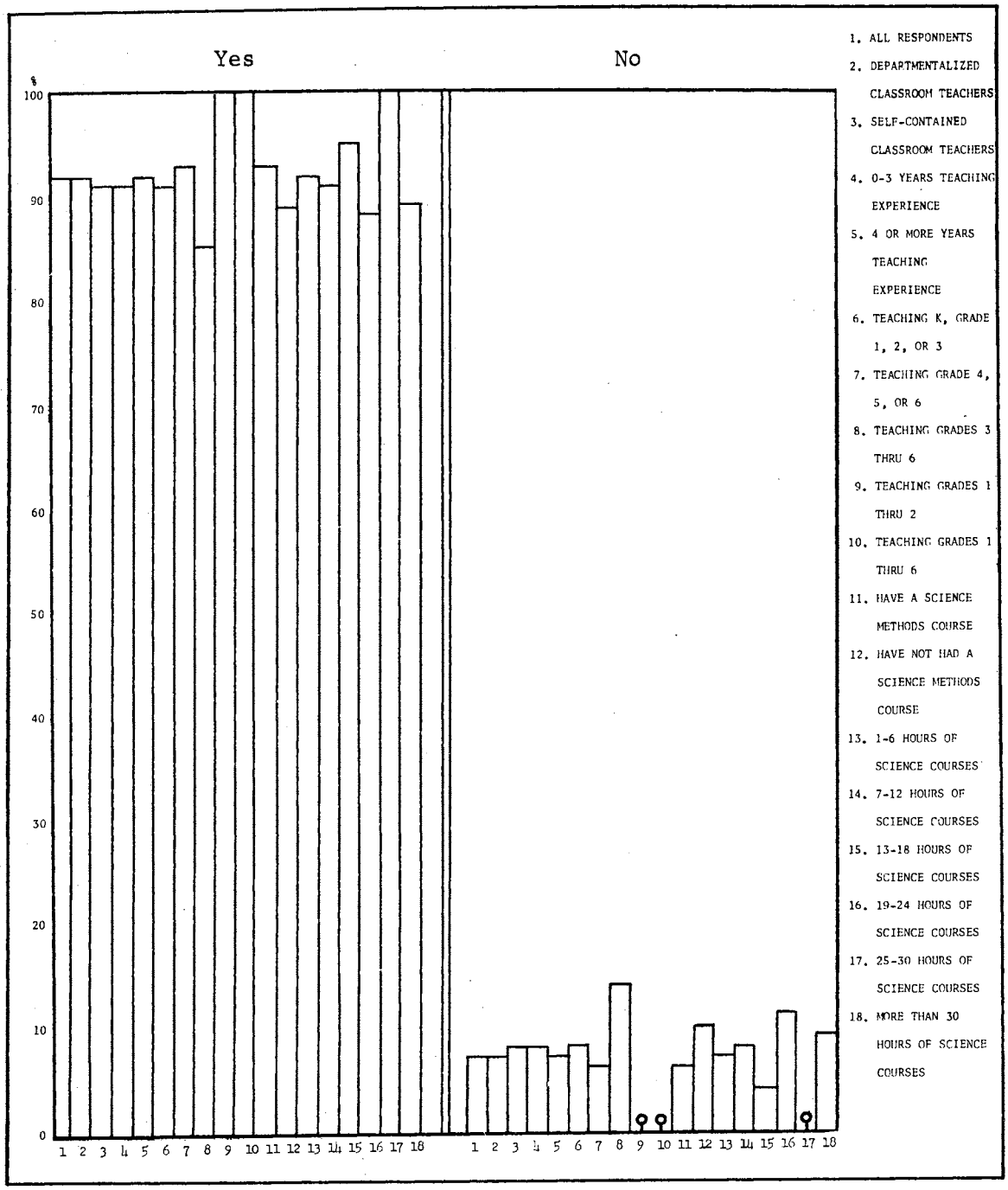

Figure 91. Workshop or Institute Should Provide a Greater Interest in Teaching Science

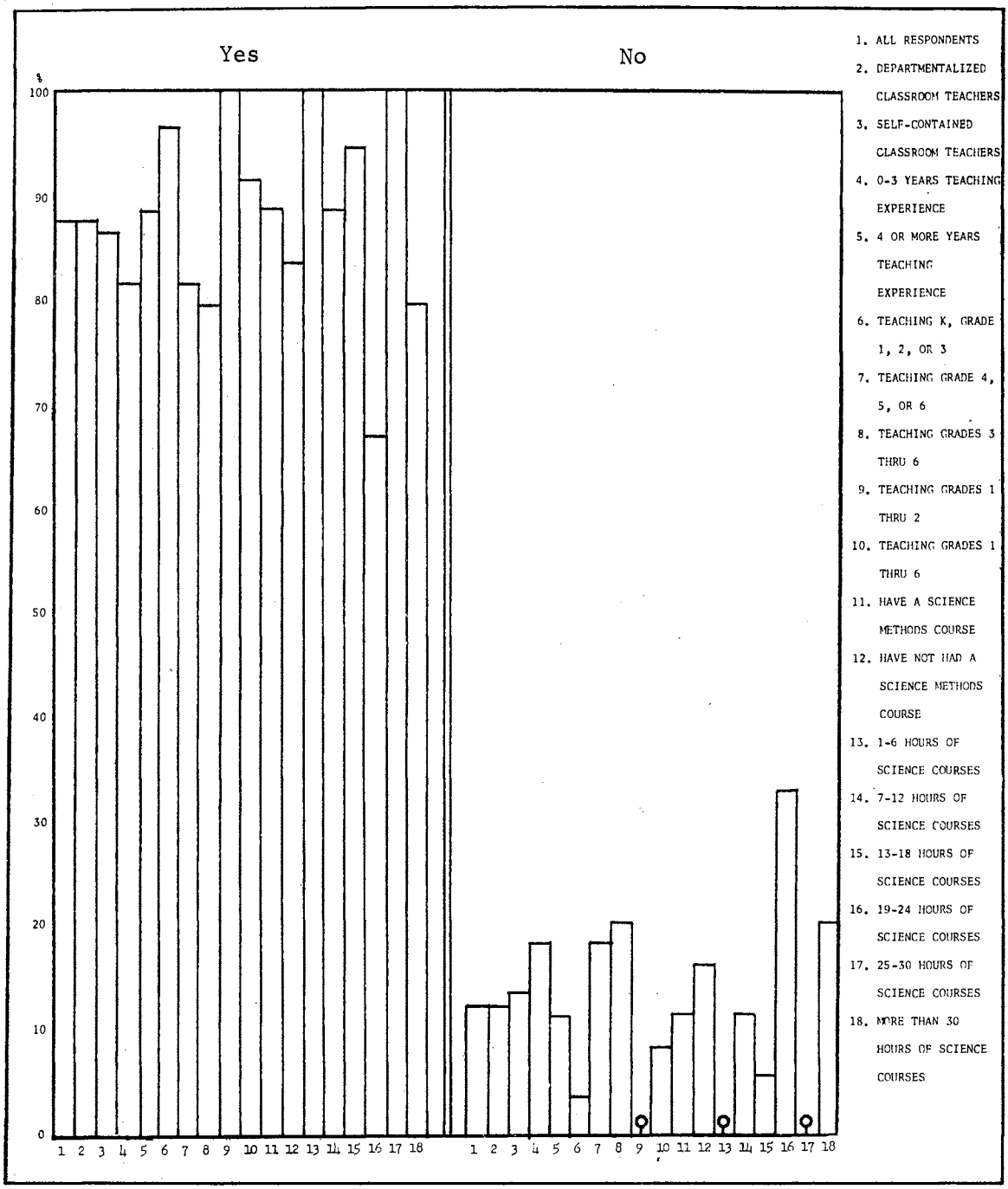

Figure 92. Workshop or Institute Did Provide a Greater Interest in Teaching Science

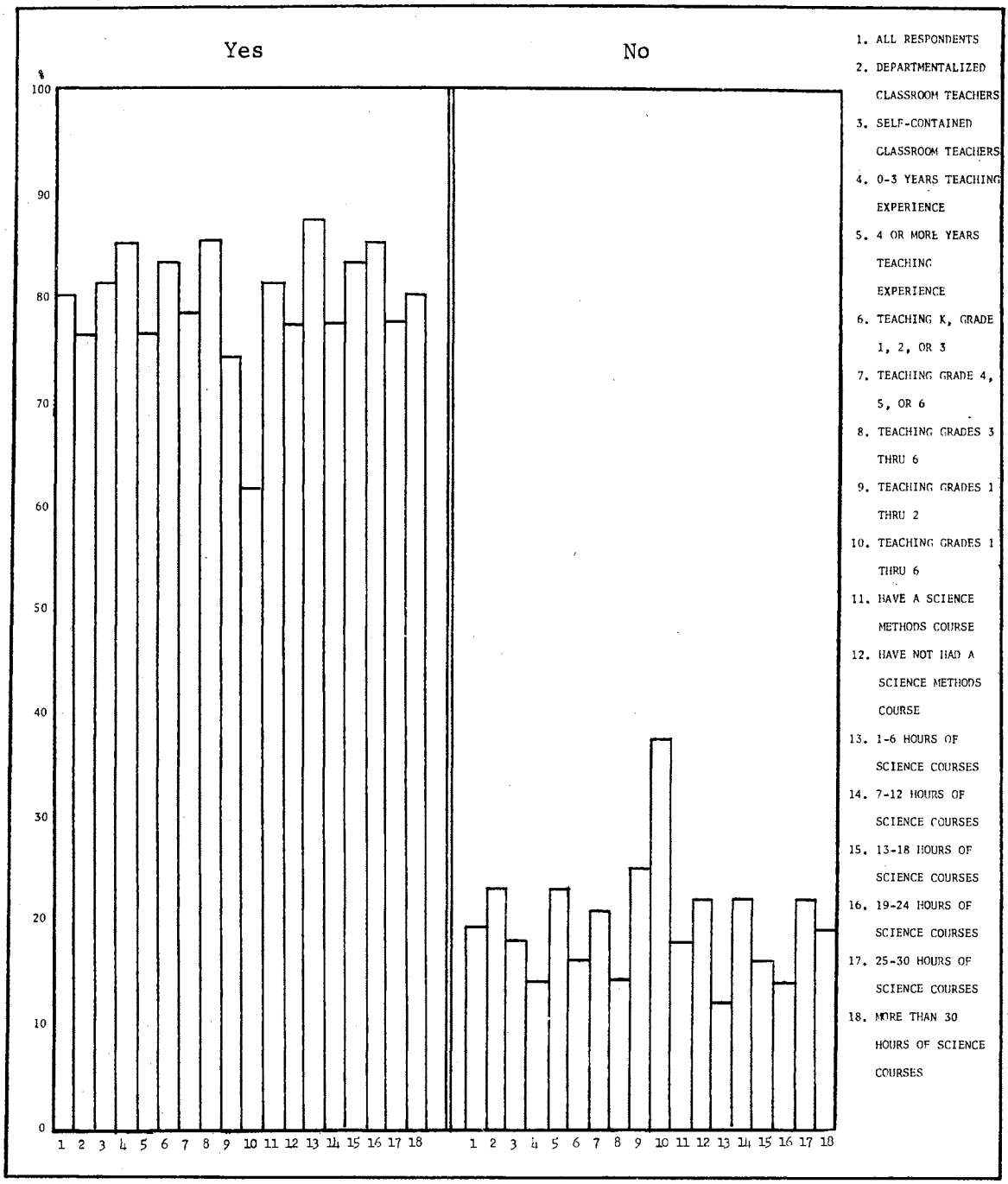

Figure 93. Workshop or Institute Should Provide Units and Materials Necessary to Teach Science

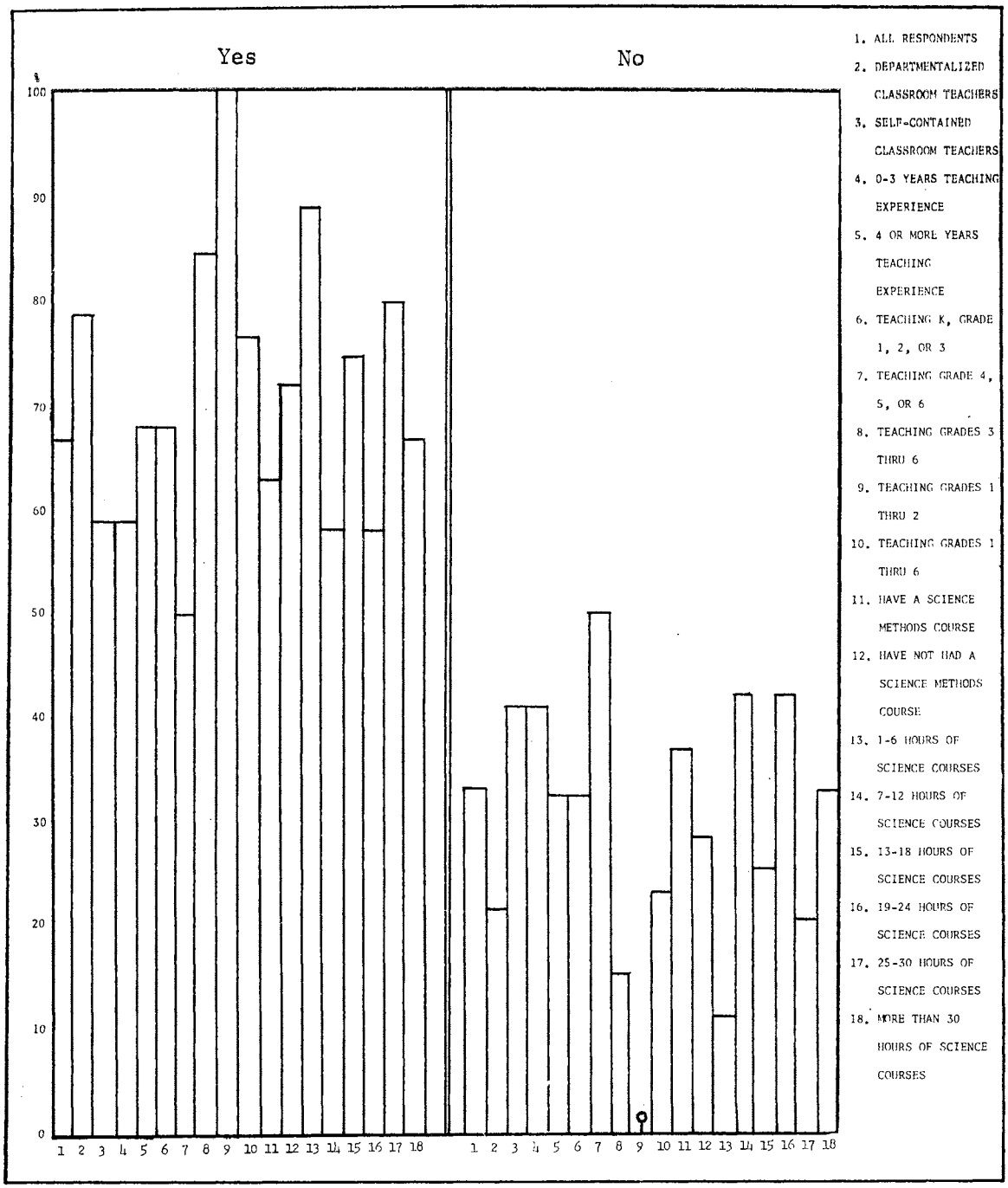

Figure 94. Workshop or Institute Did Provide Units and Materials Necessary to Teach Science

without a methods course, and teachers with 1-6 hours of science course work indicate a greater degree of agreement than do the other members of their comparative groups.

The teachers indicate that a science workshop or institute should provide methods and techniques necessary to teach science. This information is reported in Figure 95. The comparative analysis indicates that there is little difference expressed by the comparative groups. The teachers with no methods course, with 25-30 hours and more than 30 hours of science course work and the experienced teachers indicate smaller agreement than do the other comparative groups.

The teachers indicate in Figure 96 that their science workshop or institute did provide methods and techniques necessary to teach science. The comparative analysis indicates that the differences that occur in the comparative groups are in the degree of agreement with the statement. The self-contained classroom teachers, the experienced teachers, the primary grade teachers, the teachers of grades 1-2, and the teachers with 1-6 hours of science course work indicate greater agreement with the statement than do their comparative groups.

Contributions of Science Supervisors to Teaching Elementary Science

The teachers were asked to report the availability of the services of a science supervisor by a yes or no response. This information is reported in Figure 97 which illustrates that most of the teachers did not have the services of a science supervisor available. The comparative analysis indicates considerable variation in the responses. The departmentalized classroom teachers indicate that most of them have science supervisors; the self-contained classroom teachers indicate that they do

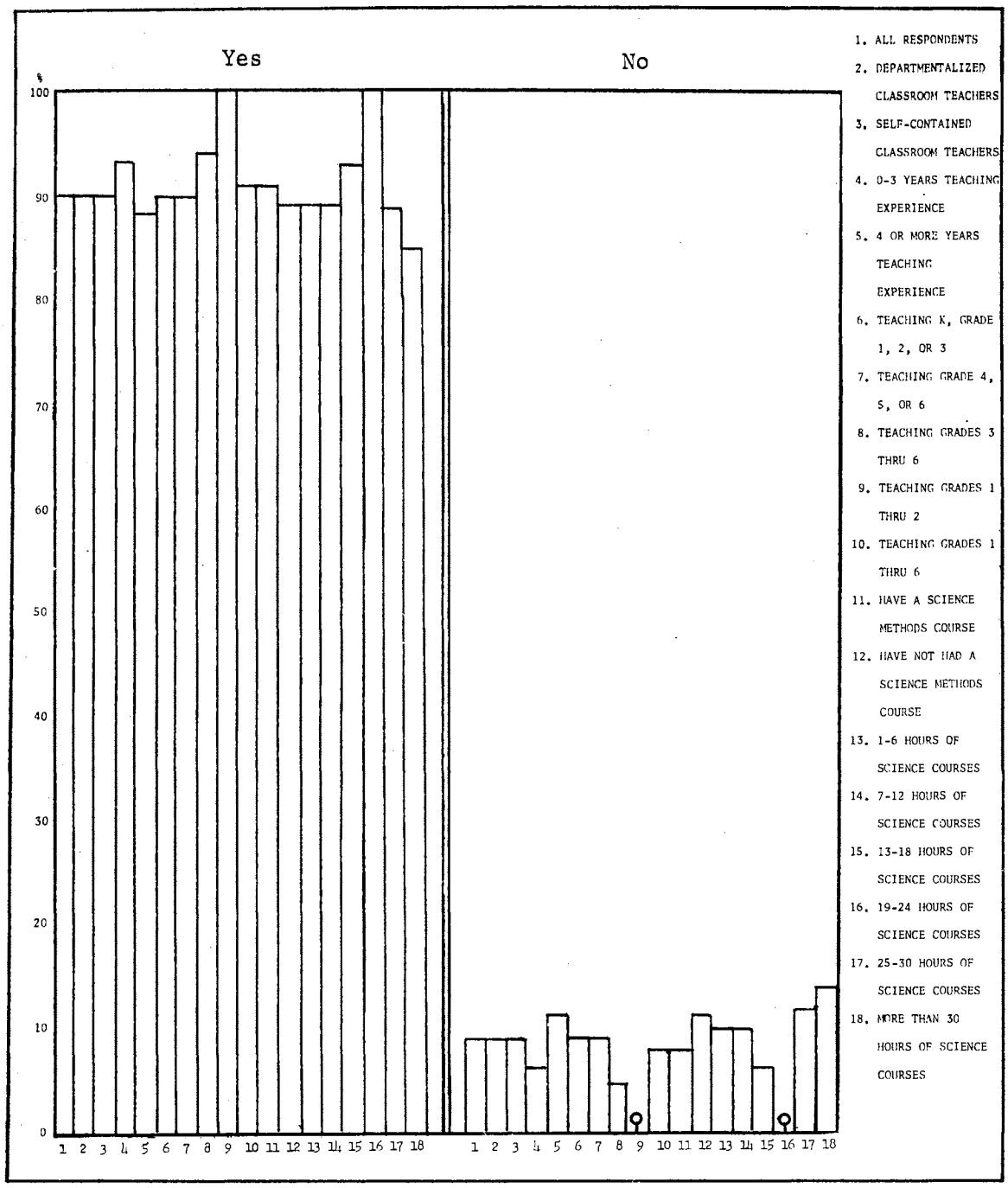

Figure 95. Workshop or Institute Should Provide Methods and Techniques for Teaching Science

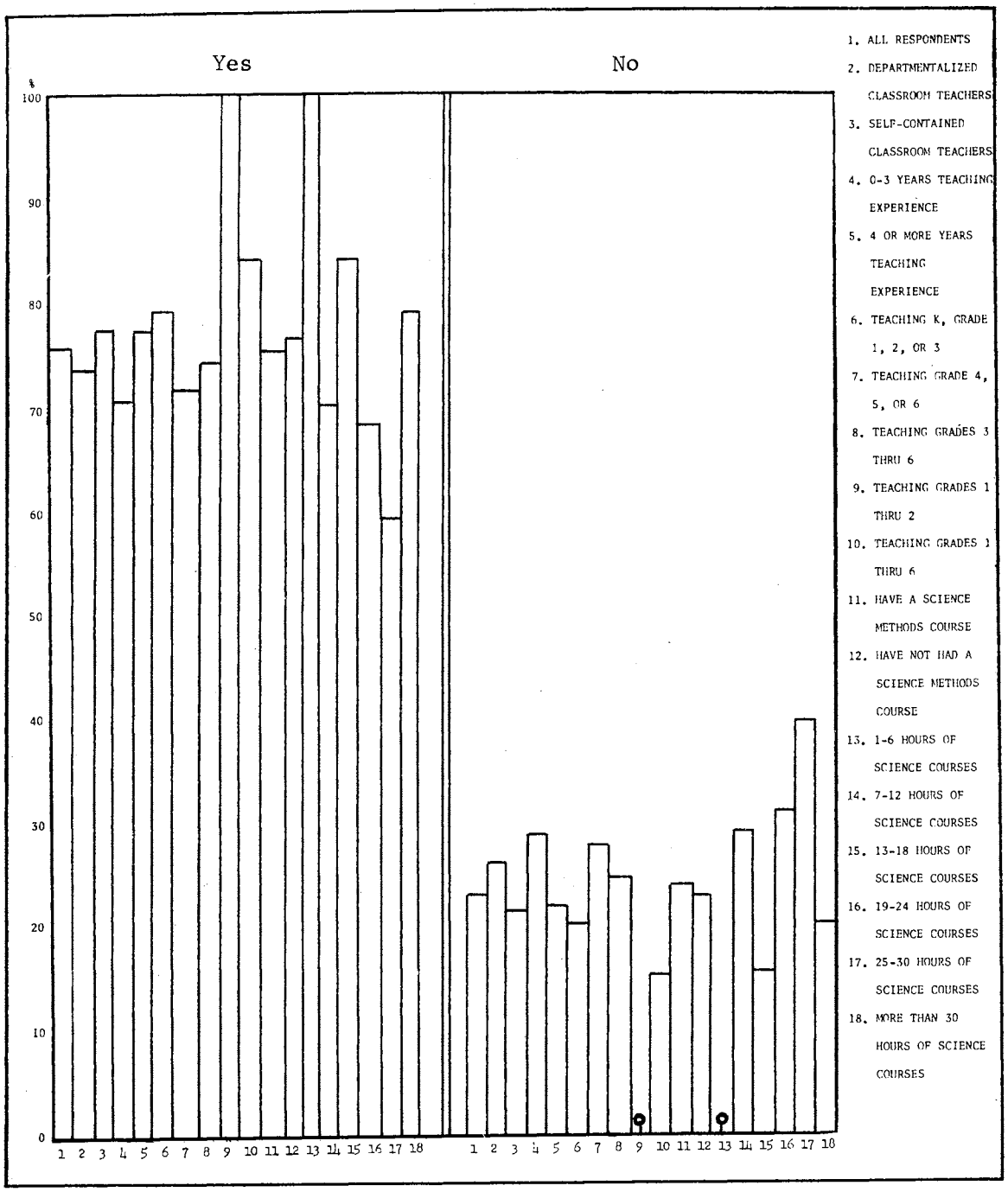

Figure 96. Workshop or Institute Did Provide Methods and Techniques for Teaching Science

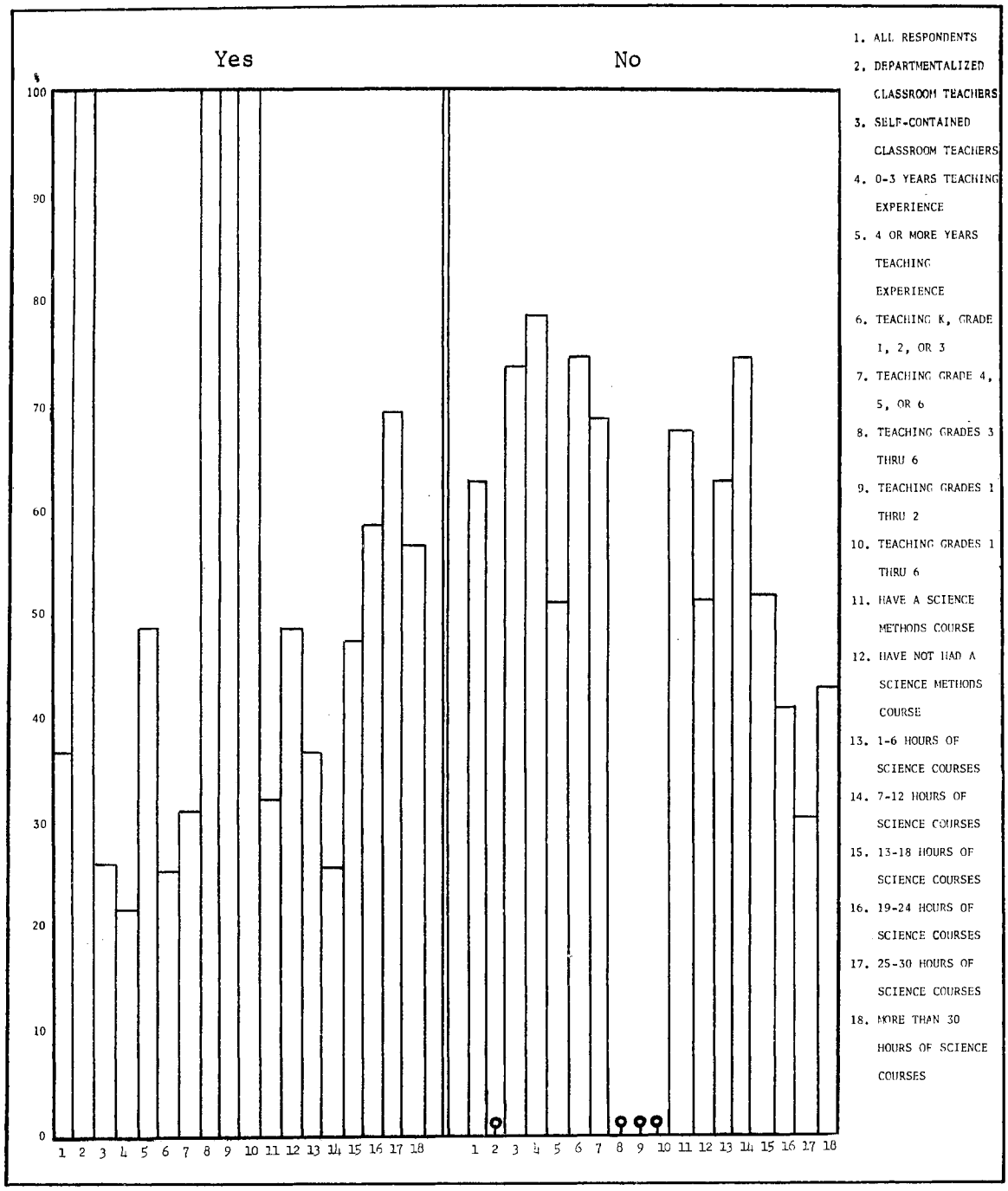

Figure 97. The Availability of the Services of a Science Supervisor

not have science supervisors. More of the teachers with fewer years of teaching experience indicate that they do not have science supervisors than do the teachers with more teaching experience. The primary grade teachers indicate a greater disagreement than do the intermediate grade teachers. The teachers of grades 3-6, 1-2, and 1-6 indicate that they all have science supervisors. The teachers with a methods course indicate a greater negative response than do those teachers without a methods course. The teachers with a smaller amount of science course work indicate disagreement, and the teachers with more science course work indicate an agreement with the statement.

The teachers were asked to respond to the statement that they increased the time that they devote to science teaching since the services of a science supervisor are available by a yes, no, or does not apply response. Figure 98 shows that most of the teachers did not have the services of a science supervisor available. The comparative analysis indicates considerable variation among the groups which responded with a yes or no. The departmentalized classroom teachers indicate agreement with the statement; the self-contained classroom teachers indicate disagreement. The experienced teachers indicate greater disagreement than do the inexperienced teachers. The intermediate grade teachers indicate greater disagreement than do the primary grade teachers. The teachers of grades 3-6 and 1-6 indicate agreement and the teachers of grades 1-2 indicate disagreement. The teachers without a methods course indicate greater disagreement than do the teachers with a methods course. The teachers with 1-6 and 25-30 hours of science course work indicate agreement and the other groups in this category indicate disagreement with the statement.

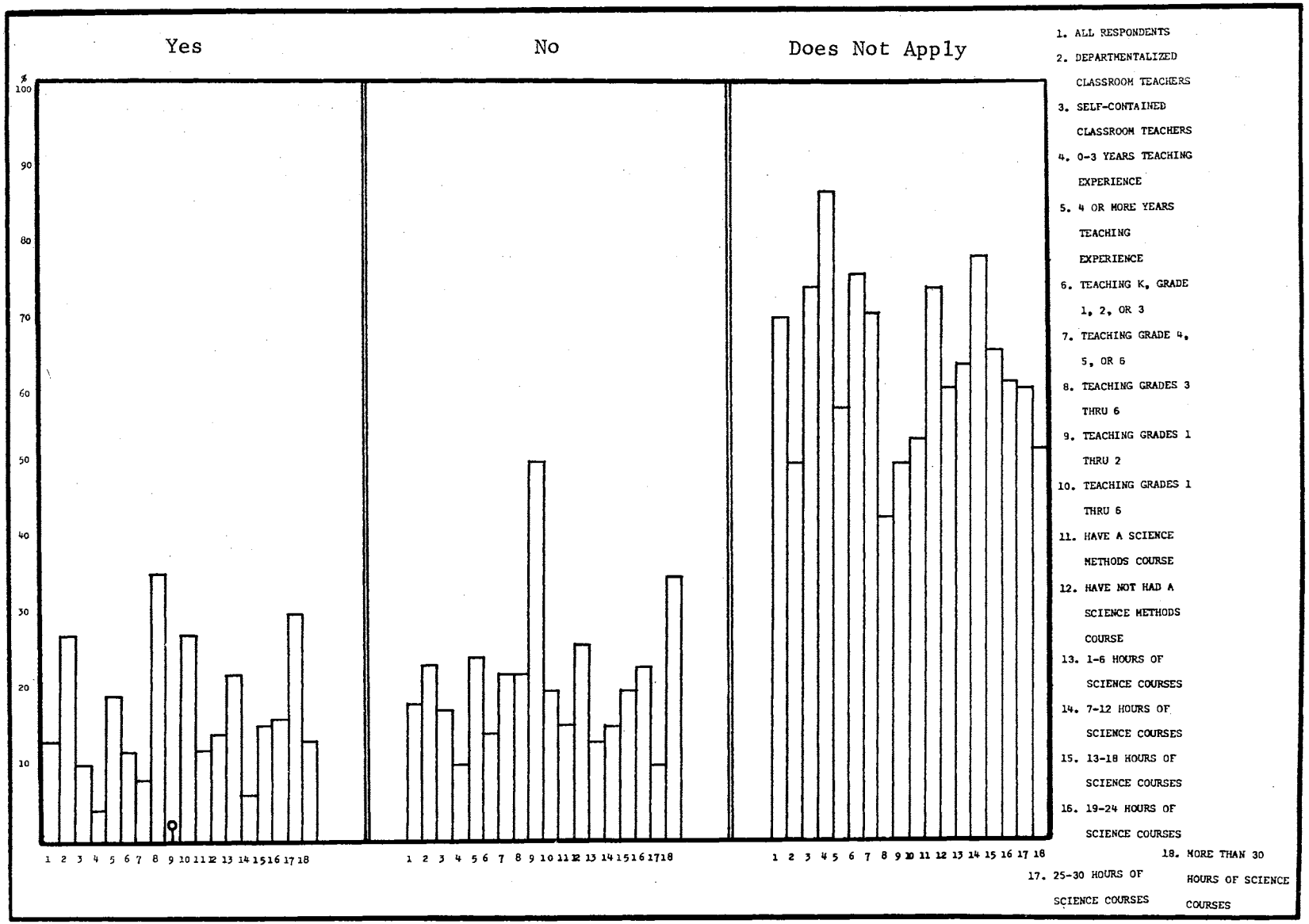

Figure 98. Increase in Time Devoted to Teaching Science Since the Services of a Science Supervisor Are Available

By means of the eight unfinished statements, the teachers were asked to express opinions on the services provided by a science supervisor. Everyone was asked to report what a science supervisor should probide. Only those teachers who had a science supervisor were asked to report what their science supervisor did provide.

The teachers indicate that a science supervisor should provide assistance in planning and organizing science teaching. This information is reported in Figure 99. The comparative analysis indicates that the only difference that occurs in the groups is a slight difference in the degree of agreement.

The teachers indicate that their science supervisor does provide assistance in planning and organizing science teaching. This information is shown in Figure 100. The comparative analysis indicates that the differences that occur among the groups are in the degree of agreement. The departmentalized classroom teachers, the experienced teachers, the primary grade teachers and the teachers of grades 3-6, the teachers without a science methods course, and the teachers with more than 30 hours and 13-18 hours of science course work indicate a greater degree of agreement than do their comparative groups.

The teachers indicate that a science supervisor should provide subject-matter content for science teaching. This information is reported in Figure 101. The comparative analysis indicates that the differences that occur among the groups are in the degree of agreement. The departmentalized classroom teachers, the experienced teachers, the primary grade teachers and the teachers of grades 1-2, the teachers without a methods course and the teachers with 25-30 hours of science course work indicate greater agreement with the statement than do their

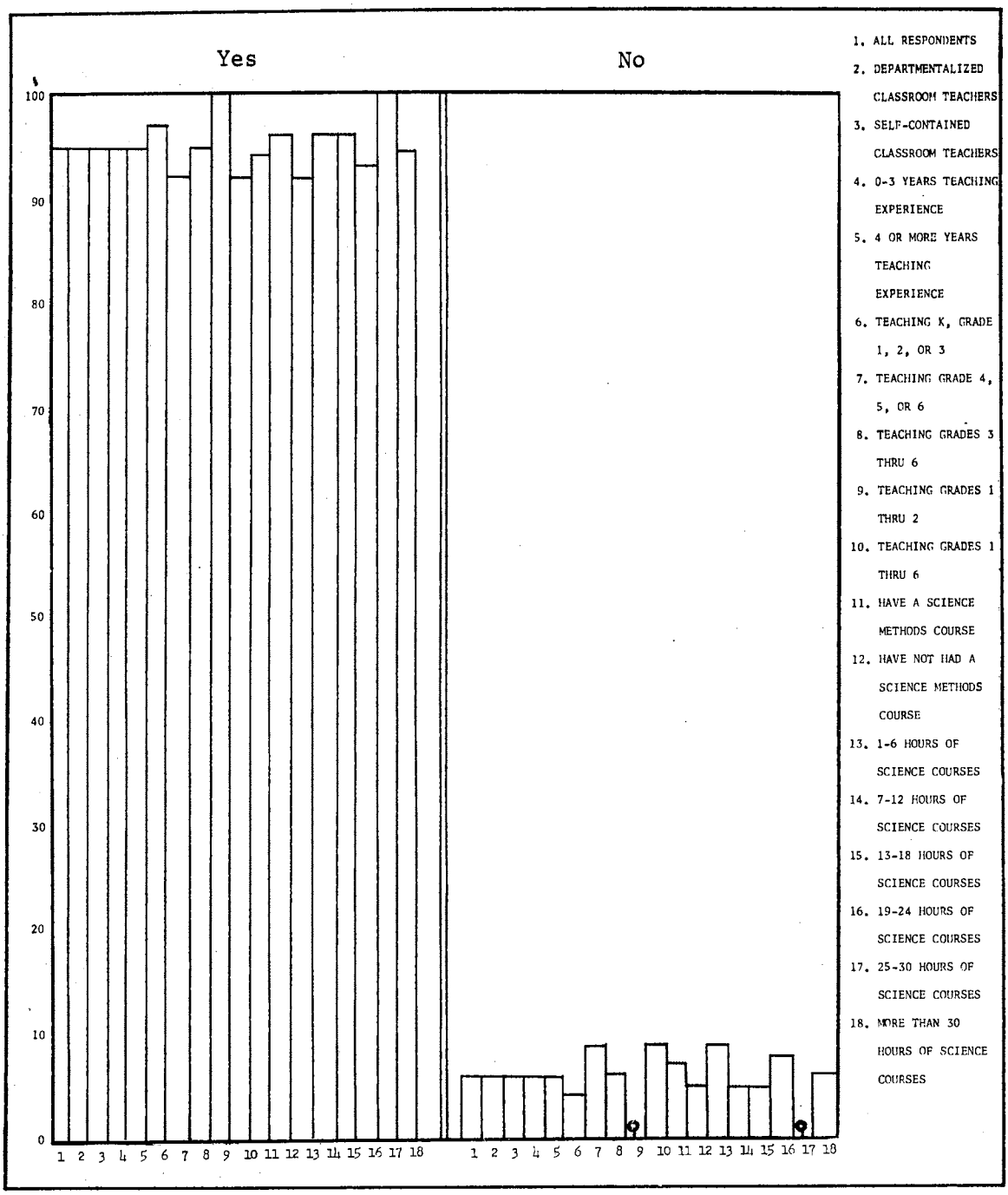

Figure 99. Science Supervisors Should Provide Assistance in Planning and Organizing Science Teaching

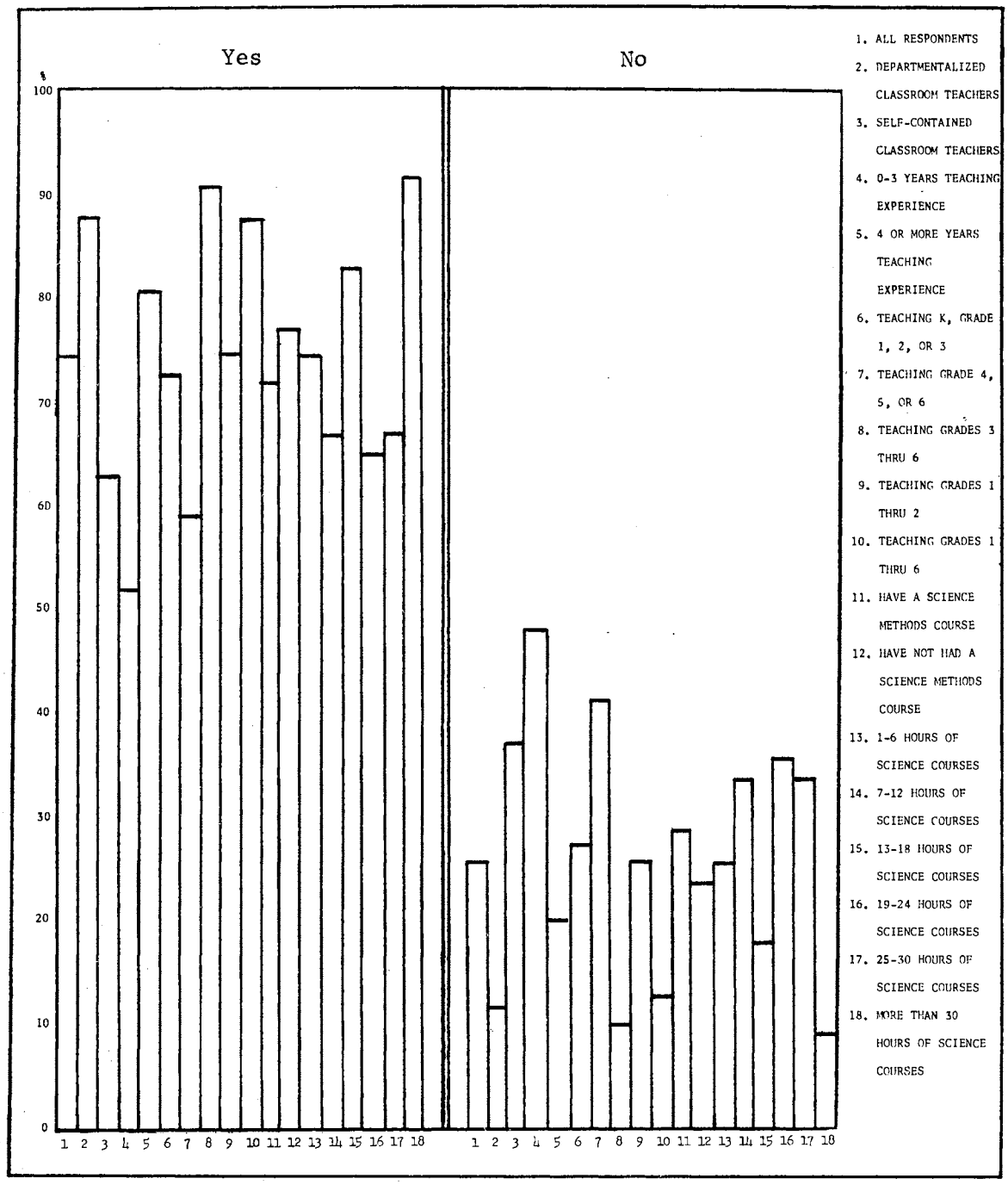

Figure 100. Science Supervisors Did Provide Assistance in Planning and Organizing Science Teaching

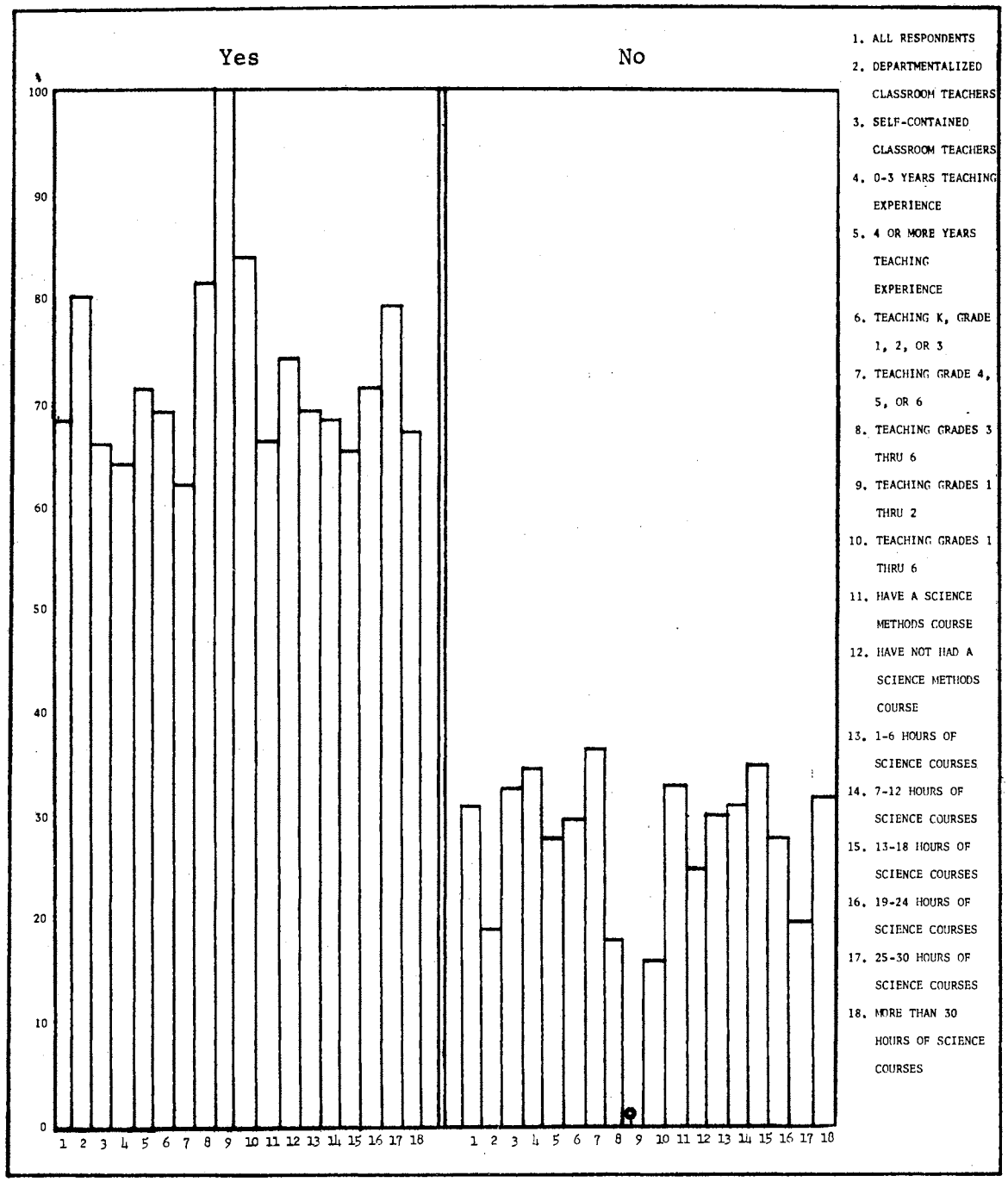

Figure 101. Science Supervisors Should Provide Subject Matter Content for Teaching Science

comparative groups.

The teachers indicate that their science supervisor does provide subject-matter content for science teaching. This information is reported in Figure 102. The comparative analysis indicates that the differences that occur among the groups are in the degree of agreement. The departmentalized classroom teachers, the experienced teachers, the primary grade teachers and the teachers of grades 1-2, the teachers with a science methods course, and the teachers with 1-6 and more than 30 hours of science course work indicate a greater agreement with the statement.

The teachers indicate that a science supervisor should provide an understanding of experimentation and demonstration for science teaching. This information is reported in Figure 103. The comparative analysis indicates that in general the only difference that occurs among the groups is a slight difference in the degree of agreement. Exceptions to this generalization are the teachers of grades 3-6, who indicate a strong agreement with the statement, the teachers of grades 1-2, who indicate a slight agreement with the statement, the teachers with 13-18 hours of science course work, who indicate a strong agreement with the statement, and the teachers with more than 30 hours of science course work, who indicate a smaller amount of agreement with the statement.

The teachers indicate that their science supervisor did provide an understanding of experimentation and demonstration for science teaching. This information is provided in Figure 104. The comparative analysis indicates an agreement with the statement by all groups with the degree of agreement the only difference among the groups. The self-contained classroom teachers, the experienced teachers, the primary grade teachers, the teachers of grades 3-6 and 1-6, and the teachers with 1-6 hours of

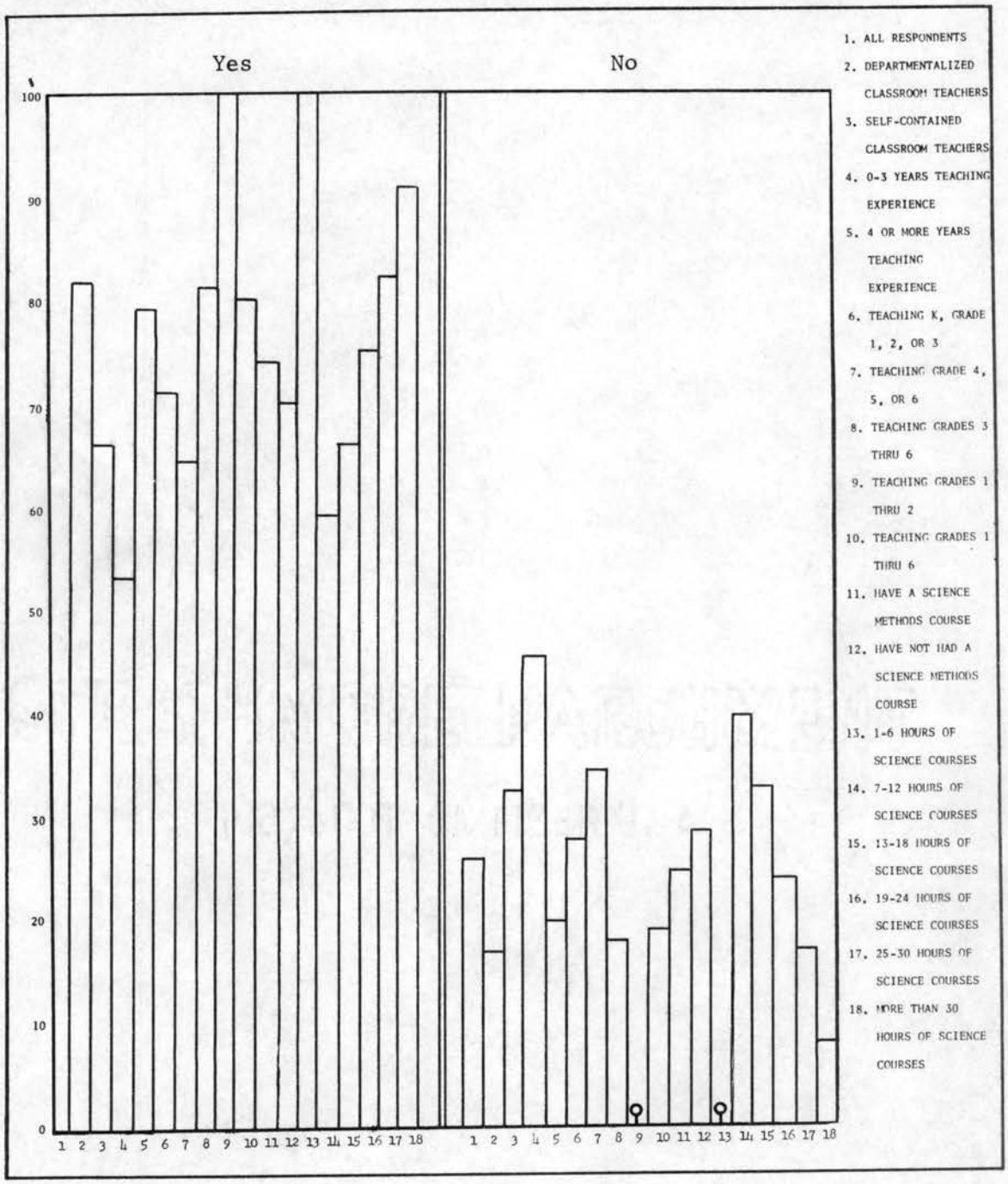

Figure 102. Science Supervisors Did Provide Subject Matter Content for Teaching Science

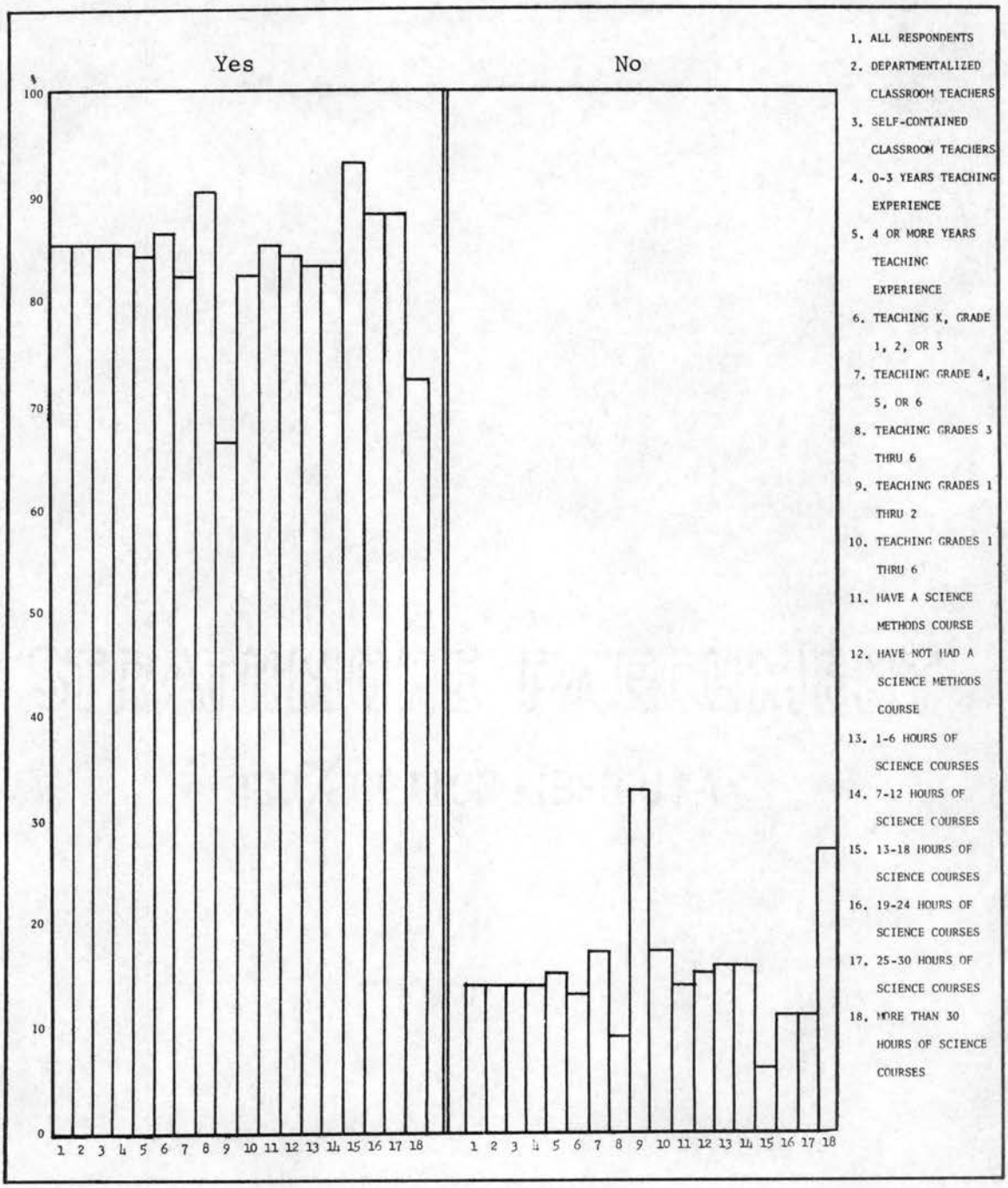

Figure 103. Science Supervisors Should Provide an Understanding of Experimentation and Demonstration

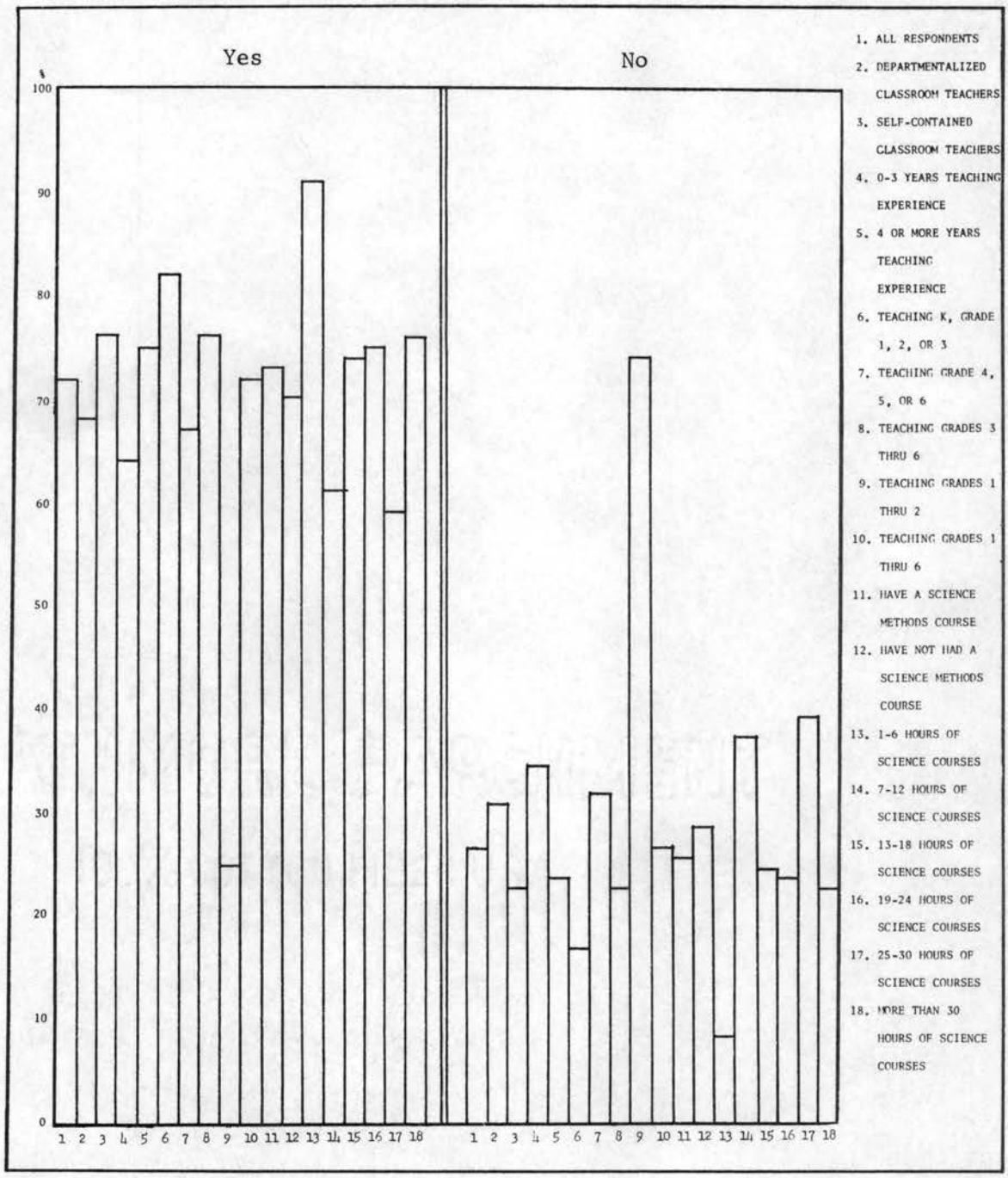

Figure 104. Science Supervisor Does Provide an Understanding of Experimentation and Demonstration

science course work indicate greater agreement with the statement.

The teachers indicate that a science supervisor should provide a feeling of security in science teaching. This information is reported in Figure 105. The comparative analysis indicates that the only difference among the groups is in the degree of agreement. The teachers of grades 1-2, 1-6 and the teachers with 25-30 hours of science course work indicate a greater agreement than do their comparative groups.

The teachers indicate that their science supervisor does provide a feeling of security in science teaching. Figure 106 illustrates this information. The comparative analysis indicates that the differences that occur among the groups are in the degree of agreement with the statement. The departmentalized classroom teachers, the experienced teachers, the primary grade teachers, the teachers of grades 3-6, the teachers with a science methods course and the teachers with 25-30 hours of science course work indicate a greater agreement with the statement than do their comparative groups.

The teachers indicate that a science supervisor should provide an idea of what should be taught at various grade levels. Figure 107 reports this information. The comparative analysis indicates that the differences that occur among the groups are in the degree of agreement with the statement. The departmentalized classroom teachers, the experienced teachers, the primary grade teachers, the teachers of grades 1-2, 3-6, and 1-6, the teachers without a methods course and the teachers with 25-30 hours all indicate a greater agreement with the statement than do their comparative groups.

The teachers indicate that their science supervisor does provide an idea of what should be taught at various grade levels. Figure 108 reports

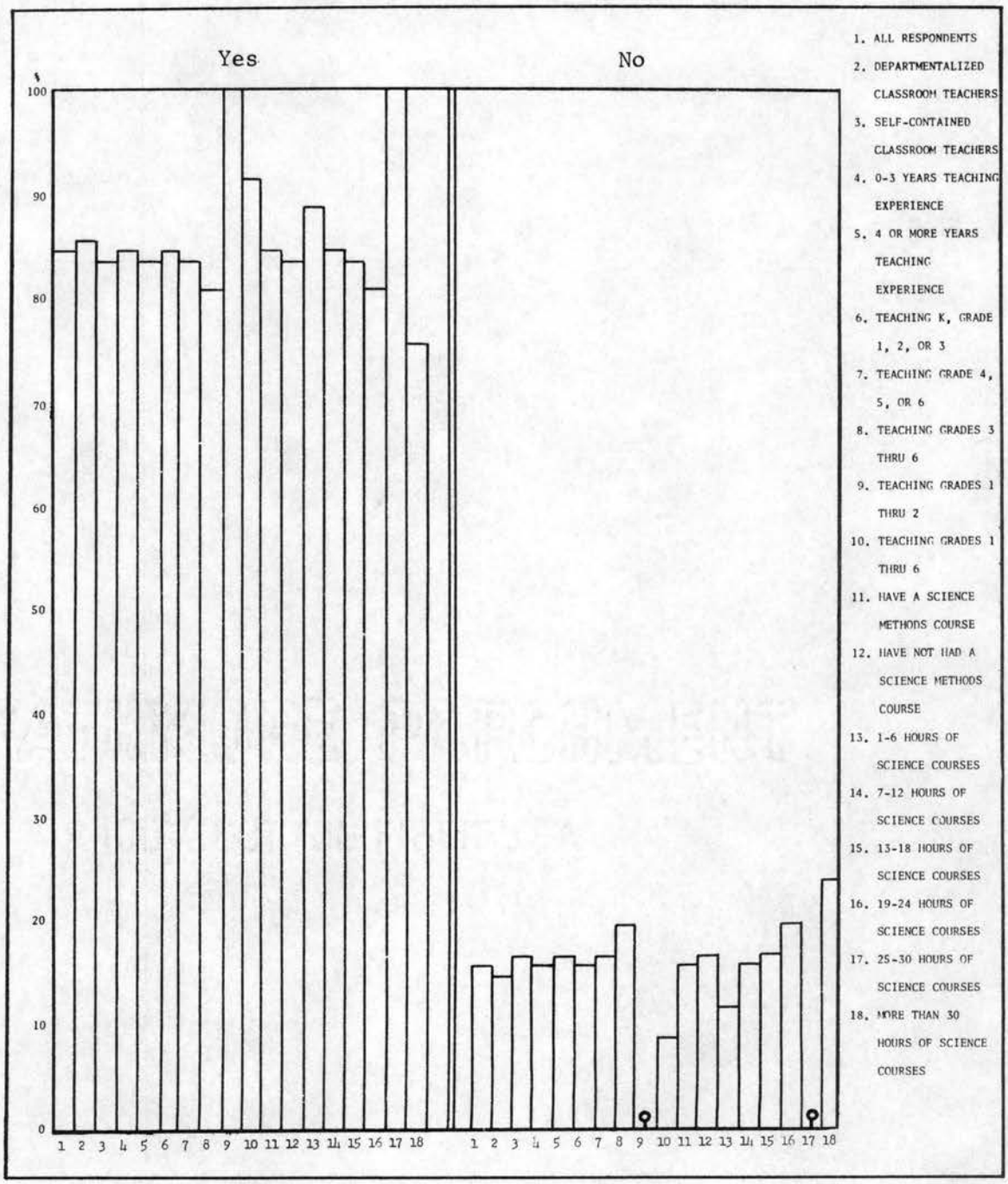

Figure 105. Science Supervisor Should Provide a Feeling of Security in Teaching Science

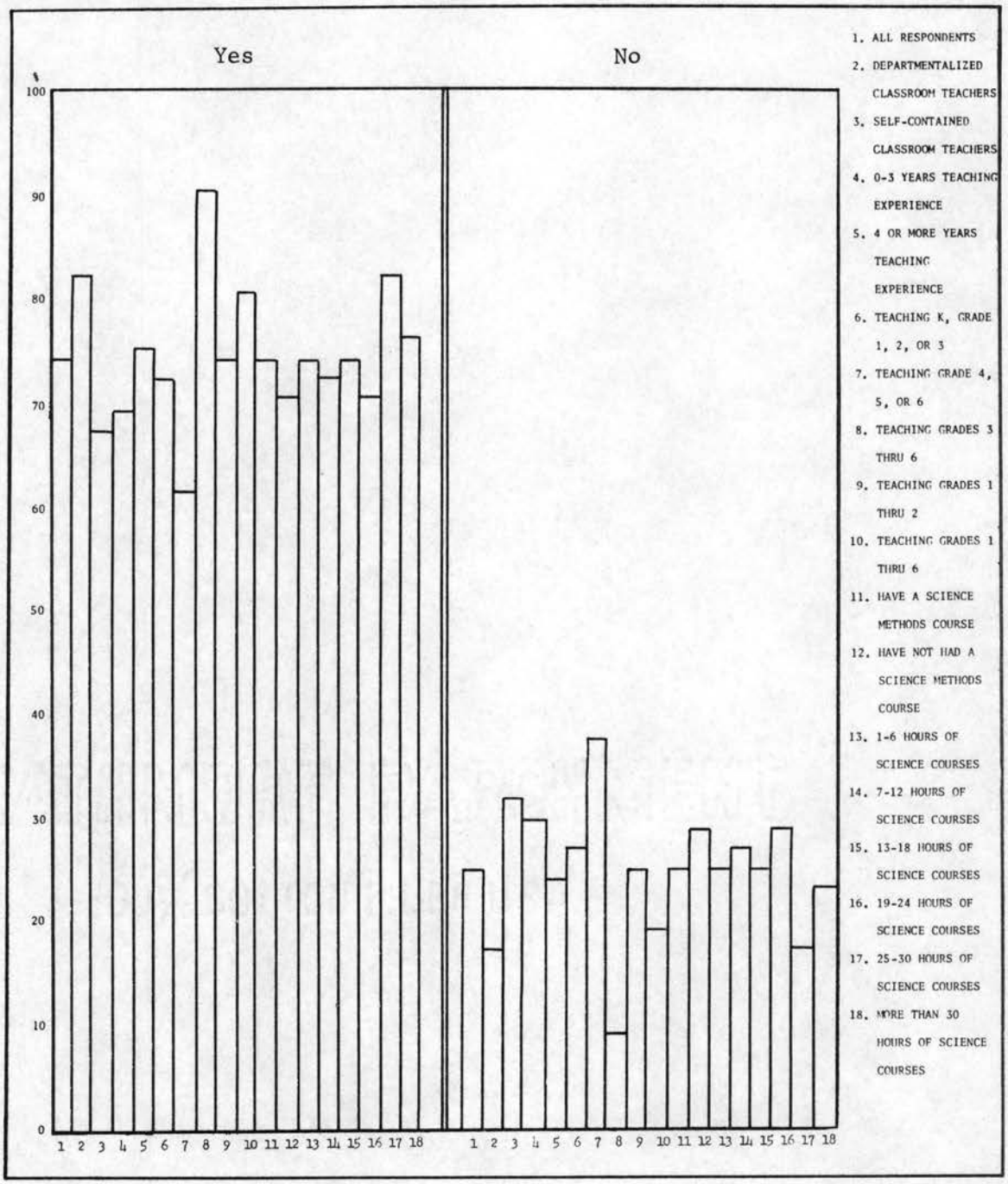

Figure 106. Science Supervisor Does Provide a Feeling of Security in Teaching Science

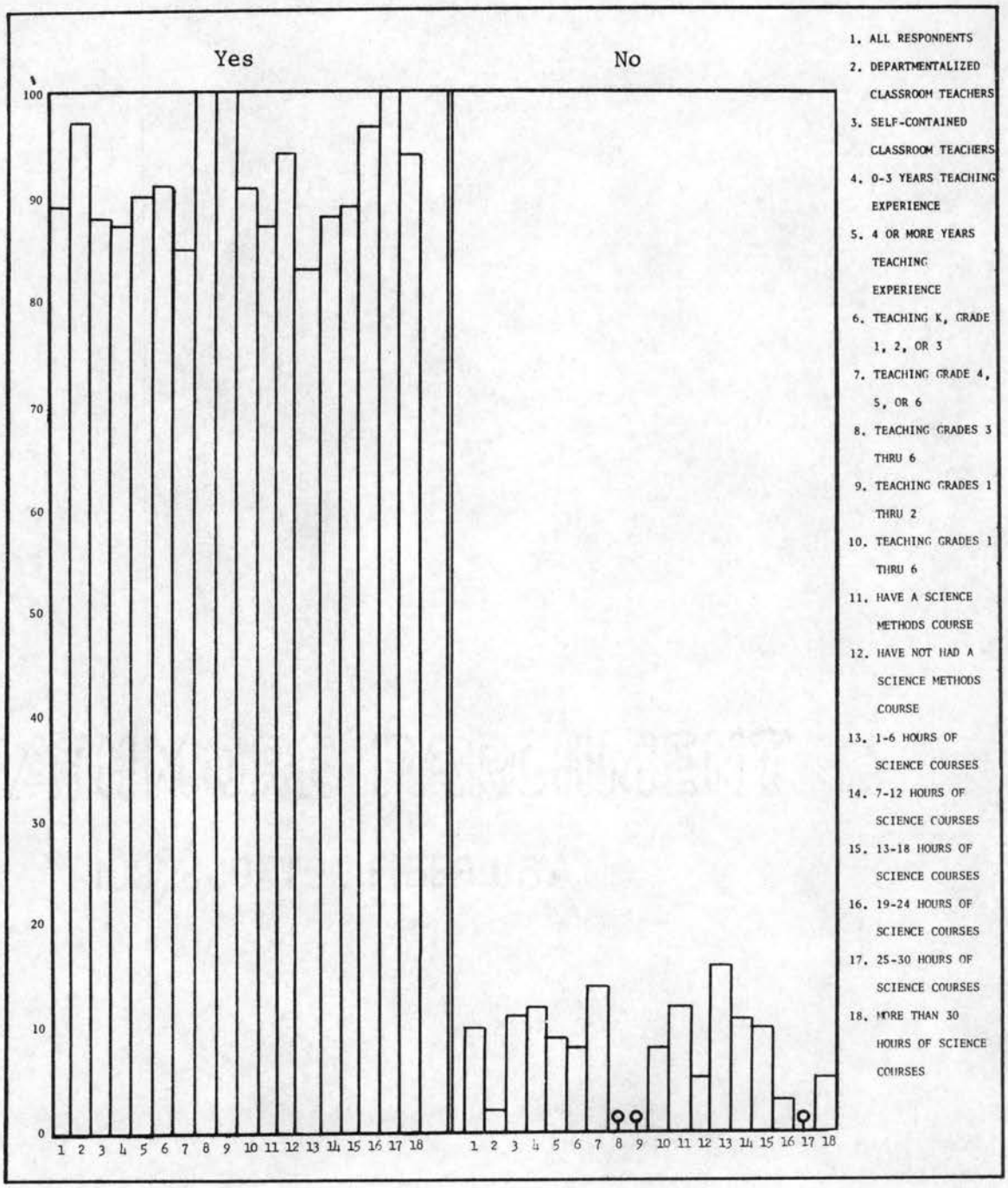

Figure 107. Science Supervisor Should Provide an Idea of What Should Be Taught at Various Grade Levels

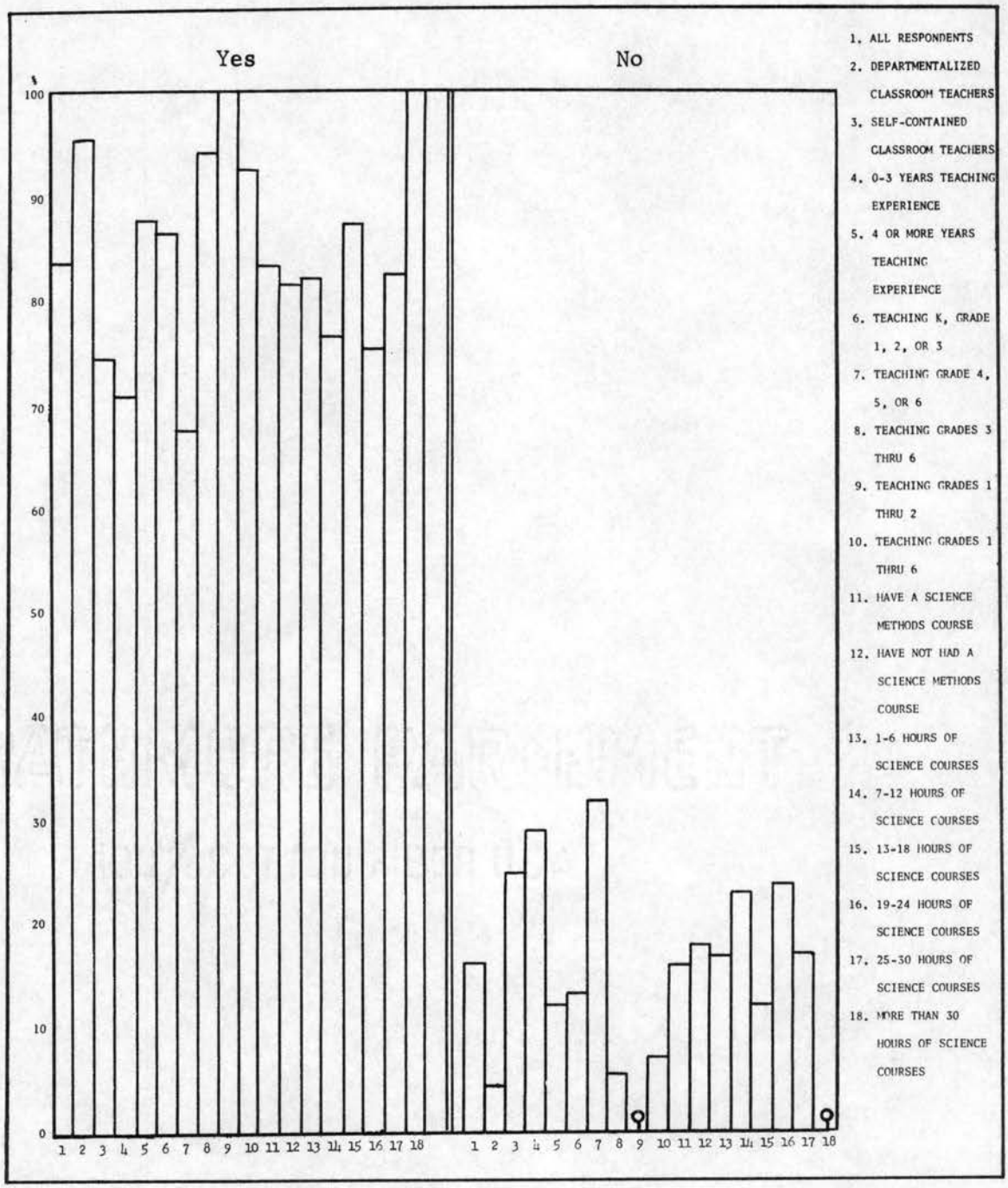

Figure 108. Science Supervisor Does Provide an Idea of What Should Be Taught at Various Grade Levels

this information. The comparative analysis indicates that the difference that occurs among the groups is in the degree of agreement with the statement. The departmentalized classroom teachers, the experienced teachers, the primary grade teachers, the teachers of grades 1-2, the teachers with a methods course, and the teachers with more than 30 hours of science course work indicate greater agreement with the statement than do their comparative groups.

The teachers indicate that a science supervisor should provide a greater interest in science teaching. Figure 109 reports this information. The comparative analysis indicates that the differences that occur among the groups are in the degree of agreement with the statement. The teachers with a methods course, the teachers of grades 3-6, and the teachers with 25-30 hours of science course work indicate a greater degree of agreement with the statement than do their comparative groups.

The teachers indicate that their science supervisor does provide a greater interest in science teaching. Figure 110 reports this information. The comparative analysis indicates that the differences that occur among the groups are in the degree of agreement with the statement. The departmentalized classroom teachers, the experienced teachers, the primary grade teachers, the teachers of grades 1-6 and 3-6, and the teachers with 1-6 hours of science course work indicate a greater agreement with the statement than do their comparative groups.

The teachers indicate that a science supervisor should provide units and materials necessary to teach science. Figure 111 reports this information. The comparative analysis indicates that the differences that occur among the groups are in the degree of agreement with the statement. The departmentalized classroom teachers, the experienced teachers, the

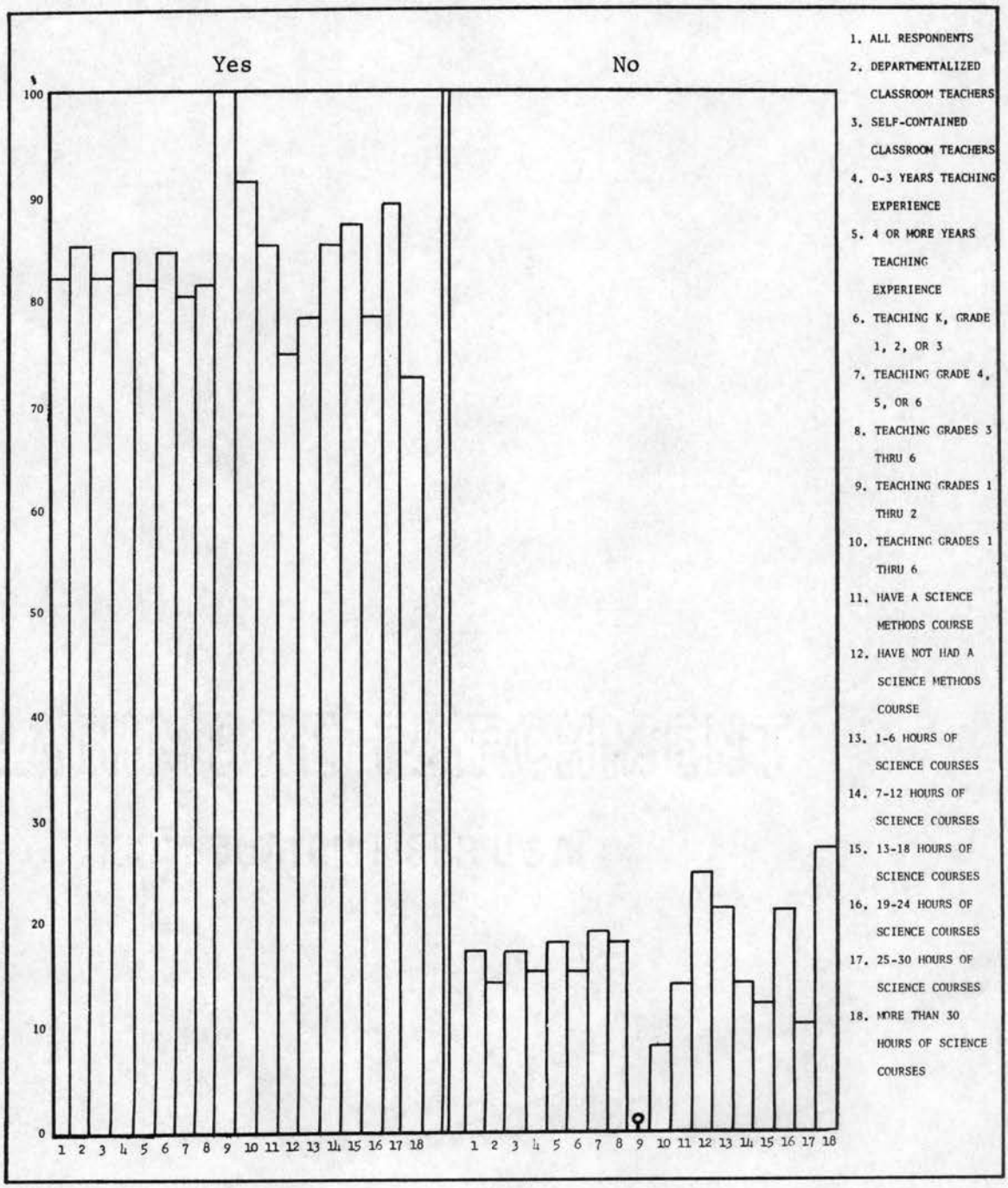

Figure 109. Science Supervisor Should Provide a Greater Interest in Teaching Science

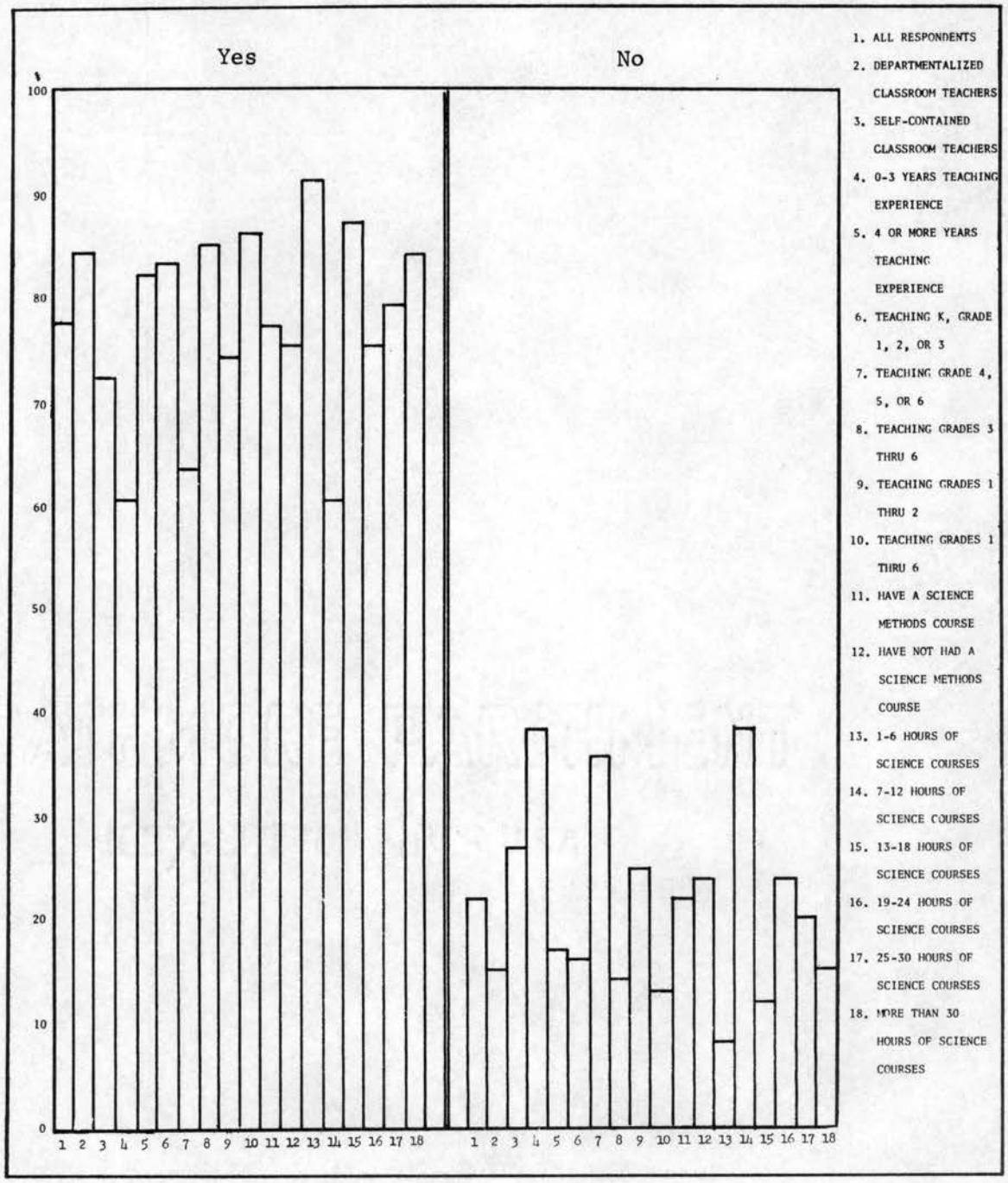

Figure 110. Science Supervisor Does Provide a Greater Interest in Teaching Science

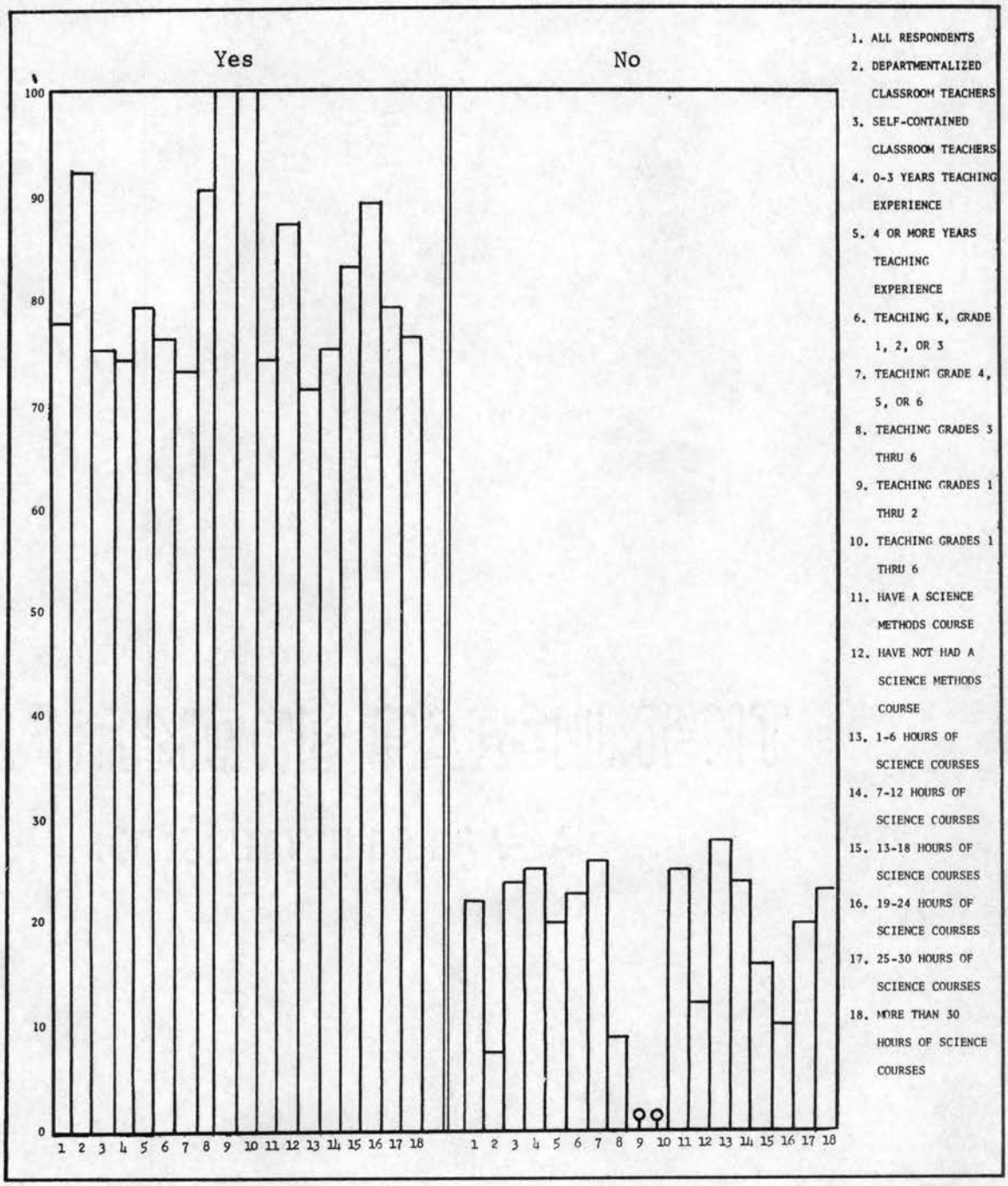

Figure 111. Science Supervisor Should Provide Units and Materials for Science Teaching

teachers of grades 1-2 and 1-6, the teachers without a science methods course and the teachers with 19-24 hours of science course work indicate greater agreement than do their comparative groups.

The teachers indicate that their science supervisor does provide units and materials necessary to teach science. Figure 112 indicates this response. The comparative analysis shows that the differences that occur among the groups, with the exception of the inexperienced teachers who indicate a slight negative response, are in the degree of agreement with the statement. The departmentalized classroom teachers, the experienced teachers, the primary grade teachers, the teachers of grades 1-2, the teachers without a methods course, and the teachers with 25-30 or more than 30 hours of science course work indicate greater agreement with the statement than do their comparative groups.

The teachers indicate that a science supervisor should provide methods and techniques necessary to teach science. Figure 113 reports this information. The comparative analysis indicates that in general the differences that occur among the groups, with the exception of the teachers of grades 1-2 who indicate a negative response, are in the degree of agreement with the statement. The teachers of grades 1-6 and the teachers with 1-6 hours and more than 30 hours of science course work indicate less agreement than do their comparative groups.

The teachers indicate that their science supervisor does provide methods and techniques necessary to teach science. Figure 114 reports this information. The comparative analysis indicates that in general the differences that occur among the groups, with the exception of the teachers who teach 1-2 and the inexperienced teachers who indicate a negative response, are in the degree of agreement. The departmentalized

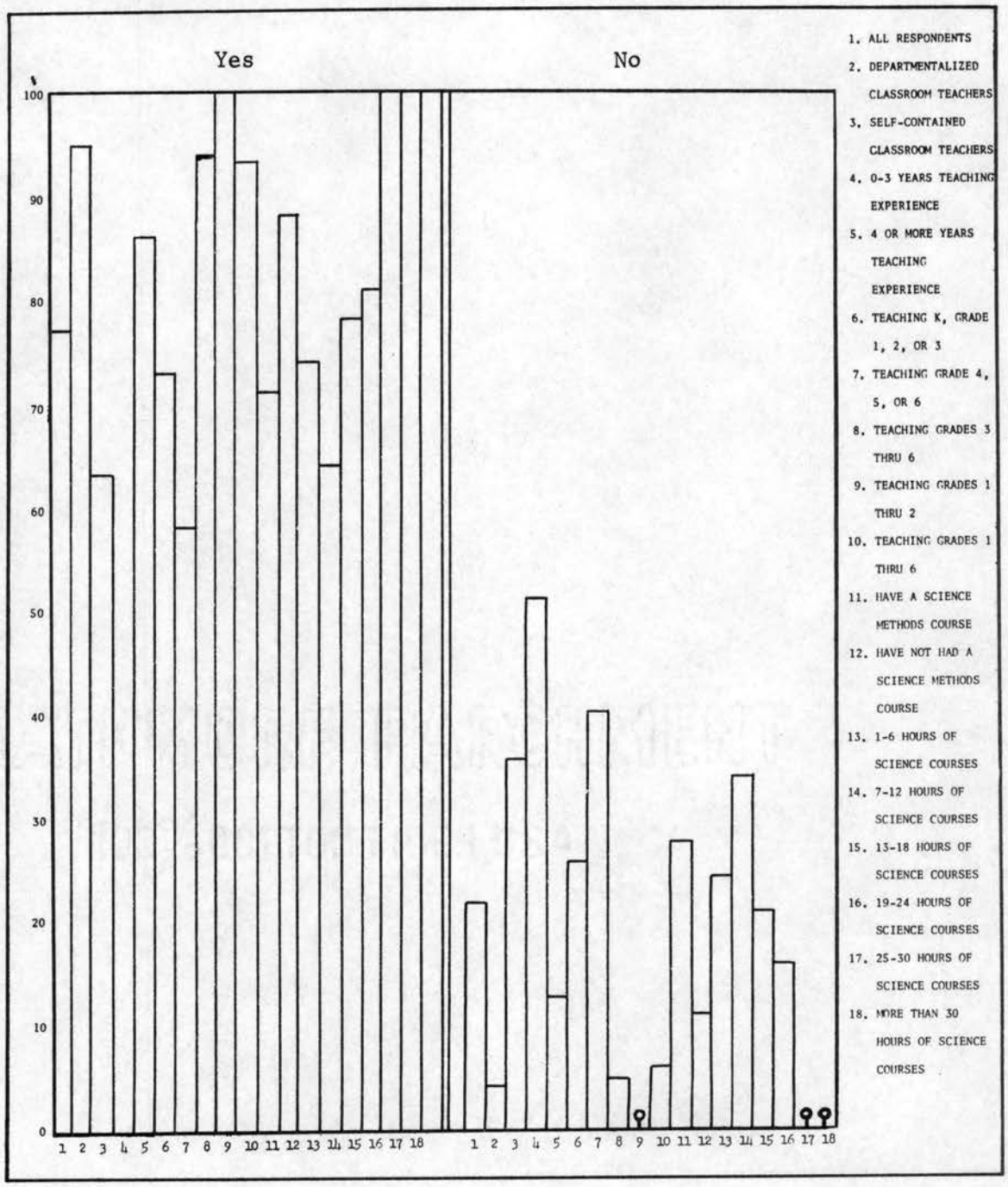

Figure 112. Science Supervisor Does Provide Units and Materials for Teaching Science

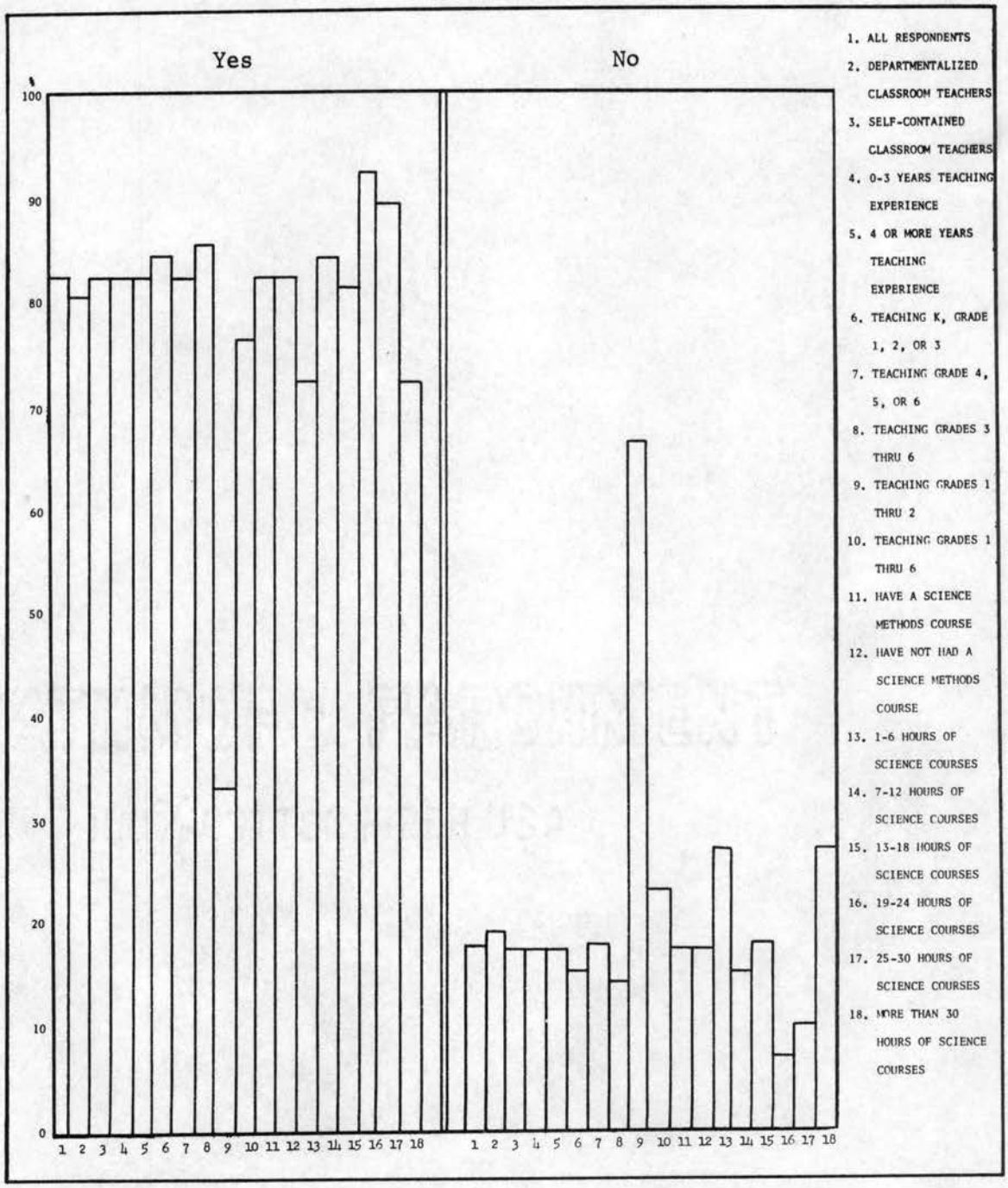

Figure 113. Science Supervisor Should Provide Methods and Techniques for Teaching Science

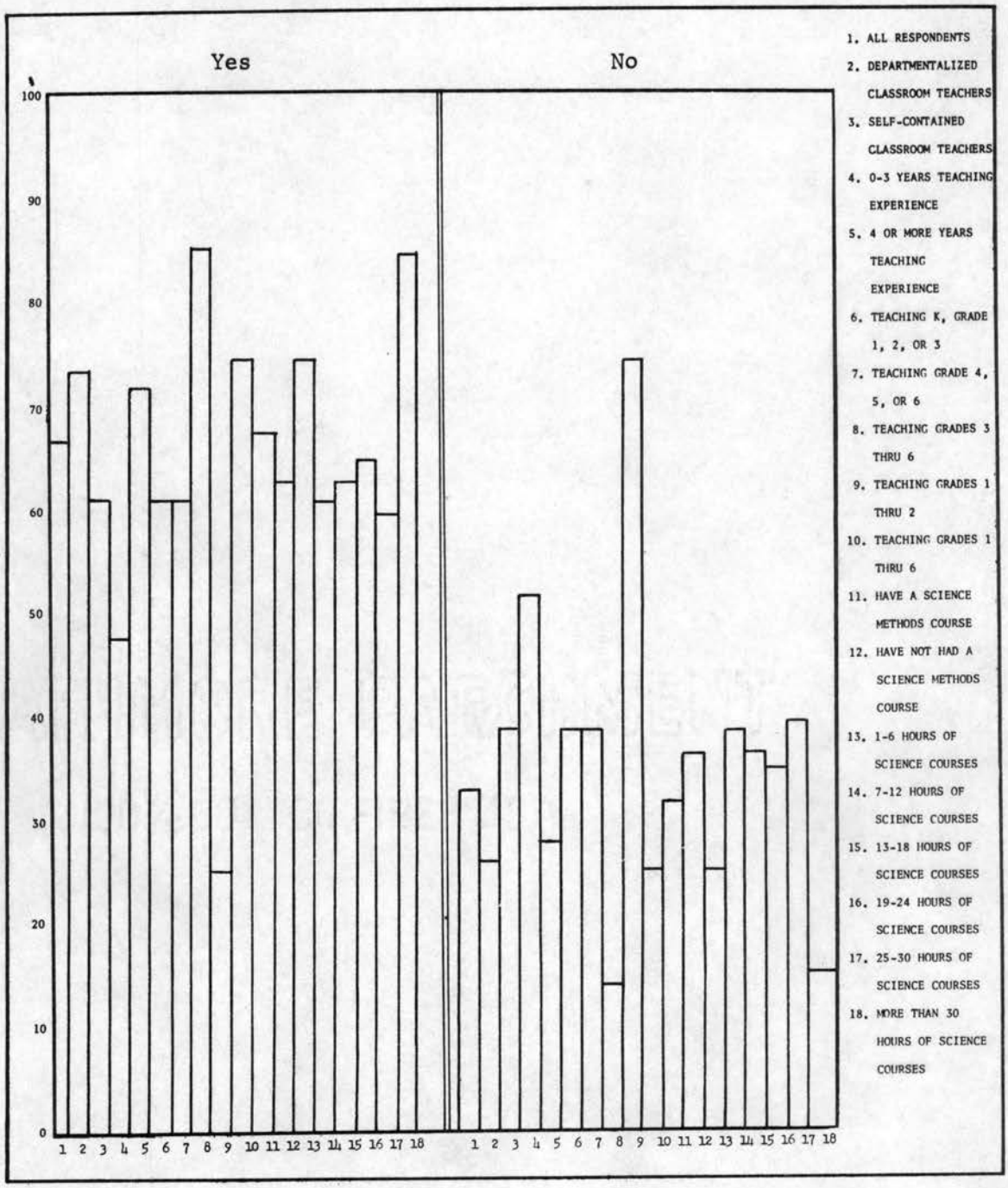

Figure 114. Science Supervisor Does Provide Methods and Techniques for Teaching Science

classroom teachers, the experienced teachers, the teachers of grades 3-6, the teachers with a science methods course and the teachers with more than 30 hours of science course work indicate a greater degree of agreement with the statement than do their comparative groups.

Contributions of Methods Courses to Teaching Elementary Science

The teachers were asked to report participation in a science methods course by a yes or no response. The information illustrated in Figure 115 indicates that most of the respondents have participated in a science methods course. The comparative analysis indicates that in general the differences among the groups, with the exception of the teachers with 1-6 hours of science course work, are in the degree of agreement with the statement. The self-contained classroom teachers, the inexperienced teachers, and the teachers of grades 1-2 indicate greater agreement than their comparative groups. The teachers with 19-24 hours of course work indicate a smaller amount of agreement than do their comparative groups.

The teachers were asked to report the level of their methods course by indicating undergraduate, graduate, or both. Figure 116 reports this information and indicates that most of the teachers had their methods course at the undergraduate level. The comparative analysis indicates that the differences that occur among the groups are in the number indicating that they had their methods course on the undergraduate level. The self-contained classroom teachers, the inexperienced teachers, the primary grade teachers and the teachers with 13-18 and 19-24 hours indicate a greater degree of participation in a science methods course on the undergraduate level than do their comparative groups.

The comparative analysis indicates that the departmentalized teachers

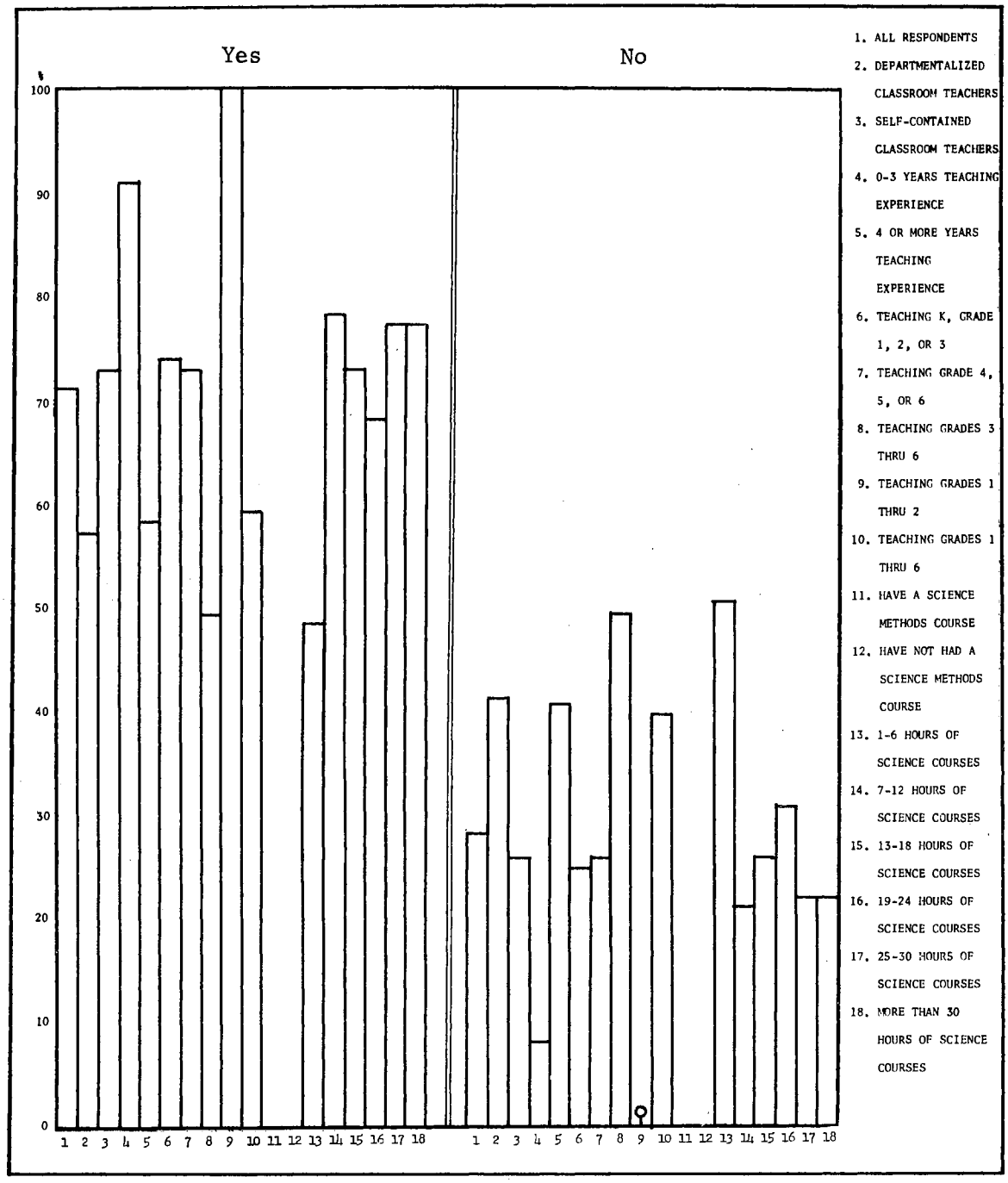

Figure 115. Participation in a Science Methods Course

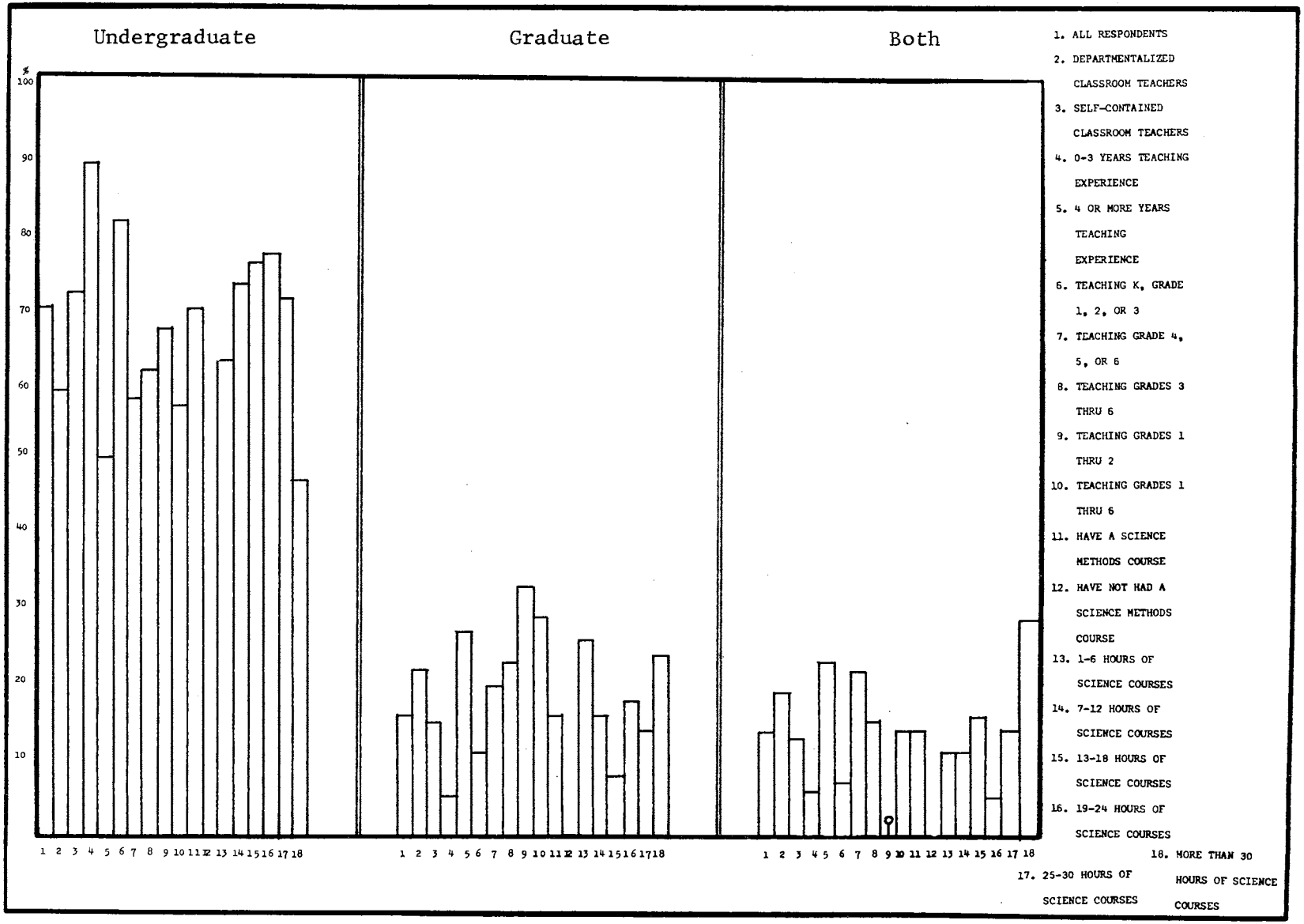

Figure 116. Academic Level of Science Methods Course

indicate more teachers in both the graduate and both categories than do the self-contained classroom teachers. The experienced teachers indicate more teachers in the graduate and both categories than do the inexperienced teachers. The primary grade teachers indicate more teachers in the graduate category, and the intermediate grade teachers indicate more teachers in the both category. The teachers of grades 3-6 indicate more teachers in the both category; the teachers of grades 1-2 indicate more teachers in the graduate category. The teachers with 1-6 hours of science course work indicate more teachers in the graduate category, and the teachers with more than 30 hours of science course work indicate more teachers in the both category.

As is illustrated in Figure 117, the teachers indicate that their methods course influenced the time that they devote to science teaching. The comparative analysis indicates that most of the groups, with the exception of the teachers of grades 1-2, and 1-6 and the teachers with more than 30 hours of science course work, felt that their science methods course influenced the time that they devote to science teaching. The self-contained classroom teachers, the inexperienced teachers, and those teachers with 7-12 hours of science course work indicate a greater agreement than do their comparative groups.

All of the teachers were asked to express their opinions as to what a science methods course should do. The teachers who had a science methods course were asked to express their opinions as to what the science methods course did.

The teachers indicate that a science methods course should provide assistance in planning and organizing science teaching. This information is reported in Figure 118. The comparative analysis indicates that the

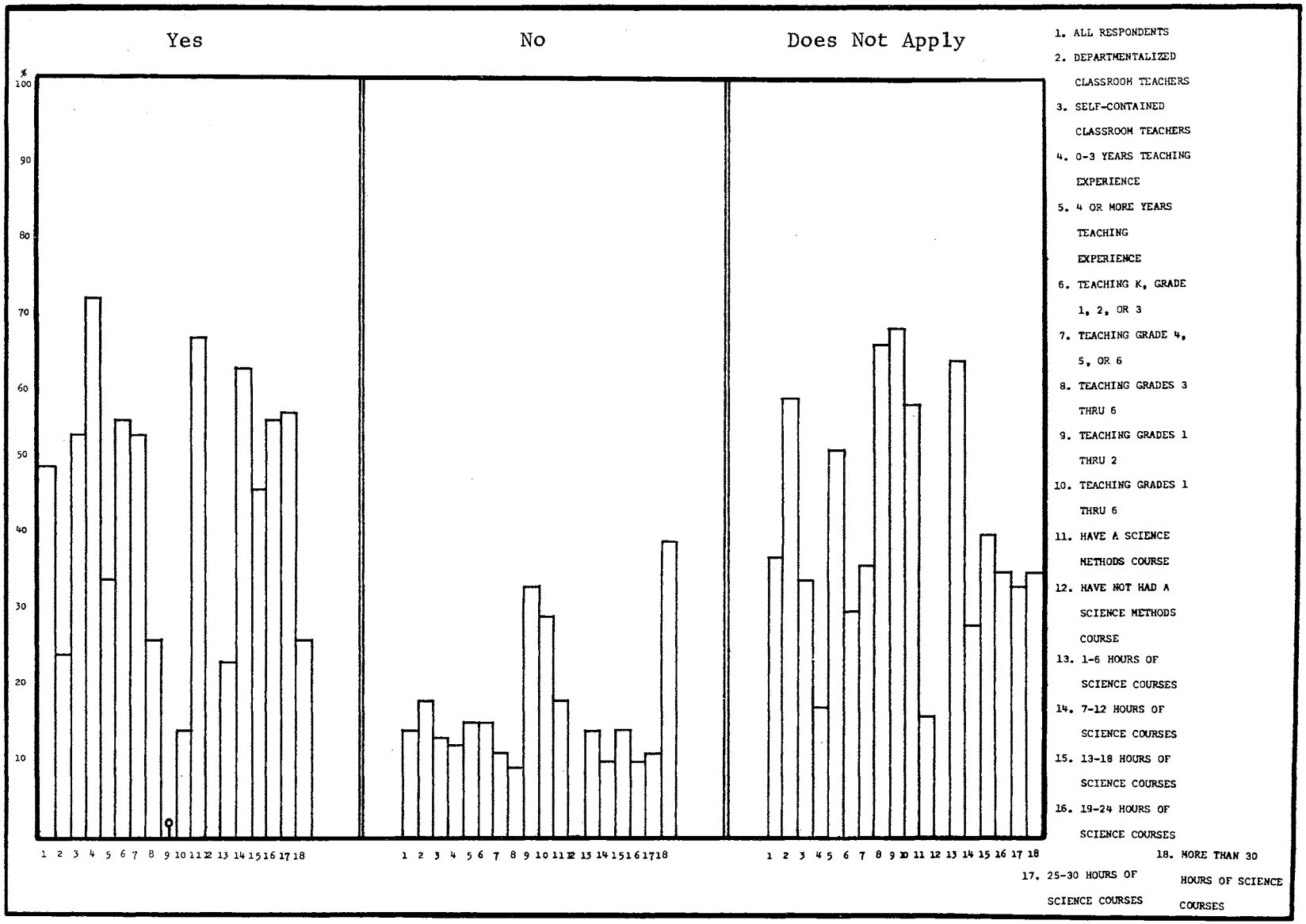

Figure 117. Science Methods Course Influenced Time Devoted to Teaching Science

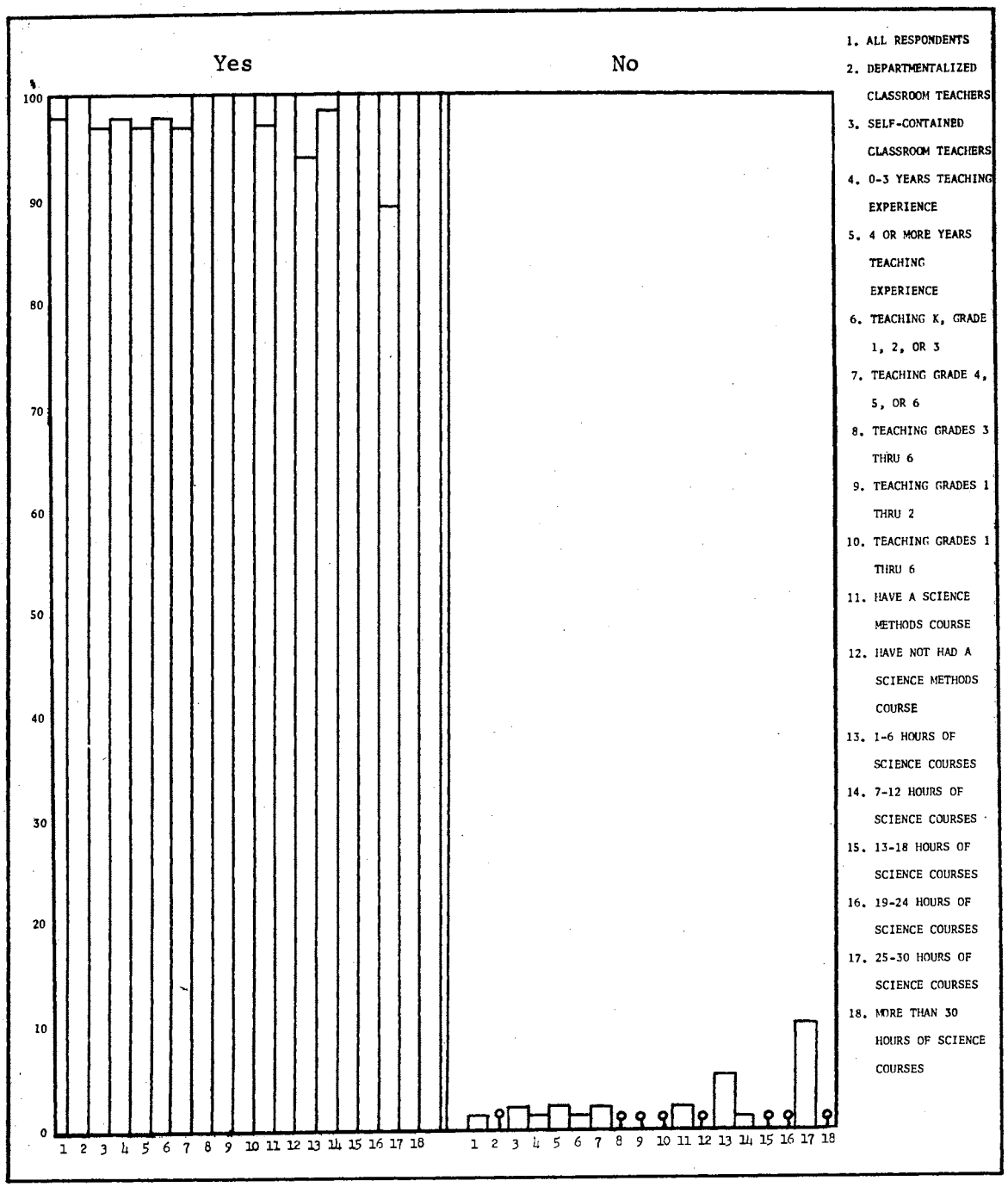

Figure 118. Science Methods Course Should Provide Assistance in Planning and Organizing Science Teaching

differences that occur among the groups are in the degree of agreement with the statement. The groups with least agreement are the teachers with 25-20 and 1-6 hours of science course work.

The teachers indicate that their methods course did provide assistance in planning and organizing science teaching. This information is reported in Figure 119. The comparative analysis indicates that the differences that occur among the groups are in the degree of agreement with the statement. The self-contained classroom teachers, the inexperienced teachers, the intermediate grade teachers, the teachers of grades 3-6, and the teachers with 25-30 hours of science course work indicate greater agreement with the statement than do their comparative groups.

The teachers indicate that a science methods course should provide subject-matter content for science teaching. This information is provided in Figure 120. The comparative analysis indicates that the differences that occur among the groups are in the degree of agreement with the statement. The experienced classroom teachers, the teachers of grades 1-6, and the teachers with 1-6 and 13-18 hours of science course work indicate greater agreement than do their comparative groups.

The teachers indicate that their science methods course did provide subject-matter content for science teaching. This information is reported in Figure 121. The comparative analysis indicates that the differences that occur among the groups are in the degree of agreement with the statement. The departmentalized classroom teachers, the experienced teachers, the primary grade teachers, the teachers of grades 1-6, and the teachers with 1-6 hours of science course work indicate greater agreement than do their comparative groups.

The teachers indicate that a science methods course should provide

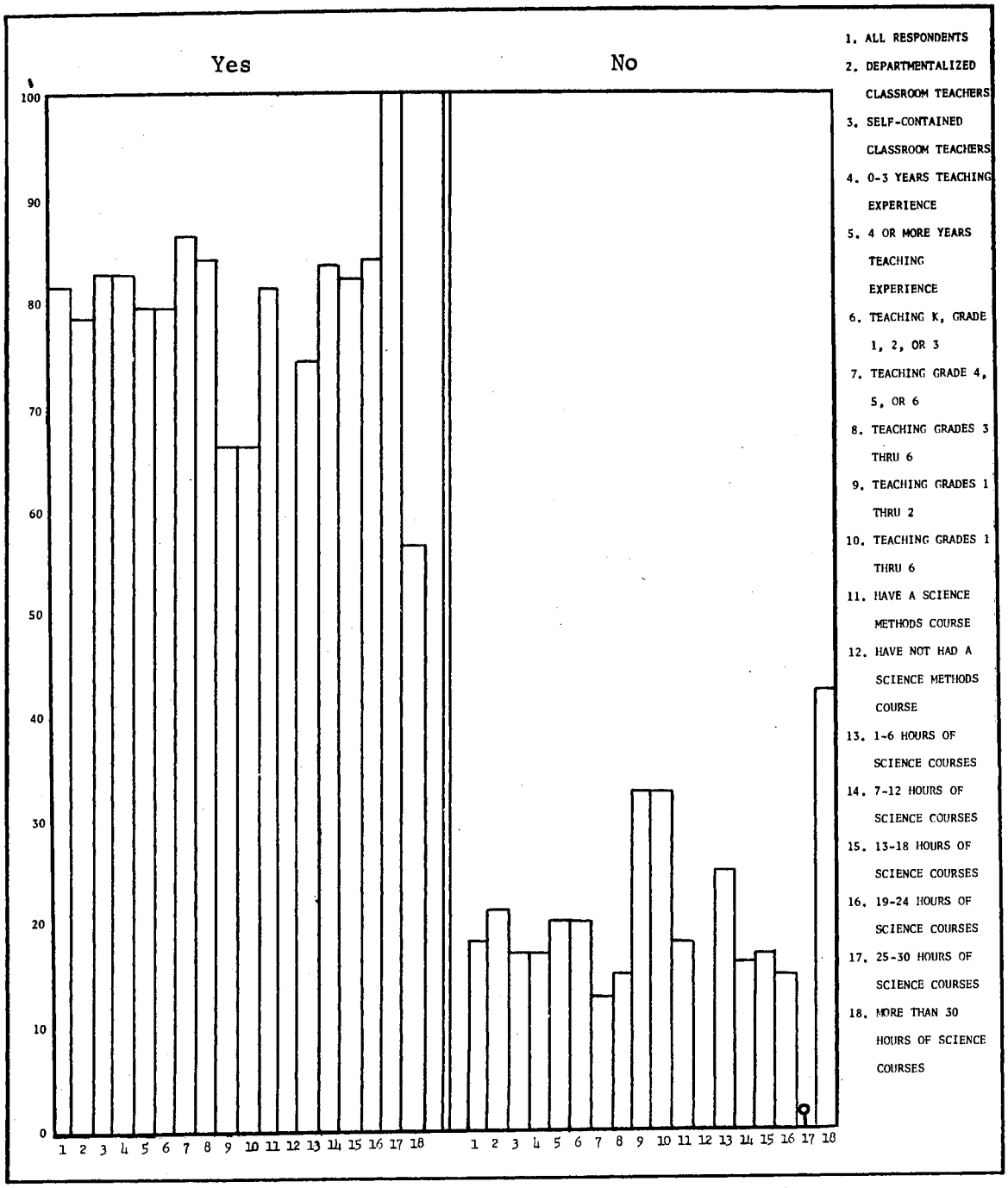

Figure 119. Science Methods Course Did Provide Assistance in Planning and Organizing Science Teaching

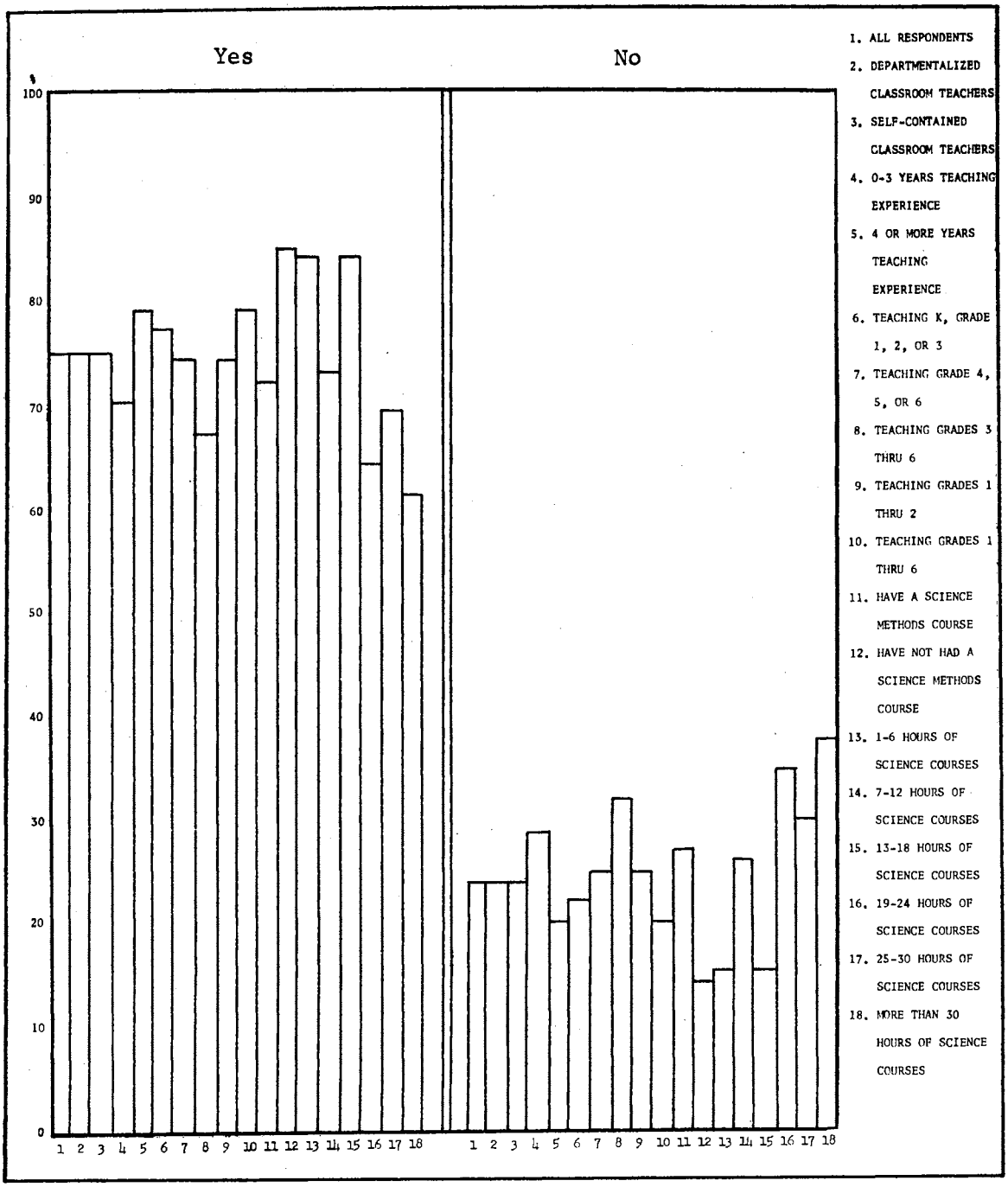

Figure 120. Science Methods Course Should Provide Subject Matter Content for Teaching Science

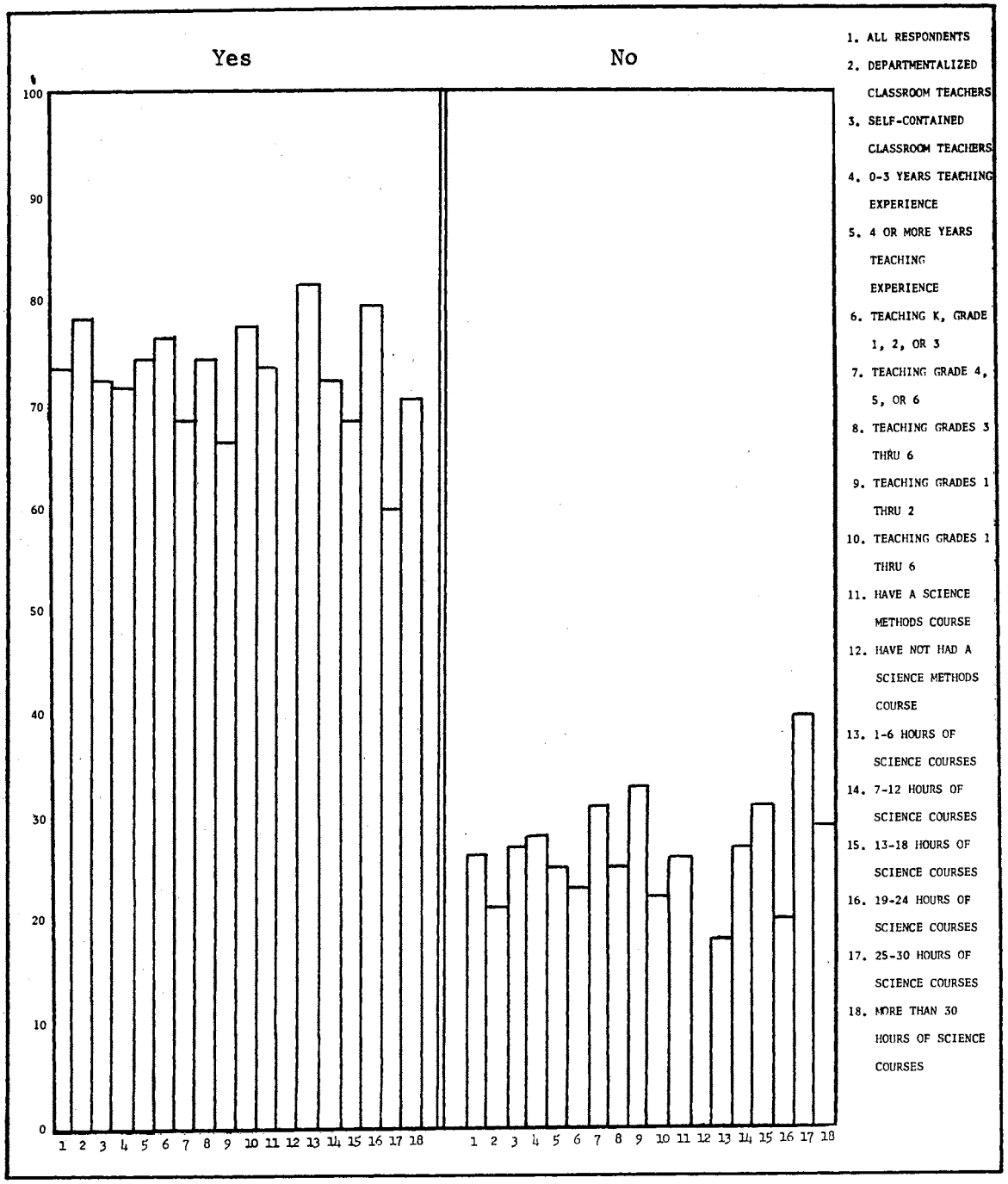

Figure 121. Science Methods Course Did Provide Subject Matter Content for Teaching Science

understanding of experimentation and demonstration for teaching science. This information is illustrated in Figure 122. The comparative analysis indicates that the only differences that occur among the groups are in the degree of agreement with the statement.

The teachers indicate that their science methods course did provide an understanding of experimentation and demonstration for science teaching. This information is reported in Figure 123. The comparative analysis indicates that the differences that occur among the groups are in the degree of agreement with the statement. The self-contained classroom teachers, the inexperienced teachers, and the teachers with 1-6 hours of science course work indicate a greater agreement than do their comparative groups.

The teachers indicate, as is illustrated in Figure 124, that a science methods course should provide a feeling of security in science teaching. The comparative analysis indicates that the only differences that occur among the groups are in the degree of agreement with the statement.

As is illustrated in Figure 125, the teachers indicate that their science methods course did provide a feeling of security in science teaching. The comparative analysis indicates that the only differences that occur among the groups are in the degree of agreement with the statement. The teachers of grades 1-2 and the teachers with 25-30 hours and 19-24 hours of science course work indicate a greater agreement with the statement than do their comparative groups.

The teachers indicate that a science methods course should provide an idea of what should be taught at various grade levels. This information is reported in Figure 126. The comparative analysis indicates

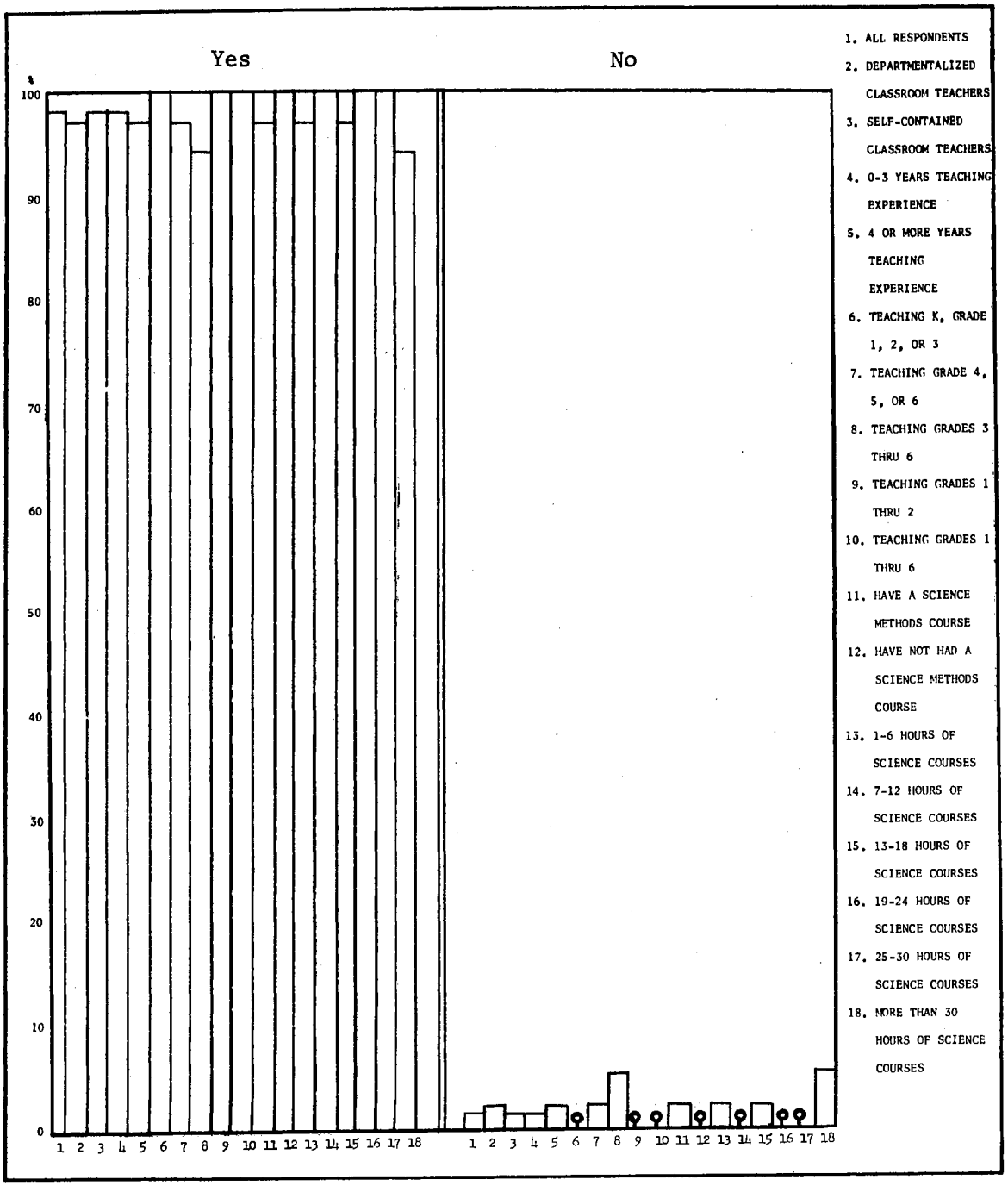

Figure 122. Science Methods Course Should Provide an Understanding of Experimentation and Demonstration

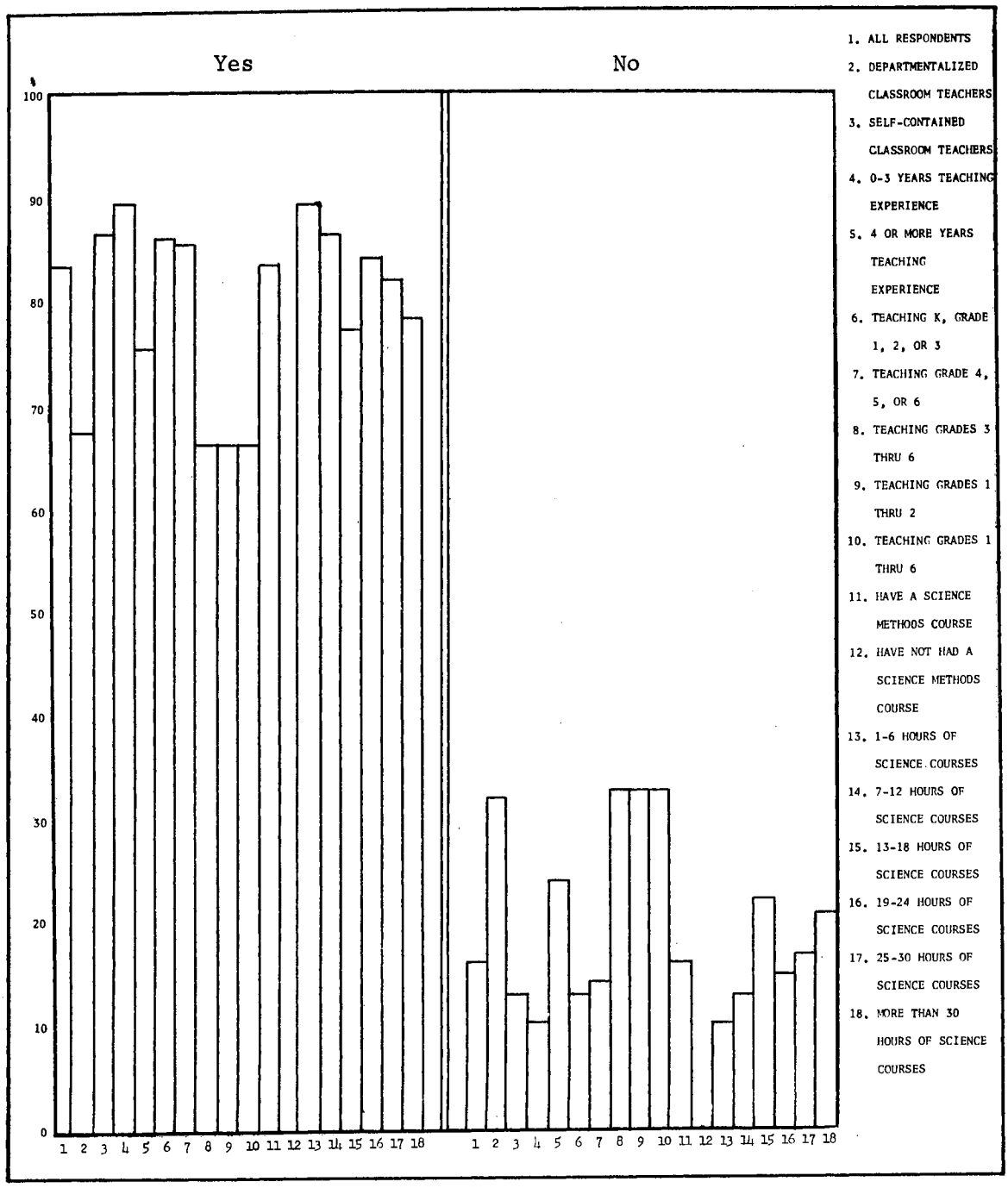

Figure 123. Science Methods Course Did Provide an Understanding of Experimentation and Demonstration

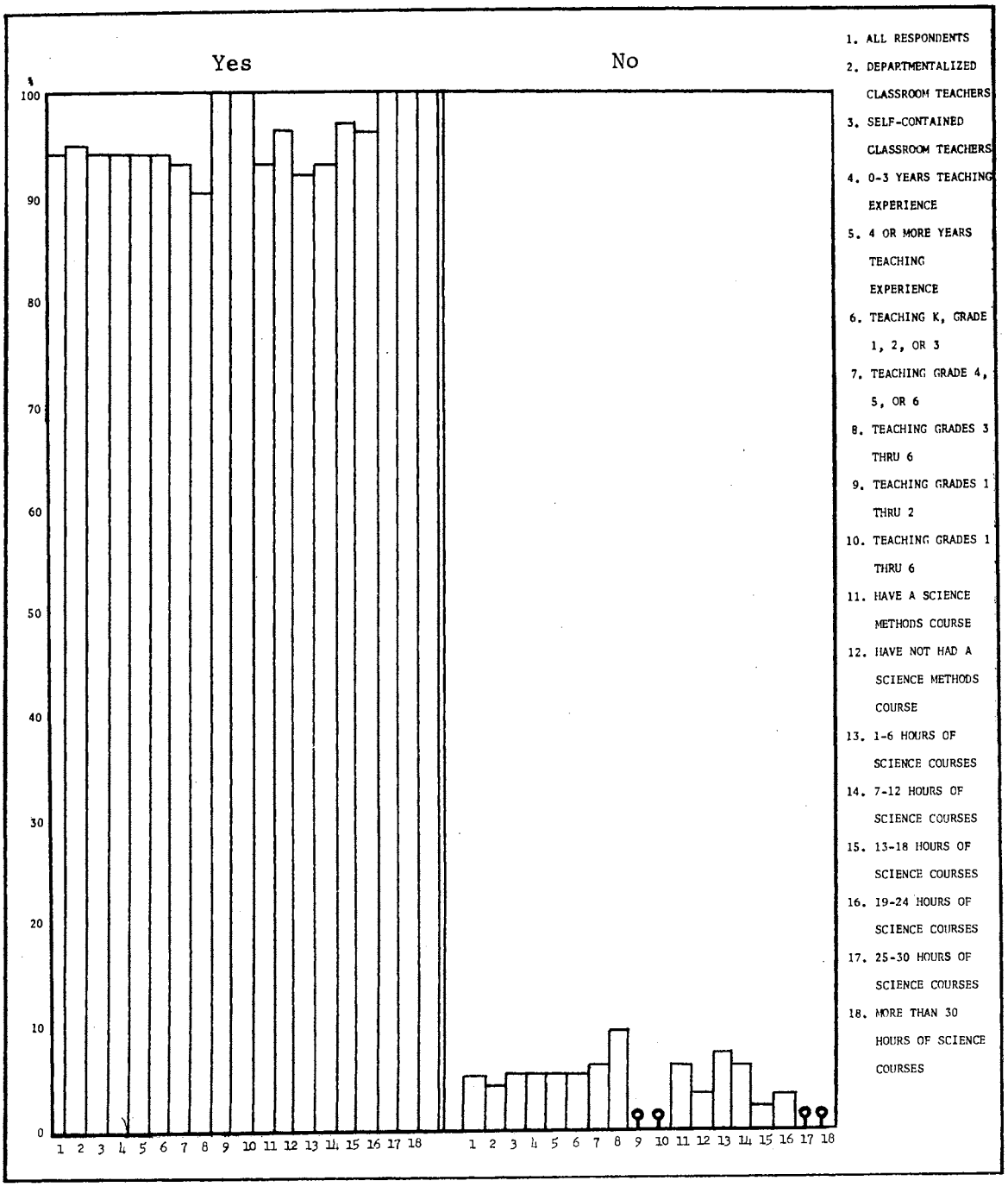

Figure 124. Science Methods Course Should Provide a Feeling of Security in Teaching Science

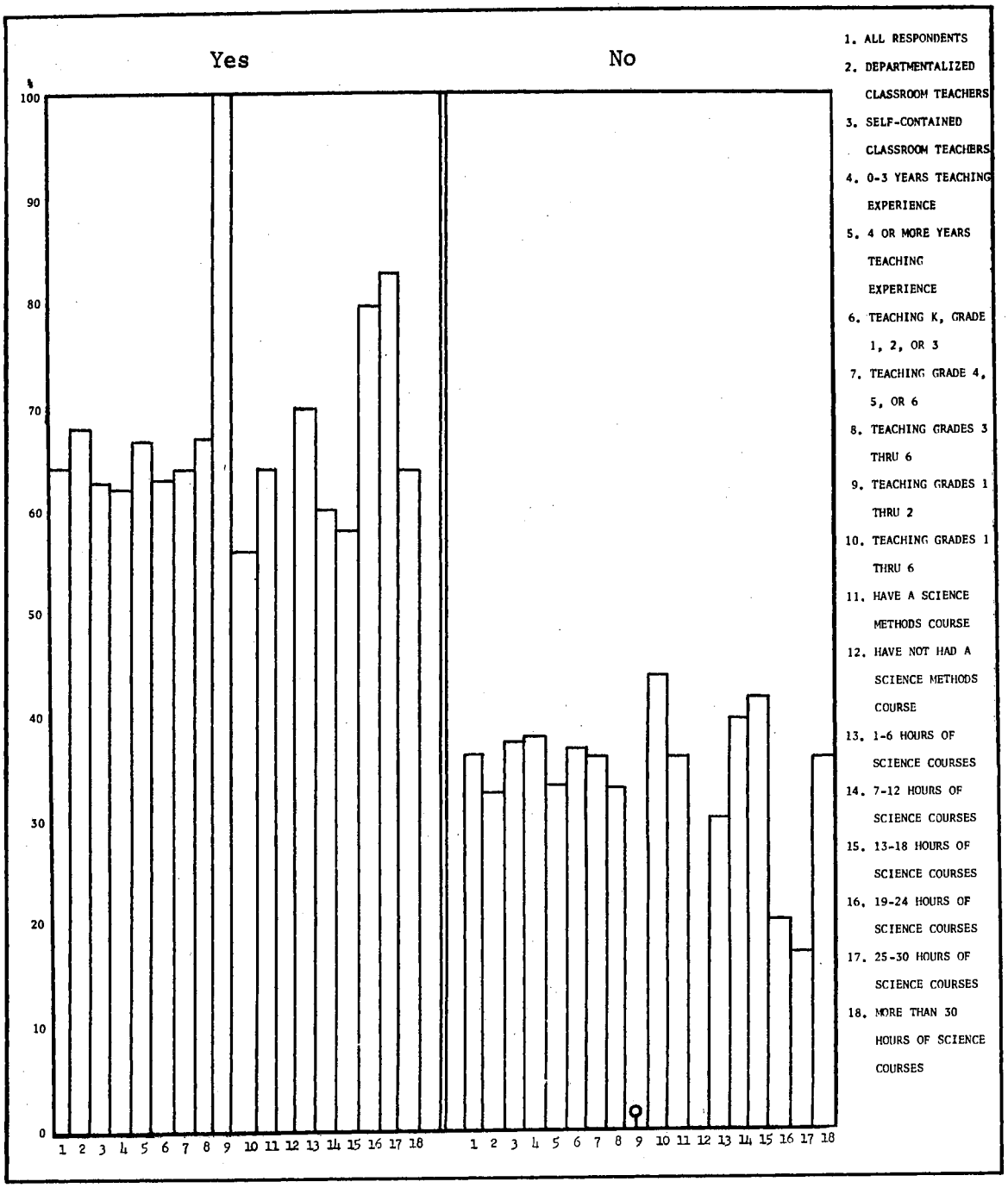

Figure 125. Science Methods Course Did Provide a Feeling of Security in Teaching Science

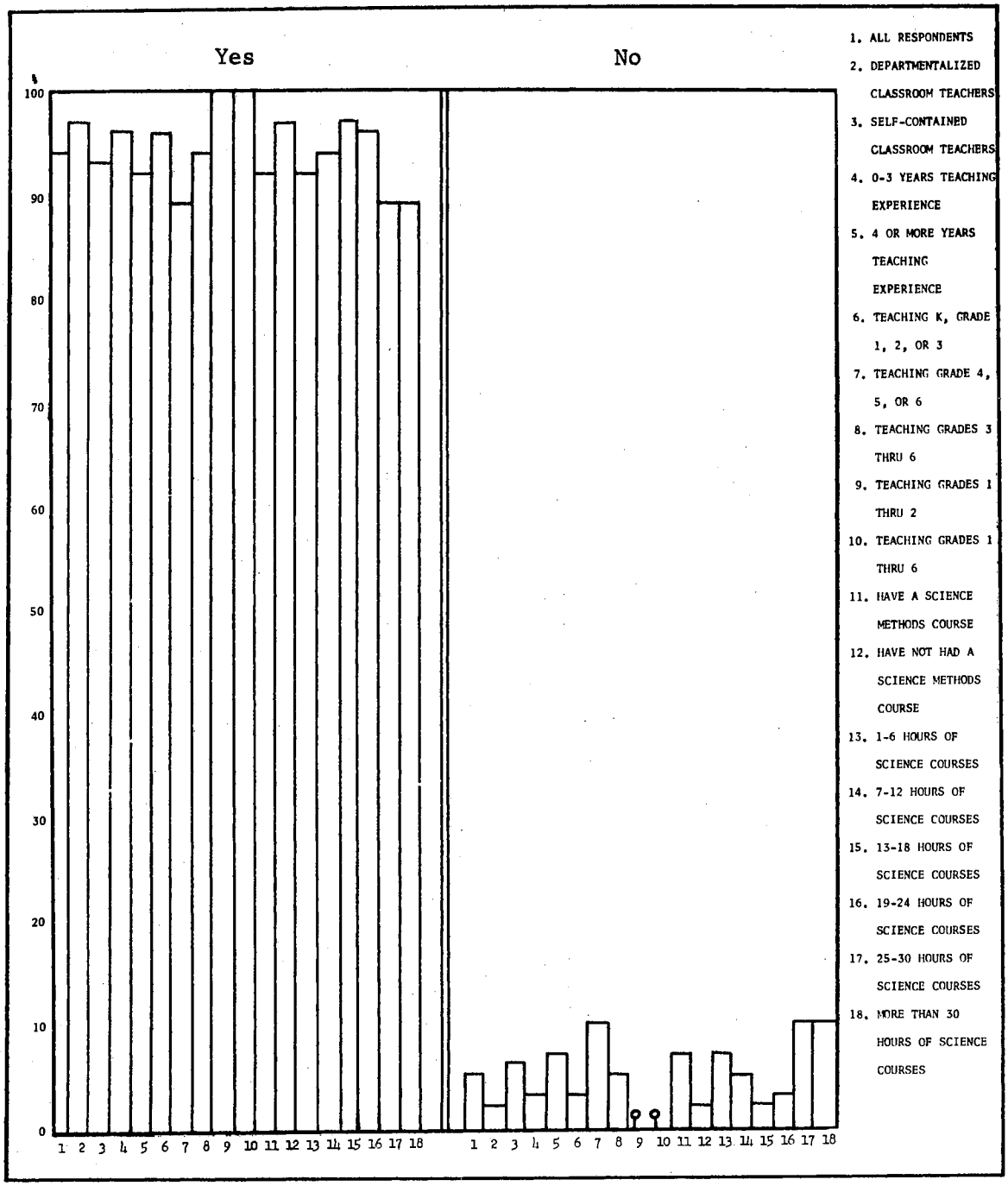

Figure 126. Science Methods Course Should Provide an Idea of What Should Be Taught at Various Grade Levels

that the differences that occur among the groups are in the degree of agreement with the statement.

The teachers indicate that their science methods course did provide an idea of what should be taught at various grade levels. This information is reported in Figure 127. The self-contained classroom teachers, the inexperienced teachers, the primary grade teachers, the teachers of grades 1-6, and the teachers with 19-24 hours of science course work indicate greater agreement with the statement than do their comparative groups.

The teachers indicate that a science methods course should provide greater interest in science teaching. This information is reported in Figure 128. The comparative analysis indicates that the differences that occur among the groups are in the degree of agreement with the statement. The greatest differences are in the categories established for departmentalized classroom teachers in the grade teaching. The teachers of grades 1-2 and 1-6 indicate total agreement; the teachers of grades 3-6 indicate smaller agreement with the statement.

The teachers indicate that their science methods course did provide greater interest in science teaching. This information is illustrated in Figure 129. The comparative analysis indicates that the differences that occur among the groups are in the degree of agreement. The self-contained classroom teachers, the inexperienced teachers, the teachers with 1-6 and 19-24 hours of science course work and the teachers of grades 1-2 indicate greater agreement than do the others in their comparative groups.

The teachers indicate that a science methods course should provide units and materials for science teaching. This information is reported in Figure 130. The comparative analysis indicates that the differences

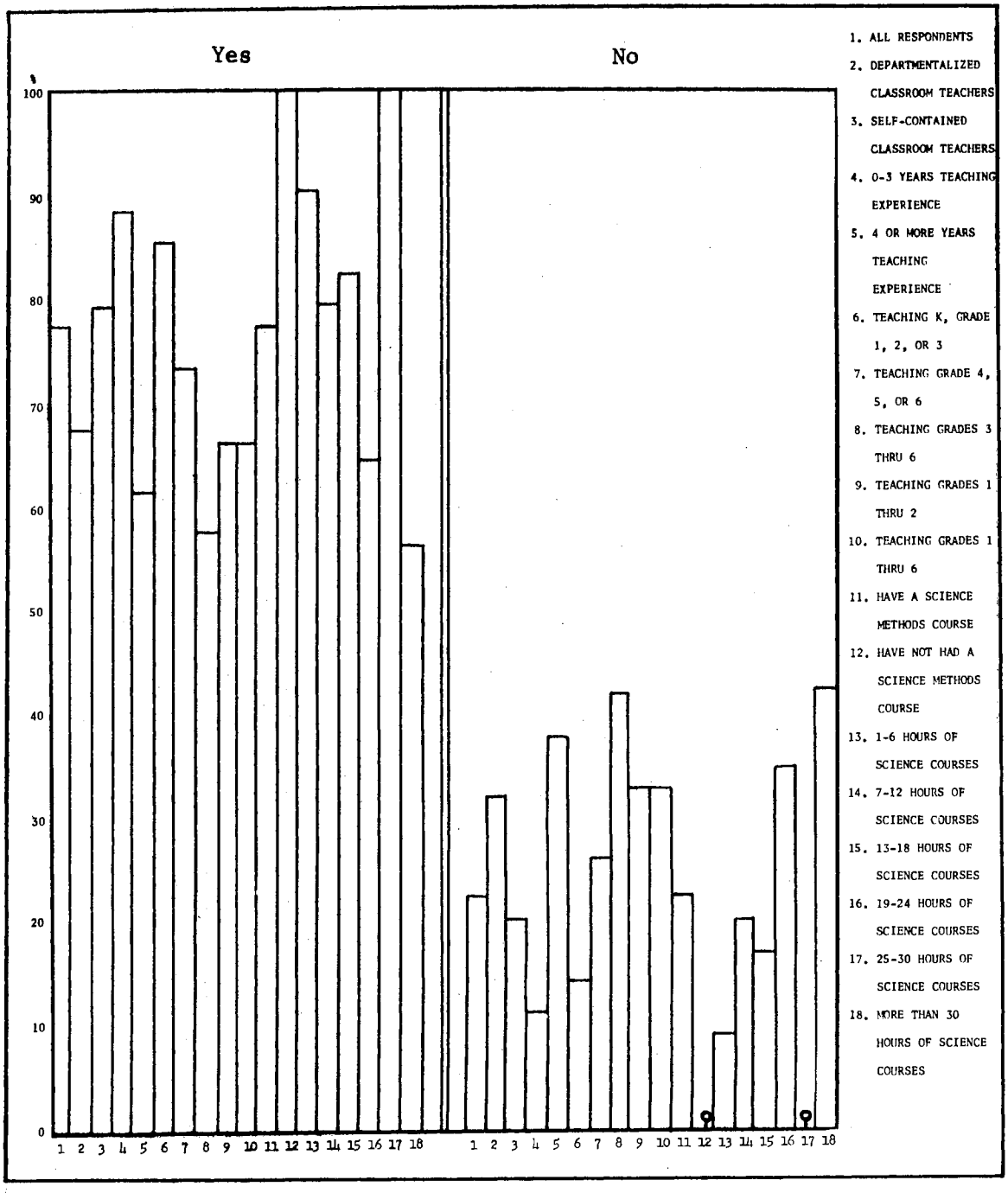

Figure 127. Science Methods Course Did Provide an Idea of What Should Be Taught at Various Grade Levels

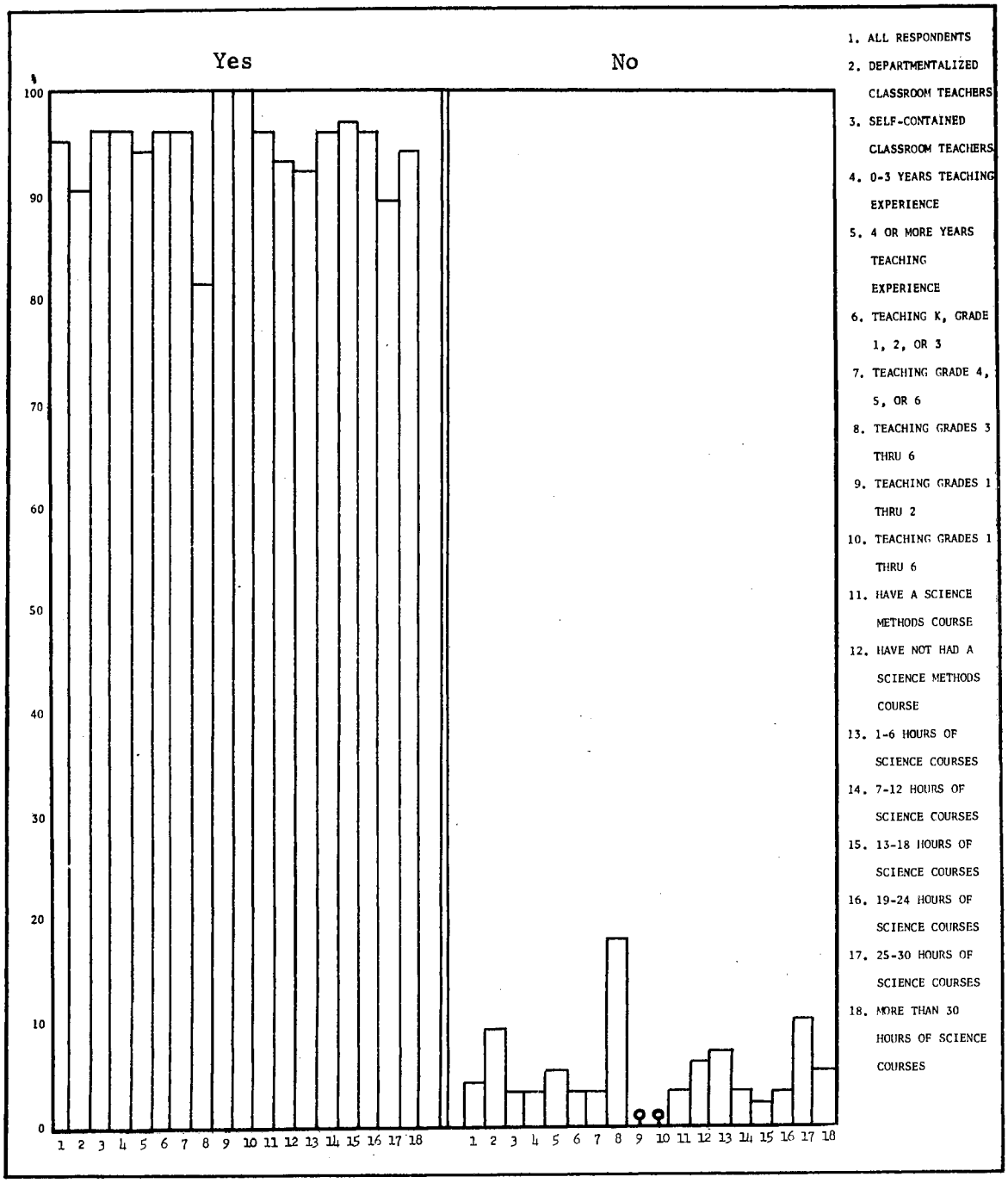

Figure 128. Science Methods Course Should Provide a Greater Interest in Teaching Science

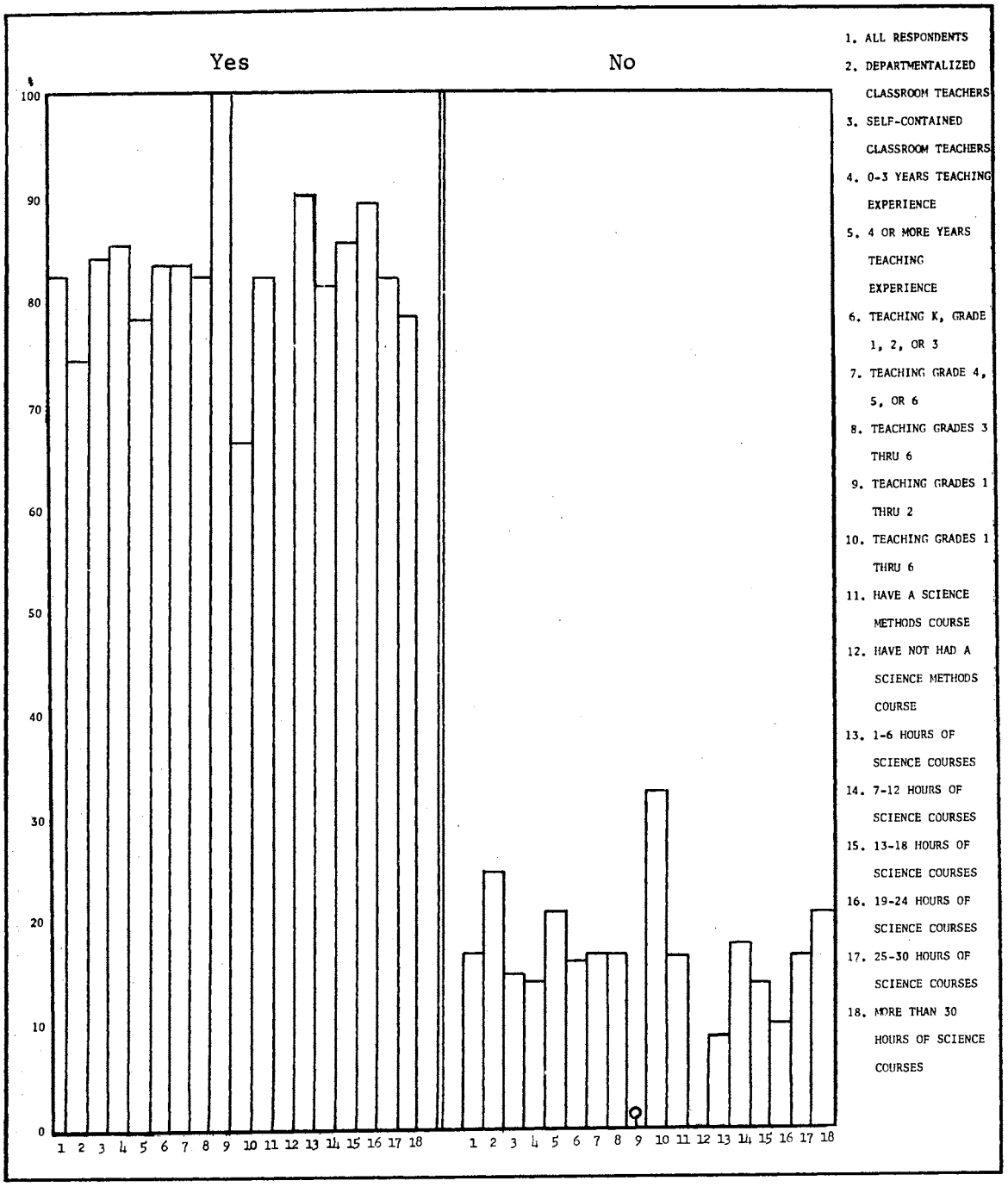

Figure 129. Science Methods Course Did Provide a Greater Interest in Teaching Science

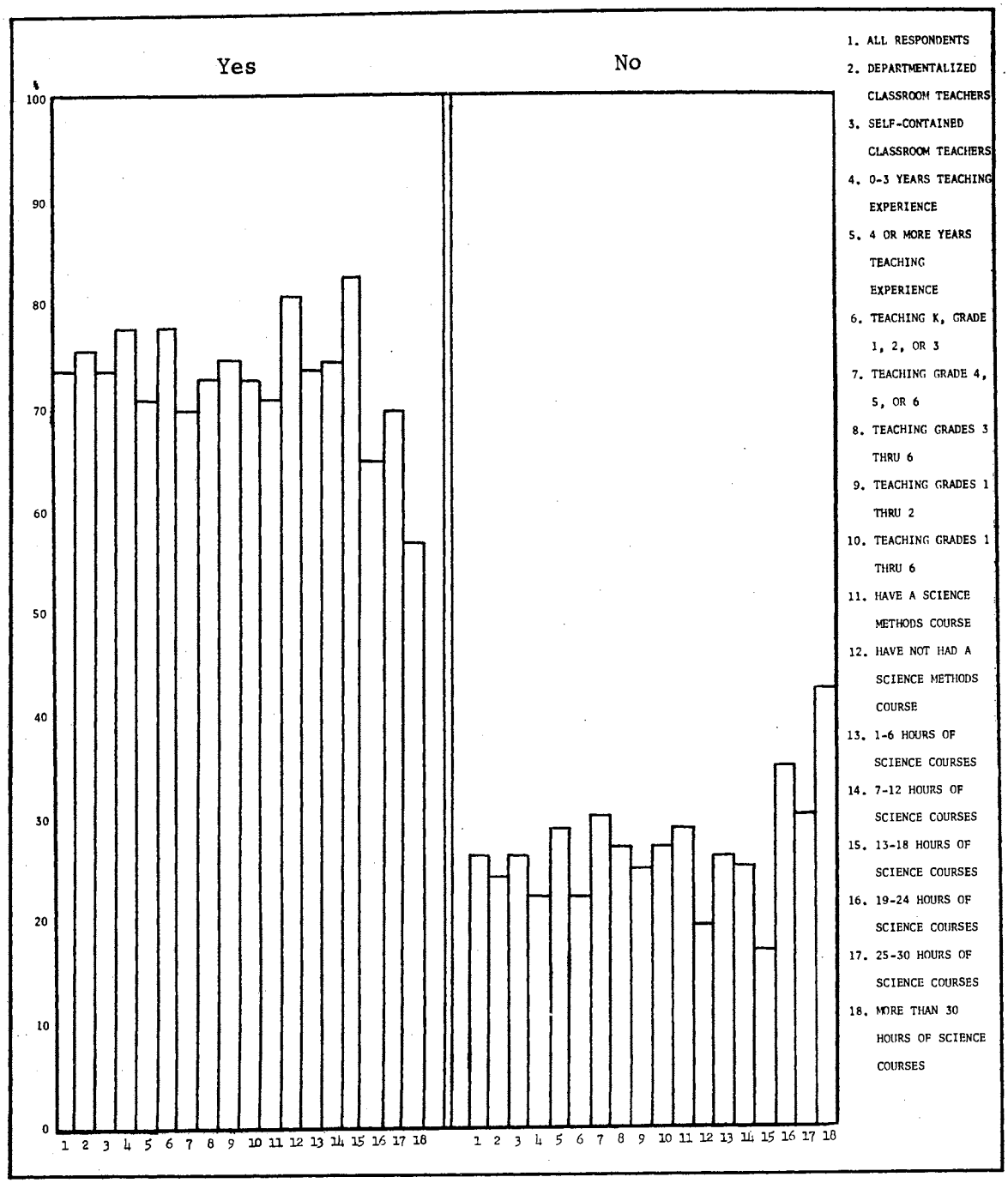

Figure 130. Science Methods Course Should Provide Units and Materials for Teaching Science

that occur among the groups are in the degree of agreement with the statement. The inexperienced classroom teachers, the primary grade teachers, and the teachers with 13-18 hours of science course work indicate greater agreement with the statement than do their comparative groups.

The teachers indicate that their science methods course did provide units and materials for science teaching. This information is reported in Figure 131. The comparative analysis indicates that the differences that occur among the groups are in the degree of agreement with the statement. The self-contained classroom teachers, the inexperienced teachers and the teachers with 1-6 hours of science course work indicate greater agreement with the statement than do their comparative groups.

The teachers indicate that a science methods course should provide techniques and methods necessary to teach science. This information is presented in Figure 132. The comparative analysis indicates that the differences that occur among the groups are in the degree of agreement with the statement.

The teachers indicate that their science methods course did provide methods and techniques necessary to teach science. This information is reported in Figure 133. The comparative analysis indicates that the differences that occur among the groups are in the degree of agreement with the statement. The departmentalized classroom teachers, the experienced teachers, the intermediate grade teachers, the teachers of grades 1-2, and the teachers with more than 30 hours of science course work indicate greater agreement with the statement than do their comparative groups.

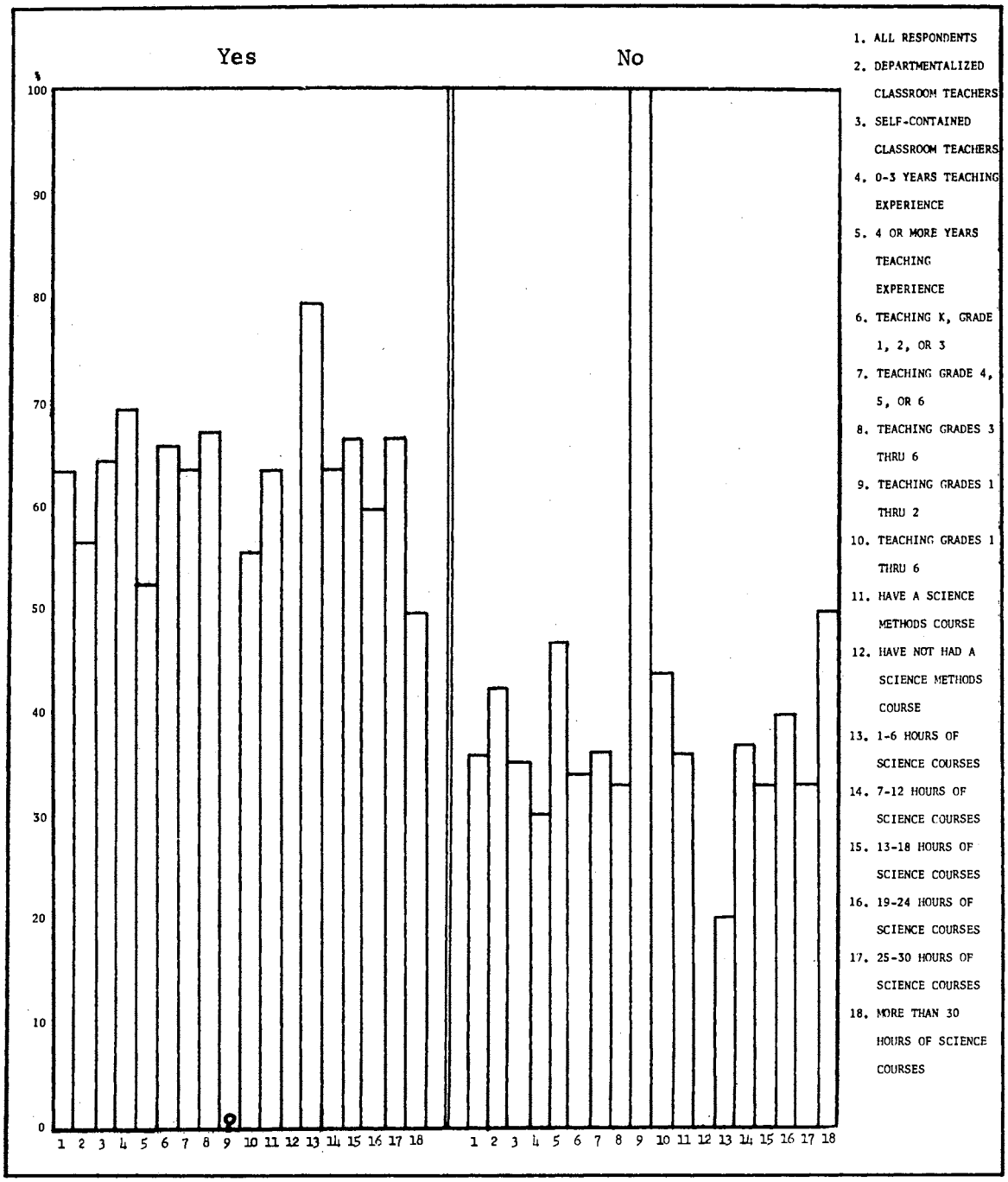

Figure 131. Science Methods Course Did Provide Units and Materials for Teaching Science

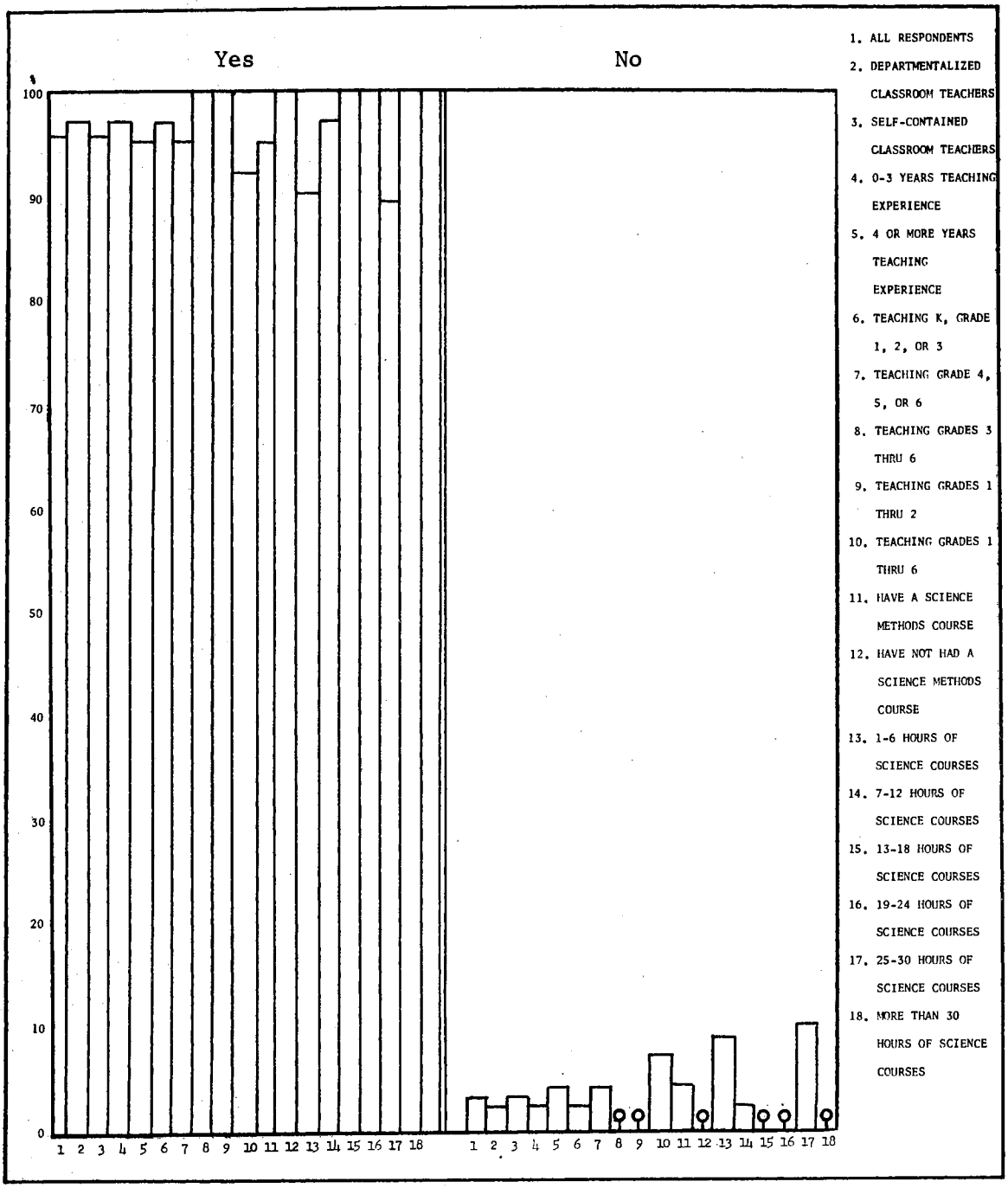

Figure 132. Science Methods Course Should Provide Methods and Techniques for Teaching Science

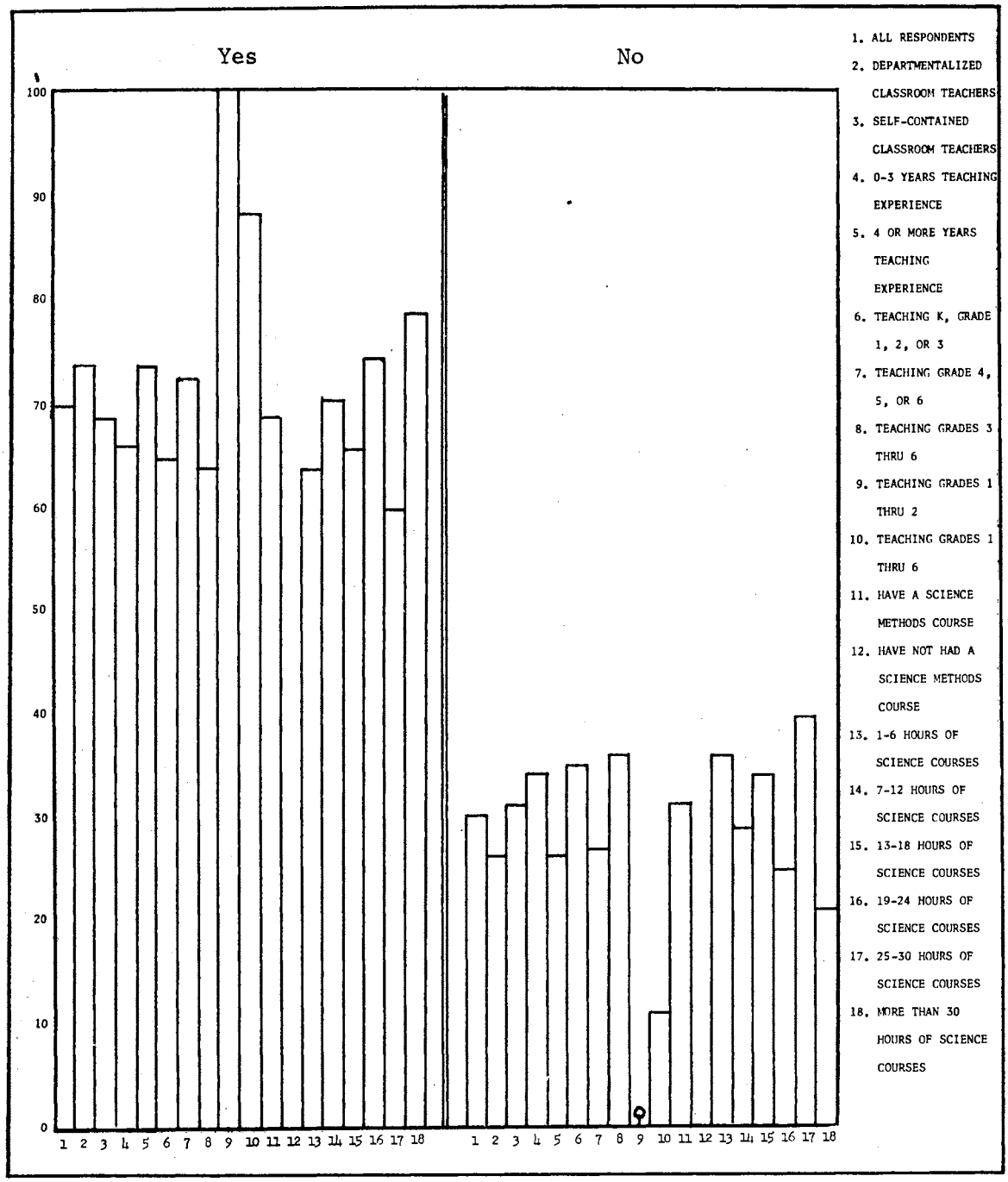

Figure 133. Science Methods Course Did Provide Methods and Techniques for Teaching Science

CHAPTER V

SUMMARY AND INTERPRETATIONS, CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

Review of Purpose and Design

Considerable evidence was presented in the review of the research to substantiate the view that elementary teachers are reluctant to teach science. Many reasons for this reluctance have been postulated, and some research has attempted to provide factors that might be involved in this reluctance.

This study was undertaken because of personal contacts with elementary teachers who expressed that they were not reluctant to teach science and that they were teaching science, because of ambiguity in the results in some of the research, because of apparent contradictions among the findings of various studies, and because of a tendency for different procedures of research on the matter to produce different results. The writer felt there was evidence to justify a more recent and perhaps more conclusive investigation of certain factors which might influence the teaching of science at the elementary school level.

The review of the research furnished possible factors which might be included. However, few of the investigators reporting in the literature consulted the teacher in their investigations. At the same time, it should be noted, most of the studies operated from pre-determined standards, and measured the teachers according to the pre-determined standards.

The present investigator felt that the authorities in elementary science teaching should be those teachers involved in teaching elementary science. Also, the writer felt that the approach to make in the investigations was to ascertain the areas which teachers felt might influence science teaching in the elementary grades.

This study was an exploratory one designed to gather date to determine the opinions of elementary school teachers concerning science and elementary science teaching in an attempt to provide insight into their reported reluctance to teach science.

The investigator realized that an attempt to cover all of the factors which might be concerned with science teaching at the elementary school level would be impossible.

Therefore, nine factors were established for the study and an instrument was designed to furnish information concerning each factor as follows:

1. The amount of time that is devoted to teaching science.
2. The number of semester hours of academic course credit in science.
3. The belief that science is a man's field.
4. The nature of the understanding of the modern goals of science teaching.
5. The belief that the major responsibility of elementary teachers should be in the areas of the basic communication skills.
6. The belief that there is a loss of classroom prestige in teaching science.
7. The belief that science demands too much time, creates a cluttered classroom, or disrupts normal classroom routine.

8. The belief concerning the availability and use of science teaching equipment and materials.
9. The belief concerning the responsibility for designing and controlling the elementary school science program.

In addition to these factors the teachers were asked to state their opinions concerning the contributions that have been made and should be made by their science courses, by science workshops or institutes, by science supervisors, and by science methods courses in preparing them for teaching science.

No standardized measuring device existed for measuring the opinions of elementary teachers concerning science and science teaching in the elementary school. The investigator constructed an opinionnaire in an attempt to elicit opinions concerning the selected factors which might influence science teaching at the elementary school level. A pilot study was conducted with a group of elementary teachers enrolled in an extension class provided by Oklahoma State University. After this initial administration, the opionnaire was revised and sent to selected schools in Oklahoma, selected extension classes and two groups enrolled in elementary science methods courses provided by Oklahoma State University.

The results were computer-processed and percent was selected to compare the opinions expressed by the sample. The investigator felt that percent would provide the clearest insight into the factors under consideration. The investigator also felt that additional insight might be provided in the analysis of the responses if comparisons were made among selected groups for each statement or question. The following groups were selected for comparative analysis:

1. The type of classroom teaching situation (departmentalized and

self-contained) in which the teachers were then teaching.

2. The number of years of teaching experience (inexperienced teachers and experienced teachers).
3. The grade that the respondents were then teaching (primary grade teachers and intermediate grade teachers; special categories established for the departmentalized classroom teaching situation of grades 3-6, 1-2 and 1-6).
4. Participation in a science methods course.
5. The number of hours of science course work the teachers had earned (1-6 hours, 7-12 hours, 13-18 hours, 19-24 hours, 25-30 hours and more than 30 hours.)

Summary and Interpretations of Major Findings

Opinionnaires were sent to 523 elementary teachers. Returns were received from 335 respondents. The sample for the study thus consisted of those teachers who responded to the opinionnaire.

Description of the Sample

A general description of the sample would read as follows: a majority of the teachers had four or more years teaching experience, were involved in self-contained classroom teaching situations, were teaching the primary grades, were females, were in the age bracket of 20-29 years of age, had taken 7-12 hours of science course work, had taken a science methods course, did not have the services of a science supervisor available, had not participated in a science workshop or institute, and had earned a bachelor's degree.

Evidence of Time Devoted to Teaching Science

Most of the respondents indicated that they teach science from 30 minutes to one hour a day. The results clearly showed that the departmentalized classroom teachers teach more science than the other groups. (This would be expected for these teachers have as their major responsibility the teaching of science or a combination of science and some other subject matter area.) The category of teaching science all day originated for this group, and most of these teachers report that they do teach science all day. The differences that occurred in the grade teaching and in the amount of science course work also appeared to be due to the fact that these categories are primarily composed of departmentalized classroom teachers. The departmentalized classroom teachers teach grades 3-6, 1-2 and 1-6 and had more science course work in the categories where differences occur.

No clear pattern was indicated by the sample in providing demonstration and experimentation. The respondents were concentrated in four categories: 30 minutes to one hour a week was reported most often, followed by less than 30 minutes a day, none, and one to three hours a week. The departmentalized classroom teachers contended that they spend more time in demonstration and experimentation. (This result might be expected when we consider the fact that these teachers spend more time teaching science.) The differences in the grade teaching appeared to be in those categories established for the departmentalized classroom teachers. The respondents with smaller amounts of course work appeared to devote a smaller amount of time to demonstration and experimentation than do those teachers with more science course work. (This might be due to the departmentalized classroom teaching situation or to the fact that teachers with

more course work might provide more of these activities. A noticeable exception to either generalization would be the group with 25-30 hours of science course work which has a surprising percent of respondents who provide no demonstration or experimentation and who provide less than 30 minutes a day for these activities.)

The response to both of these items appears to indicate that the teachers are providing more time to science teaching and to science demonstration and experimentation than the review of the research indicated. The major differences that occur in both appear to be due to the type of classroom teaching situations in which the teachers are involved.

Teacher Preparation

The importance of adequate teacher preparation to teach elementary school science was well established. The teachers surveyed were asked to respond to thirteen items concerning various phases of teacher preparation as related to science teaching at the elementary school level.

Most of the teachers did not feel their present science background was adequate for teaching science at the elementary school level. This feeling agrees with the views expressed in the review of the literature.

The teachers felt that their science background was not sufficient, and they expressed a positive response to the statement that they are not familiar with science and would prefer that others teach science. (This would appear to indicate that they are willing to teach science even though they feel their science background is not adequate.)

The teachers contended that the science courses taken in college did not provide an adequate background for teaching science in the elementary school. This response agrees with the views expressed in the review of

the literature.

In general, the major differences that occurred in the comparative groups in the responses to these three statements appear to be in the departmentalized classroom teachers and the teachers with a methods course. The differences that occurred in the grade teaching appear to be due to the groups established for the departmentalized classroom teachers. The differences that occurred in the number of hours of science course work could also be due to the fact that the departmentalized classroom teachers appear to be concentrated in the groups where differences occurred. (These differences do not appear surprising when we consider the type of teaching situation and that more course work or a science methods course might provide a greater feeling of adequacy in science.)

The teachers were asked how much science knowledge they thought was necessary for an elementary school teacher to do an adequate job in teaching science. Most of the teachers were of the opinion that a knowledge of the content of junior high school textbooks, senior high school biology, chemistry and physics textbooks, and the basic college introductory science courses would not be sufficient for an elementary teacher to do an adequate job of teaching science. (These results are surprising when we consider that science in the elementary school should be kept on a beginning level. However, these results approximate those found in the literature.)

The comparative analysis indicates only slight variation among the groups. The statement concerning the basic college introductory courses provides some variation in degree of disagreement. Again this variation appears to be due to the types of classroom teaching situations and the number of hours of science course work.

It appeared evident that the teachers felt that the breadth of pre-service requirements left little time for them to pursue science to the depth needed to prepare them for science teaching. However, their responses were not as positive as we would expect from the review of the research. The departmentalized classroom teachers, the teachers of the grades established for the departmentalized classroom teachers, and the teachers in the number of course hours that seem to be dominated by the departmentalized classroom teachers indicated a negative response. (These respondents appear to have found the time to pursue science to the depth they feel is needed for science teaching at the elementary school level.)

The teachers felt the need for additional science preparation on the college level. The experienced teachers and those teachers with 7-12 hours of science course work expressed the greatest need. The departmentalized classroom teachers, the teachers of grades 1-6, 3-6 and 1-3 the primary grade teachers and the teachers with more science course work expressed smaller need. (This is not surprising when we consider that the science course work of the experienced teachers is not recent, the number of hours of science course work and the classroom teaching situations.)

It appeared evident that the teachers believe that a special science course should be offered to provide an orientation to subject matter that is suitable for teaching science in the elementary grades. All of the groups felt this strongly and emphasized the need which was stressed in the review of the research.

Most of the teachers responded positively to the statement that they would like to up-date their science background but do not have the time available for doing so. The experienced teachers, the primary grade

teachers and the teachers without a methods course indicated greater agreement with the statement. The inexperienced teachers, the teachers of grades 1-6, 3-6 and 1-2, the teachers with a methods course and the teachers with 19-24 hours or more than 30 hours of science course work indicated smaller agreement with the statement. (This could be due to the age factor, the teaching load influencing the diversity of areas in which to keep current, a methods course influencing the need to make time and the number of hours of science course work influencing a need for up-dating.) However, the choice of the wording of the item was unfortunate. (There is a double meaning in the statement, and it would be difficult to ascertain whether the up-dating of the science background or the time factor is the one that is influencing the decision or if both might be involved.)

The teachers expressed a negative response to the statement that they felt that their science background is out-of-date and that they would prefer not to teach science. (If we assume that they are expressing the feeling that their science background is out-of-date in the preceding statement, then the teachers are again emphasizing that they are willing to teach science.) The departmentalized classroom teachers, the teachers of grades 1-6, 3-6 and 1-2, the experienced teachers, the teachers with 7-12 hours, 19-24 and more than 30 hours of science course work indicated greater disagreement with the statement. The teachers with 1-6 hours of science course work indicated the least disagreement with the statement. (These responses would lead us to believe that the teachers are indicating that they are willing to teach science even though they may feel that their background in science is out-of-date. The inexperienced teachers may not feel that their background is out-of-date. The teachers

with 1-6 hours of science course work may feel inadequate in teaching science or their science background may be out-of-date. Again, this is an unfortunate choice in a statement with a double meaning which leads to confusion in interpretation of the data.)

It appeared evident that the teachers would like to up-date their science background by attending special science classes for elementary teachers. The departmentalized classroom teachers, the inexperienced teachers, and the teachers with more course work indicated a greater disagreement with the statement. The differences that occurred in the grade teaching appear to be due to the categories established for the departmentalized classroom teachers.

The teachers reported slight agreement with the statement that they have kept their science background up-to-date by reading current scientific information. The departmentalized classroom teachers, the experienced teachers, the teachers with a methods course, and the teachers with more course work express greater agreement with the statement. Differences that occurred in the grade teaching appear to be due to the categories established for the departmentalized classroom teachers. (These results are not surprising when we consider that these categories would see more need and might have more opportunity to read current scientific information.)

The Belief that Science is a Man's Field

The respondents indicated a slight preference that men are more familiar with science than women. The intermediate grade teachers, the departmentalized classroom teachers of grades 1-6, the teachers with 1-6 and 13-18 hours of science course work expressed greater agreement with

the statement. The departmentalized classroom teachers of the grades 3-6 and 1-2 and the teachers with 7-12 and 19-24 hours of science course work expressed disagreement with the statement.

The teachers did not feel that men have more aptitude for teaching science or that men make better science teachers. There was a stronger positive response to both statements by the departmentalized teachers, the teachers in the categories of grade teaching established for the departmentalized classroom teachers, and the teachers in the hours of course work that are dominated by the departmentalized classroom teachers.

The teachers indicated a slight agreement that men have more familiarity with the use of science materials and equipment than women. The intermediate grade teachers, the teachers with 1-6, 13-18 and more than 30 hours of science course work indicated greater agreement; the departmentalized classroom teachers, the teachers of grades 1-6, 3-6 and 1-2 and the teachers with 25-30 hours of science course work indicated disagreement with the statement.

The responses to all four questions do not approach the strong negative response to statements of similar nature reported in the review of the literature.

Understanding of the Modern Goals of Science Teaching

The evidence indicated a slight agreement with the statements that science in the elementary school should be taught as a factual course, that students should be expected to know and if necessary memorize basic scientific facts, and that it is more important to learn the practical applications of science than to learn the underlying scientific principles.

The departmentalized classroom teachers and the teachers of grades 1-6 and 3-6, the experienced teachers, the teachers without a methods course and the teachers with 1-6 and 25-30 hours of science course work indicated greater agreement with the first two statements. The inexperienced teachers, the primary grade teachers, the departmentalized teachers of grades 1-2, the teachers with a methods course and the teachers with 7-12, 19-24 and 25-30 hours of science course work indicated greater agreement to the third statement. The intermediate grade teachers, the departmentalized teachers of grades 1-2 and the teachers with 13-18 hours and more than 30 hours of science course work indicated a negative response to the third statement.

The teachers did not believe that the need for acquiring factual information is greater than the need for understanding the ways in which hypotheses are developed. The departmentalized classroom teachers, the teachers of grades 3-6 and 1-6, the inexperienced teachers, the teachers with a methods course and the teachers with more hours of science course work indicated the greatest disagreement to the statement.

In general, while these teachers appear to be fact-oriented, they do see the need for developing understandings. The teachers who spend more time teaching science and have more science background indicated a greater tendency toward being fact-oriented. The inexperienced teachers and the teachers with a methods course appear to have a greater understanding of the process approach.

The teachers believed that first-hand laboratory experiences do not demand skills which are above the capacities of elementary school children. The inexperienced teachers and the departmentalized teachers of

grades 1-2 expressed a stronger positive response that these experiences do not demand skills above the capacities of the children; the teachers with 25-30 hours of science course work expressed the smallest agreement.

It is easy to understand that the inexperienced teachers might have more indoctrination in the process approach and that the departmentalized teachers who work with science primarily might feel as strongly as they do that these skills are not above the capacities of elementary school children. But it is surprising to note that some individuals with 25-30 hours of science course work might feel that first-hand laboratory experiences could demand skills which are above the capacities of elementary school children.

The teachers believed that work should be centered in laboratory-type experiences where real problems are explored. The surprising factor here is that the departmentalized teachers of grades 1-2 and 1-6, as well as the teachers with 25-30 hours of science course work, indicated smaller agreement with the statement. (This feeling could be due in part to the fact that these teachers are working with primary students.) The groups with 25-30 hours of science course work indicated smaller agreement.

The teachers believed that it is more important to gain understanding of the purposes and methods of science than to gain acquaintance with the latest theories and facts of science. The departmentalized teachers of grades 1-6, the teachers with 1-6 hours and with 25-30 hours of science course work indicated greater agreement with the statement. (This causes us to wonder how the group with 25-30 hours of science course work is going to develop the understanding of the purpose and methods of science.)

Definite evidence has been encountered which revealed that the teachers felt that science should be taught as a method of inquiry and that students understand science through participating in science rather than reading about science.

A number of conflicts appeared in understanding and modern objectives of teaching science. While the teachers did not indicate that they are as fact-oriented as those teachers in other samples which were reported in the literature, they did report a slight degree of positive responses toward teaching facts. And they did appear to indicate strong positive responses toward the process approach to teaching elementary school science. (We are left to wonder if they emphasize facts or process in actual practice.)

The Major Responsibility of the Elementary Teachers Is in the Area of the Basic Communication Skills

The teachers reported that science does not interfere with the basic elementary school program. However, they expressed a slight positive response that the demands of the basic communication skills leave little time for teaching science. They reported that language arts, social studies, and arithmetic are not more essential than teaching science.

In general, the teachers who responded with more favorable opinions toward science were the departmentalized classroom teachers, the teachers of grades 1-6, 3-6 and 1-2, the inexperienced teachers, the teachers with a science methods course and the teachers with more science course work. The teachers who responded more favorably to the other areas of the curriculum were the self-contained classroom teachers, the teachers of the primary and intermediate grades and the teachers with fewer hours

of science course work, the experienced teachers, and the teachers without a methods course. (These results are not surprising when we consider the teaching responsibilities, the more recent training, the possibility that more emphasis is placed upon science because of a science methods course, and the number of hours of science course work possessed by the respondents. It is surprising to note that twenty to forty percent of the following groups indicated that science interferes with the basic elementary school program: all respondents, self-contained classroom teachers, experienced teachers, the primary and intermediate grade teachers, the teachers without a science methods course and the teachers with 1-6 and 7-12 hours of science course work.

Loss of Classroom Prestige

The teachers expressed a strong negative response to the statement that they feel a loss of classroom prestige due to the difficulty of answering questions concerning science. They expressed a slight positive response to the statement that they often find it difficult to answer some of the questions concerning science. They reported a negative response to the statement that too often they have to answer "I don't know" to science questions. They also indicated a negative response to the statement that students often want to study phases of science which are unfamiliar to them.

In general, the self-contained classroom teachers, the inexperienced teachers, the teachers of the intermediate grades, the teachers with a methods course and the teachers with smaller amounts of course work indicated more positive responses than the other groups. (These teachers might feel more loss of classroom prestige because they are concerned

with all areas of the curriculum and do not feel as familiar with science, because they do not feel secure in teaching, because they are teaching the higher grade levels and become more involved in science teaching, and because they do not have adequate preparation.) (It was surprising to find the teachers with a methods course indicating a more positive response. This might be an indication that these teachers did not receive the proper assistance in their methods course.)

Loss of classroom prestige might be a logical consequence of an inadequate science background. If so, it too might be a definite factor influencing teaching of elementary school science. However, these teachers indicate a feeling of inadequacy of science background but do not feel a loss of classroom prestige.

Science Demands too Much Time, Creates a Cluttered Classroom or Disrupts Normal Classroom Routines

The teachers were asked to respond to three statements that teaching science demands too much time. They reported a negative reply to all three statements that teaching "the scientific method" takes too much time, that experimentation and demonstration require equipment that is too time consuming, and that first-hand laboratory-type experimentation cannot be justified in terms of the amount of time which it demands.

The teachers were asked to respond to two statements concerning confusion which science teaching might create. Their reply was negative to both responses that teaching "the scientific method" is too confusing and that experimentation and demonstration require equipment that causes too much confusion in the classroom.

The teachers expressed a strong negative response to the statements

that teaching science creates a cluttered classroom and that science teaching disrupts normal classroom activities.

The comparative analysis of all of these statements indicated variation only in the degree of the negative responses. In general, the departmentalized classroom teachers, the teachers of grades 1-6, 3-6 and 1-2, the inexperienced teachers and the teachers with more than 30 hours of science course work indicated greater negative responses. The experienced teachers, the teachers without a science methods course and the teachers with smaller amounts of course work indicated less negative response. (It is surprising to note that the groups with 25-30 hours of science course work also expressed a less negative response.)

Again the differences appear to be due to the classroom teaching situation: the inexperienced teachers perhaps have more recent training with emphasis upon process approach, and the teachers with more course work have been exposed to more of these activities.

Availability and Use of Science Teaching Equipment and Materials

The teachers reported that they use science textbooks as well as additional science books or written materials in teaching science. They reported that these materials were available in the library in the school building and that a local library had films or film strips available for their use. They also indicated that science equipment is available for use in their school building and in their classrooms.

The teachers expressed a negative response to the statement that they keep demonstration and experimentation to a minimum because of inadequate science equipment and materials. However, the teachers

indicated that they would provide more experimentation and demonstration if they were more familiar with the use of the equipment.

The comparative analysis illustrated that the primary differences among the groups were in the degree of their responses. In general, the departmentalized classroom teachers, the teachers of grades 1-6, 3-6 and 1-2, the experienced teachers and the teachers with more science course work indicated a stronger response that materials and equipment were available and in use. The inexperienced teachers, the primary grade teachers, and the teachers with smaller amounts of course work indicated less frequent use and rarer availability of equipment and materials. (These replies are not surprising if we remember that a school system which would establish a departmentalized classroom situation would probably supply adequate materials and equipment. Also, the experienced teachers would be more aware of what was available than the inexperienced teachers, and the teachers with more course work might be more aware of what materials and equipment were available.)

Responsibility of Designing and Controlling the Elementary School Science Program

The teachers reported a negative response to the statement that there is no need for revision of the available science textbooks and a positive response to the statement that wholesale revision of conventional textbooks is needed. Departmentalized classroom teachers, teachers of grades 1-6, 3-6 and 1-2, the teachers without a methods course and the teachers with more than 30 hours of science course work indicated a stronger positive response to the statement that the present textbooks need no revision and that there is no need for wholesale revision. The

inexperienced teachers, the primary grade teachers and the teachers with a methods course indicated a greater need for wholesale revision. (It is surprising to note that teachers who specialize in teaching science would indicate that present materials are adequate. This may be due to the fact that these individuals indicated that they are fact-oriented. It would appear that these teachers should be aware of the more recent advancements in science curricular experimentation. But their responses would indicate either that they are not aware of these developments or that they do not believe that the process approach is what is needed for elementary science teaching.)

The teachers expressed the opinion that scientists and elementary teachers should be responsible for designing and controlling the elementary science program. In general, the inexperienced teachers, the intermediate grade teachers, the teachers without a methods course and the teachers with smaller amounts of science course work express a stronger positive response that the elementary teachers should be responsible for designing and controlling the elementary school science program. (These results are not surprising when we consider that the inexperienced teachers and the teachers with a methods course might have received more recent indoctrination in the process approach what with the increasingly cooperative efforts of scientists and elementary teachers; the teachers with more course work and the intermediate grade teachers might be more aware of the problems of developing a curriculum at their more advanced level.)

Contributions of Science Courses, of Science Workshops and Institutes, of Science Supervisors, and of Science Methods Courses in Preparing Elementary Teachers to teach Science

A majority of the teachers indicated they have 7-12 hours of science course work. This group included all of the teachers other than the departmentalized classroom teachers and the teachers of grades 1-6, 3-6 and 1-2. In general, the greatest distribution of the departmentalized classroom teachers was in the category with 30 or more hours of science course work. The teachers of grades 3-6 were in the categories with 13-18, 19-24 and more than 30 hours. The teachers of grades 1-2 were in the categories with 1-6, 13-18, 25-30 and more than 30 hours. The teachers of grades 1-6 were in the categories with 13-18, 25-30 and more than 30 hours. (This appears to illustrate that the departmentalized classroom teachers had more science course work than the other comparative groups.)

Approximately two-fifths of the respondents reported a science workshop or institute experience. Among these teachers, approximately one-fourth indicated participation prior to the last three years; approximately three-fifths indicated participation during the last three years; and approximately one-fifth indicated participation both prior to the last three years and during the last three years. Among those teachers who replied that they had a workshop or institute experience, there is an indication of an equal division of teachers who reported an increase in time and no increase in time devoted to teaching science after participating in the workshop or institute. More than two-thirds of the teachers expressed an interest in participating in a workshop or institute.

Fewer than one-third of the respondents reported the availability of the services of a science supervisor. Among those who replied that these services were available, there is a slightly stronger indication that they did not devote more time to teaching science after the services of a supervisor were available.

Over two-thirds of the teachers reported that they had a science methods course. Among the teachers who reported a science methods course, more than two-thirds indicated that their science methods course was on the undergraduate level, fewer than one-fifth indicated their methods course was on the graduate level and fewer than one-fifth indicated a science methods course at both the graduate and undergraduate level. Among those teachers who reported a science methods course, there was greater indication that they did increase the time devoted to teaching science after participating in the science methods course.

The teachers were asked to respond to eight basic unfinished statements to find their opinions of the contributions that should be made and that were made by science courses, by science workshops and institutes, by science supervisors, and by science methods courses in preparing them to teach science at the elementary school level. The eight basic unfinished statements were:

1. Provide me with assistance in planning and organizing science teaching.
2. Provide me with subject-matter content for science teaching.
3. Provide me with an understanding of experimentation and demonstration for science teaching.
4. Provide me with a feeling of security in science teaching.
5. Provide me with an idea of what should be taught at my grade level.

6. Provide me with a greater interest in science teaching.
7. Provide me with units and materials necessary to teach science.
8. Provide me with methods and techniques necessary to teach science.

Each teacher was asked to respond to each of the eight basic unfinished statements with the preface that a science course should, that a science workshop or institute should, that a science supervisor should, and that a science methods course should. Only those teachers who had a science workshop or institute experience, a science supervisor, or a science methods course were asked to reply that theirs did.

Most of the teachers thought that a workshop or institute, a science supervisor, and a science methods course should provide assistance in planning and organizing science teaching. There was smaller indication that science courses should provide this assistance.

Most of the teachers thought that science courses should provide subject-matter content necessary for teaching science. There was smaller indication that a workshop or institute and science methods courses should provide these activities. The least frequently expressed opinion was that a science supervisor should provide subject-matter content necessary for teaching science.

The teachers expressed the feeling that science courses, science workshops or institutes and science methods courses should provide understandings in experimentation and demonstration. There was smaller indication that science supervisors should provide these understandings.

It was felt by the teachers that science courses, science workshops or institutes and science methods courses should provide a feeling of

security in teaching science. There was less frequent expression that science supervisors should provide this feeling.

The teachers thought that science workshops or institutes, science supervisors and science methods courses should provide an idea of what should be taught at various grade levels. There was smaller indication that science courses should provide this information.

It was felt by the teachers that science courses, science workshops or institutes and science methods courses should provide interest in teaching science. There was smaller indication that science supervisors should provide this interest.

In general, the comparative groups that reported the greatest agreement to these statements were the departmentalized classroom teachers, the teachers of grades 1-6, 3-6, and 1-2 and the teachers with more hours of science course work. The experienced teachers indicated stronger agreement that the science courses should provide most of the eight basic unfinished statements. The inexperienced teachers indicated stronger agreement that the science workshop or institute should provide most of the eight basic unfinished statements.

It was informative that the teachers felt as strongly as they indicated that science courses should provide all of the eight basic unfinished statements.

The teachers reported that their science courses did not provide assistance in planning and organizing science teaching. The teachers with a science workshop or institute experience, a science supervisor and a science methods course indicated strongly that these did provide assistance in planning and organizing.

The teachers felt that their science courses, their science workshop or institute experience, their science supervisor and their science methods course did provide subject-matter content for science teaching.

Most of the teachers were of the opinion that their science workshop or institute experience, their science supervisor and their science methods course provided a greater understanding of experimentation and demonstration than did their science courses.

The evidence indicated that the teachers believed their science workshop or institute and their science supervisor provided a greater feeling of security than did their science courses or their science methods course.

The teachers thought that their science workshop or institute experience, their science supervisor and their science methods course did provide an idea of what should be taught at various grade levels. However, they reported that their science courses did not provide this information.

Most of the teachers expressed the opinion that their workshop or institute experience and their science methods course provided a greater interest in teaching science than did their science courses or their science supervisor.

Most of the teachers indicated that their science workshop or institute experience, their science supervisor and their science methods course did provide units and materials necessary to teach science. However, they reported that their science courses did not provide these materials.

The evidence indicated that the teachers felt that their science workshop or institute experience, their science supervisors and their science methods course did provide methods and techniques for teaching

science. However, they reported that their science courses did not provide these skills.

The comparative analysis indicates that in general the inexperienced teachers, the intermediate grade teachers, the teachers with a methods course, the departmentalized classroom teachers, the teachers of grades 1-6, 3-6, 1-2 and the teachers with more science course work indicated stronger feelings on the statements concerning science courses. The primary grade teachers, the teachers with 1-6 hours and 13-18 hours of course work, the departmentalized classroom teachers, the teachers of grades 1-6, 3-6, 1-2 and the teachers with more hours of science course work indicated stronger feeling on the statements concerning science supervisors. There was considerable variation among the groups concerning science methods courses and little pattern in the distribution of differences established.

Most of the teachers were of the opinion that science courses should provide instruction in the care, use and construction of science equipment.

It was informative that the teachers reported that the science workshop or institute experience, the science supervisor and the science methods course were providing for all eight unfinished statements. The science courses were not providing assistance in planning and organizing, an idea of what should be taught at various grade levels, units and materials, or methods and techniques necessary for teaching science.

Conclusions

This study was undertaken as an exploratory effort to find out whether there existed evidence as to factors that might influence science teaching at the elementary school level. It must be pointed out that the levels of confidence with which stated opinions can be judged are by no means dramatic. What has been found is some indication of direction only. Nonetheless, the analysis appears to justify these assertations:

1. The teachers are providing more time to science teaching and to science demonstration and experimentation than we would expect from the review of the research.

2. An inadequate science background appears to be a definite factor influencing science teaching at the elementary school level. However, while the teachers felt their background was inadequate, they indicated a willingness to teach science. The teachers reported that they would like to up-date their science background but that they do not have the time available to do so. However, they did express the opinion that they would like to up-date their science background by attending special classes for elementary teachers. There was some indication that some of the teachers felt that they have kept their science background up-to-date by reading current scientific information. The teachers reported that their science courses taken in college did not prepare them for teaching science at the elementary school level. They did indicate that they felt that special science courses should be offered to provide orientation to subject matter suitable for teaching science in the elementary grades.

3. The belief that science is a man's field may have some influence upon science teaching at the elementary school level. However, the

teachers did not feel that men have more aptitude for teaching science or that men make better science teachers. They did feel (slightly) that men are more familiar with science and have greater familiarity with the use of science materials and equipment.

4. Understanding the modern goals of science teaching may have some influence upon science teaching at the elementary school level. The teachers indicated that they were fact-oriented even though they recognize the importance of developing understandings of first-hand laboratory experiences, of the methods of science and of teaching science as a method of inquiry.

5. Competition with other subject-matter areas may have come influence upon science teaching at the elementary school level. The teachers did not feel that science interferes with the basic elementary school program but did provide a slight indication that the demands of the basic communication skills leave little time for teaching science. They believe that language arts, social studies and arithmetic are not more essential than teaching science.

6. A loss of classroom prestige does not appear to be a factor influencing science teaching at the elementary school level. The teachers reported a strong negative feeling of loss of classroom prestige. They reject the statement that too often they have to answer "I don't know" or that students often want to study phases of science with which they are not familiar. They do indicate a slight positive response to the statement that they often find it difficult to answer some of the questions concerning science.

7. The statements that science demands too much time, creates a cluttered classroom or disrupts normal classroom routines were not

indicated as factors influencing science teaching at the elementary school level.

8. The availability and use of science materials and equipment were not indicated as factors influencing the teaching of science at the elementary school level. The teachers expressed strong opinions that materials and equipment are available and are used. However, they did indicate that they would provide more experimentation and demonstration if they were more familiar with the use of the equipment.

9. The responsibility for designing and controlling the elementary school science program did not appear to be a factor influencing the teaching of science on the elementary school level. The teachers felt a need for revision of present textbooks. They also believed that designing and controlling the elementary school science program should be a cooperative effort of scientists and the elementary school teachers.

10. It was felt by the teachers that science courses, science workshops or institutes, science supervisors and science methods courses should make the following provisions:

a. Provide me with assistance in planning and organizing science teaching.

b. Provide me with subject-matter content for science teaching.

c. Provide me with an understanding of experimentation and demonstration for science teaching.

d. Provide me with a feeling of security in science teaching.

e. Provide me with an idea of what should be taught at my grade level.

f. Provide me with a greater interest in science teaching.

indicated as factors influencing science teaching at the elementary school level.

8. The availability and use of science materials and equipment were not indicated as factors influencing the teaching of science at the elementary school level. The teachers expressed strong opinions that materials and equipment are available and are used. However, they did indicate that they would provide more experimentation and demonstration if they were more familiar with the use of the equipment.

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a. Provide me with assistance in planning and organizing science teaching.

b. Provide me with subject-matter content for science teaching.

c. Provide me with an understanding of experimentation and demonstration for science teaching.

d. Provide me with a feeling of security in science teaching.

e. Provide me with an idea of what should be taught at my grade level.

f. Provide me with a greater interest in science teaching.

g. Provide me with units and materials necessary to teach science.

h. Provide me with methods and techniques necessary to teach science.

11. Most of the teachers were of the opinion that their science workshop or institute experience, their science supervisors and their science methods course did provide these eight basic items.

12. The teachers felt that their science courses did not provide assistance in planning or organizing science teaching, an idea of what should be taught at their grade level, units and materials necessary to teach science or methods and techniques necessary for teaching science at the elementary school level.

13. The comparative analysis indicated that the differences that occurred among the groups were due primarily to the types of classroom teaching situations in which the teachers were involved. There was little difference expressed among the number of years of teaching experience, the grade level they were teaching (other than those established for the departmentalized classroom teachers) or whether they had a science methods course. There was some indication of differences in the number of hours of science course work, but these appear to be closely associated with the departmentalized classroom teaching situation.

It should be emphasized that the findings of this study are based upon the expressed opinions of the sample to selected factors which might influence science teaching at the elementary school level. In any type of investigation of expressed opinions there may be other external as well as other internal factors influencing the responses made. The crude nature of the instrument employed in the collection of the data limits

the extent to which generalizations and conclusions could be drawn from the analyses. A standardized instrument should be devised, validated and cross-validated for more conclusive results. The instrument used in this study may be acceptable for exploratory purposes, but it is costly in time and money to make possible research with the size of samples that would give a study greater inferential scope.

Implications

Definite evidence has been encountered which reveals that an inadequate science background is a definite factor in influencing science teaching at the elementary school level. Other factors also appear to exist. As factors possibly influencing science teaching at the elementary school level, they must be taken into consideration in any program, either pre-service or in-service, that is designed for preparing elementary school teachers for the teaching of science. These factors must also be taken into consideration by those individuals who are responsible for providing assistance to the elementary teachers in the teaching of science.

It is reasonable to conclude that elementary science education will improve when programs of teacher preparation are evaluated in terms of the kinds of experiences that will produce teacher competence. Present indications are that teachers are interested in doing much more in their classrooms than their science backgrounds will permit them to do. The typical college science courses apparently do not prepare the elementary teachers to the level of performance with which they desire. Formal course work in science may not be sufficient. Perhaps another type of science course more specifically directed toward the needs of elementary

school teacher candidates and special courses for in-service teachers might be more fruitful.

Suggestions for Further Study

The conclusions and implications of the present study suggest that more refined and intensive investigations should consider the following recommendations:

1. An attempt should be made to develop and validate an instrument that will adequately measure teacher opinions concerning science and science teaching at the elementary school level.

2. Longitudinal studies which would provide teacher opinions, investigations of what and how science is being taught in elementary classrooms and what is being provided in pre-service, in-service education and supervisory services to these teachers should be attempted.

3. Studies should be made that attempt to determine other factors which might influence science teaching at the elementary school level.

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APPENDICES

Dear Elementary Teacher:

Much attention has been devoted to science and science education in the past five years. School systems all over the country are giving serious thought to the development of a continuous science program for grades one through twelve. However, little has been done to secure the opinion of the elementary school teacher concerning his attitudes regarding the present situation and what needs to be done to improve present conditions.

You who are teaching in the elementary school are in an excellent position to help with this nation-wide program by providing valuable information, opinion and advice. Your assistance and cooperation would be greatly appreciated.

You will notice that there is no attempt made to identify individuals. You are not asked to sign your name to the form and you return it directly to the investigator. This study is not concerned with the identification of individuals and the special problems that each has encountered. Instead, this study is concerned with what can be done to help you solve these special problems and to prevent future difficulties by proposing changes in our present situation.

In the construction of this form, every effort has been made to make it brief, compact and easy to fill out so that you can complete it in a short time. A pilot study has been made; all respondents have completed the form within thirty minutes.

You will be doing us a great service by giving this your careful, thoughtful consideration.

Our sincere appreciation,

Sallylee Hines, Graduate Assistant
College of Education
Oklahoma State University

SH/ ssn

APPENDIX A

I. In the following statements, please check the appropriate blanks or fill in the general information as it applies to you.

1. Number of years teaching experience (including this year).
   Elementary _____; Secondary _____

2. Grade you are now teaching. 1._____; 2._____; 3._____; 4._____; 5._____; 6._____.

3. Check the range in which your age falls:

60 or above	_____
50 to 59	_____
40 to 49	_____
30 to 39	_____
20 to 29	_____
below 20	_____

4. Sex: Male _____; Female _____.

5. Please give the approximate hours that you have completed in each area and indicate the time credit was received.

	(hours completed)		
General Biology	during last 3 years_____;	prior to last 3 years	_____
Zoology	during last 3 years_____;	prior to last 3 years	_____
Botany	during last 3 years_____;	prior to last 3 years	_____
Chemistry	during last 3 years_____;	prior to last 3 years	_____
Physics	during last 3 years_____;	prior to last 3 years	_____
Physical Science	during last 3 years_____;	prior to last 3 years	_____
Meterology	during last 3 years_____;	prior to last 3 years	_____
Astronomy	during last 3 years_____;	prior to last 3 years	_____
Geology	during last 3 years_____;	prior to last 3 years	_____

6. Please indicate the level of your academic training: Bachelor's Degree_____; Master's Degree_____; _____hours above Master's Degree.

II. In the following statements, please check your agreement or disagreement by placing a ✓ in the appropriate blank.

1. I have had methods course(s) in the teaching of elementary school science.
   Yes_____; No_____; Undergraduate Level_____; Graduate Level_____.

2. The methods course that I had influences the time that I devote to science teaching.
   Yes_____; No_____; Statement does not apply to me_____.

3. I have participated in an in-service workshop or institute for elementary science teachers. Yes_____; No_____; Prior to last 3 years_____; During the last 3 years_____.

4. After participating in the workshop or institute, I increased the time that I devoted to teaching science. Yes_____; No_____; Statement does not apply to me_____.

5. I would be interested in participating in an in-service workshop or institute for elementary science teachers. Yes_____; No_____.

6. Are the services of a science supervisor available to you? Yes_____; No_____.

7. I increased the time that I devoted to teaching science since the services of a science supervisor are available to me. Yes_____; No_____; Statement does not apply to me_____.

8. The science courses taken in college provided me with an adequate background for teaching science. Yes_____; No_____.

9. The following statements are to be checked in agreement or disagreement as follows: (1) Each person is to answer each statement by checking his response to "A science methods course should" in the blanks provided to the left. (2) Only those who have had science methods course(s) are to answer each statement by checking his response to "My science methods course did" in the blanks to the right.

(1) Everyone! (Indicate your response to each statement by checking Yes or No to the following: "A science methods course should"			(2) Only those who have had science methods. Indicate your response to each statement by checking Yes or No to the following: "My science methods course did"
Yes_____; No_____	(1)	Provide me with assistance in planning and organizing science teaching.	Yes_____; No_____
Yes_____; No_____	(2)	Provide me with subject matter content for science teaching.	Yes_____; No_____
Yes_____; No_____	(3)	Provide me with an understanding of experimentations and demonstrations for science teaching.	Yes_____; No_____
Yes_____; No_____	(4)	Provide me with a feeling of security in science teaching.	Yes_____; No_____
Yes_____; No_____	(5)	Provide me with an idea of what should be taught at my grade level.	Yes_____; No_____
Yes_____; No_____	(6)	Provide me with a greater interest in science teaching.	Yes_____; No_____
Yes_____; No_____	(7)	Provide me with units and materials necessary to teach science.	Yes_____; No_____
Yes_____; No_____	(8)	Provide me with methods and techniques necessary to teach science.	Yes_____; No_____

10. I use science textbooks in teaching science. Yes_____; No_____.

11. I use additional science books or written materials in teaching science. Yes_____; No_____.

12. I make use of the science materials available in the library in my building. Yes_____; No_____; Not Available_____.

13. I make use of the local library with films or film strips available for my use. Yes_____; No_____; Not Available_____.

14. I make use of science films from the state department or science rental films in my science teaching. Yes_____; No_____.

15. I have science equipment available for use in my school building. Yes_____; No_____.

16. I have science equipment available for use in my schoolroom. Yes_____; No_____.

17. The following statements are to be checked in agreement or disagreement as follows: (1) Each person is to answer each statement by checking his response to "A science supervisor should" in the blanks provided to the left. (2) Only those who have science supervisors are to answer each statement by checking his response to "My science supervisor does" in the blanks to the right.

(1) Everyone! Indicate your response to each statement by checking Yes or No to the following: "A science supervisor should"		(2) Only those who have science supervisors. Indicate your response to each statement by checking Yes or No to the following: "My science supervisor does"
Yes_____; No_____	(1) Provide me with assistance in planning and organizing science teaching.	Yes_____; No_____
Yes_____; No_____	(2) Provide me with subject matter content for science teaching.	Yes_____; No_____
Yes_____; No_____	(3) Provide me with an understanding of experimentation and demonstration for science teaching.	Yes_____; No_____
Yes_____; No_____	(4) Provide me with a feeling of security in science teaching.	Yes_____; No_____
Yes_____; No_____	(5) Provide me with an idea of what should be taught at my grade level.	Yes_____; No_____
Yes_____; No_____	(6) Provide me with a greater interest in science teaching.	Yes_____; No_____
Yes_____; No_____	(7) Provide me with units and materials necessary to teach science.	Yes_____; No_____
Yes_____; No_____	(8) Provide me with methods and techniques necessary to teach science.	Yes_____; No_____

18. I feel the need for additional science preparation on the college level to prepare me for teaching science. Yes_____; No_____.

19. I feel that the demands of the basic communication skills leave me little time for teaching science. Yes_____; No_____.

20. I would devote more time to teaching science but it creates a cluttered classroom. Yes_____; No_____.

21. I would devote more time to teaching science but it disrupts normal classroom activities. Yes_____; No_____.

22. I would devote more time to teaching science but I feel a loss of classroom prestige as a result of science questions being difficult to answer. Yes_____; No_____.

23. Men generally are more familiar with science subjects than women. Yes_____; No_____.

24. The following statements are to be checked in agreement or disagreement as follows: (1) Each person is to answer each statement by checking his response to "A science workshop or institute should" in the blanks provided to the left. (2) Only those who have participated in an in-service workshop or institute in science are to answer each statement by checking his response to "My in-service workshop or institute in science did" in the blanks to the right.

(1) Everyone! Indicate your response to each statement by checking Yes or No to the following: "An in-service workshop or institute in science should"			(2) Only those who have participated in an in-service workshop or institute in science. Indicate your response to each statement by checking Yes or No to the following: "My in-service workshop or institute did"
Yes_____; No_____	(1)	Provide me with assistance in planning and organizing science teaching.	Yes_____; No_____
Yes_____; No_____	(2)	Provide me with subject matter content for science teaching.	Yes_____; No_____
Yes_____; No_____	(3)	Provide me with an understanding of experimentation and demonstration for science teaching.	Yes_____; No_____
Yes_____; No_____	(4)	Provide me with a feeling of security in science teaching.	Yes_____; No_____
Yes_____; No_____	(5)	Provide me with an idea of what should be taught at my grade level.	Yes_____; No_____
Yes_____; No_____	(6)	Provide me with a greater interest in science teaching.	Yes_____; No_____
Yes_____; No_____	(7)	Provide me with units and materials necessary to teach science.	Yes_____; No_____
Yes_____; No_____	(8)	Provide me with methods and techniques necessary to teach science.	Yes_____; No_____

25. Science subject matter courses in college should provide instruction in the care, use and construction of science equipment. Yes_____; No_____.

26. Because science equipment and materials are not provided for my class use, I keep demonstration and experimentation to a minimum. Yes_____; No_____.

27. Science in the elementary school should be taught as a reading course in order to provide integration of the science course and the basic communication skills. Yes_____; No_____.

28. I would provide more experimentation and demonstration in my science classes if I were more familiar with the use of the equipment. Yes_____; No_____.

29. Men generally have a greater familiarity with the use of science materials and equipment than do women. Yes_____; No_____.

30. The following statements are to be checked in agreement or disagreement as follows: (1) Each person is to answer each statement by checking his response to "The science subjects provided in college should." (2) In the blanks to the right, each person is to check his response to each statement to "The science subjects that I took in college did."

(1) Everyone! Indicate your response to each statement by checking Yes or No to the following: "Science courses should"			(2) Everyone! Indicate your response to each statement by checking Yes or No to the following: "My science courses did"
Yes_____; No_____	(1)	Provide me with assistance in planning and organizing science teaching.	Yes_____; No_____
Yes_____; No_____	(2)	Provide me with subject matter content for science teaching.	Yes_____; No_____
Yes_____; No_____	(3)	Provide me with an understanding of experimentation and demonstration for science teaching.	Yes_____; No_____
Yes_____; No_____	(4)	Provide me with a feeling of security in science teaching.	Yes_____; No_____
Yes_____; No_____	(5)	Provide me with an idea of what should be taught at my grade level.	Yes_____; No_____
Yes_____; No_____	(6)	Provide me with a greater interest in science teaching.	Yes_____; No_____
Yes_____; No_____	(7)	Provide me with units and materials necessary to teach science.	Yes_____; No_____
Yes_____; No_____	(8)	Provide me with methods and techniques necessary to teach science.	Yes_____; No_____

31. I would provide more experimentation and demonstration in my science classes if the use of equipment did not cause too much confusion in the classroom. Yes_____; No_____.

32. Science should be taught in the elementary school as a factual course in order to provide students with some knowledge of their environment. Yes_____; No_____.

33. Men generally make better science teachers than do women. Yes_____; No_____.

34. I would provide more experimentation and demonstration in my science classes if the use of equipment were not too time consuming. Yes_____; No_____.

35. Science in the elementary school should be taught as a method of inquiry in order to provide basic understanding of science. Yes_____; No_____.

36. Men have more aptitude for teaching science than do women. Yes_____; No_____.

37. Designing and controlling the elementary science program should be left to the elementary school teachers as they are more familiar with the capabilities of their students. Yes_____; No_____.

38. Students should be expected to know and, if necessary, memorize basic scientific facts. Yes_____; No_____.

39. Science textbooks presently available are adequate and there is no need for revision. Yes_____; No_____.

40. The benefits that a student derives from actual first-hand laboratory type experimentation cannot be justified in terms of the amount of time that it demands. Yes_____; No_____.

41. It is more important for the elementary student to understand the purpose and method of science than for him to be acquainted with the latest theories and facts. Yes_____; No_____.

42. The need for the student to acquire factual information is greater than the need for him to understand the ways in which hypotheses are developed. Yes_____; No_____.

43. First-hand laboratory experience demands skills which are above the capacities of elementary school children. Yes_____; No_____.

44. A student comes to understand science through participating in science rather than by serving as a bystander who only reads about science. Yes_____; No_____.

45. Wholesale revision of the conventional elementary school science course is necessary if a modern curriculum is to be developed. Yes_____; No_____.

46. I often find it difficult to answer some of the questions my students ask concerning science. Yes_____; No_____.

47. My students often want to study phases of science with which I am unfamiliar. Yes_____; No_____.

48. To do an adequate job of teaching in the elementary school, a teacher need only be familiar with that knowledge that is presented in junior high school textbooks. Yes_____; No_____.

49. I would like to teach my students the "scientific method" but it takes too much time. Yes_____; No_____.

50. I am not familiar with science and I would prefer leaving the teaching of science to those who are familiar with it. Yes_____; No_____.

51. I would like to teach my students the "scientific method" but it is too confusing. Yes_____; No_____.

52. To do an adequate job of teaching science in the elementary school, a teacher need only be familiar with that knowledge that is presented in high school biology, chemistry, and physics textbooks. Yes_____; No_____.

53. I feel that my science background is out of date; therefore, I would prefer not teaching elementary school science. Yes_____; No_____.

54. Scientists as well as elementary school teachers should be responsible for designing and controlling the elementary school science program. Yes_____; No_____.

55. To do an adequate job of teaching science in the elementary school, a teacher need only be familiar with that knowledge that is presented in the basic college introductory courses. Yes_____; No_____.

56. It is more important for children to learn the practical applications of science than to learn the underlying scientific principles. Yes_____; No_____.

57. Special science courses should be provided for elementary teachers in the teaching of science that would provide orientation of subject matter suitable for teaching in the elementary school. Yes_____; No_____.

58. In science, the student's work should be centered in laboratory type experiences where real problems are explored. Yes_____; No_____.

59. I would like to devote more time to the teaching of science but the language arts are more essential. Yes_____; No_____.

60. I would like to devote more time to science teaching, but social studies are more essential. Yes_____; No_____.

61. I would like to devote more time to science teaching, but arithmetic is more essential. Yes_____; No_____.

62. I would like to devote more time to science teaching, but it interferes with the basic elementary school program. Yes_____; No_____.

63. Too often I have to answer "I don't know" to science questions asked by my students. Yes_____; No_____.

64. The breadth of pre-service requirements for preparing for elementary school teaching left little time to pursue science to the depth needed to prepare me to teach elementary school science. Yes_____; No_____.

65. I would like to up-date my science background, but I do not have the time available for doing so. Yes_____; No_____.

66. I have kept my science background up-to-date by reading current scientific information. Yes_____; No_____.

67. I would like to up-date my science background by attending classes which offer special methods and materials for elementary science teaching. Yes_____; No_____.

68. I feel that my present science background is sufficient for teaching science. Yes_____; No_____.

69. Approximately how much time do you devote to teaching science? (State in terms of times per year, days per month, days per week, or hours per day)

_____

_____

_____.

70. Approximately how much time in proportion do you devote to science demonstrations or experimentation?

_____

_____

_____.

APPENDIX B

List of Participating Groups[98]

I. Pilot Study Group (students (who are teachers) in Oklahoma State University Extension Class, Blackwell, Oklahoma.)

II. Public School Teachers:

1. Blackwell, Oklahoma
2. Enid, Oklahoma
3. Perry, Oklahoma
4. Tulsa, Oklahoma

III. Students (who are teachers) in Oklahoma State University Extension Classes:

1. Bartlesville, Oklahoma
2. Bristow, Oklahoma
3. Claremore, Oklahoma
4. Pawhuska, Oklahoma

IV. Student-teachers (undergraduate students at Oklahoma State University, enrolled in an undergraduate science methods course, who have completed student-teaching and who, for the sake of this study are considered to be inexperienced teachers.)

V. Students (who are teachers) enrolled in a graduate science methods course on the campus of Oklahoma State University.

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[98] A Breakdown of these groups by percent which considers the five categories established for comparative analysis is found in Table IX.

Table IX

Participating Groups

Types of Information	A*	B*	C*	D*	E*	F*	G*	H*
Classroom Teaching Situation								
Departmentalized	0.00	98.00	2.00	0.00	0.00	0.00	0.00	0.00
Self-Contained	13.36	0.00	4.33	13.00	5.78	29.96	30.69	2.88
Number of Years Teaching Experience								
0 to 3 Years	2.29	8.40	3.05	3.05	2.29	63.36	13.74	3.82
4 or More Years	16.49	19.59	4.64	16.49	6.70	0.00	34.54	1.55
Grade Teaching								
K, 1, 2 or 3	9.87	1.97	5.26	11.84	4.61	38.16	26.97	1.32
4. 5 or 6	16.15	2.13	3.85	13.08	6.92	19.23	33.85	4.61
3 thru 6	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00
1 and 2	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00
1 thru 6	0.00	93.75	0.00	6.25	0.00	0.00	0.00	0.00

A* Blackwell, B* Tulsa, C* Perry, D* Extension Classes, E* Pilot, F* Student Teachers, G* Enid, H* Graduate Science Methods Course Summer 1965 Oklahoma State University

Table IX (Continued)

Types of Information	A*	B*	C*	D*	E*	F*	G*	H*
Course Work								
1-6 Hours	23.91	2.17	6.52	13.04	10.87	4.35	36.96	2.18
7-12 Hours	7.48	6.80	3.40	11.56	6.12	38.10	23.81	2.73
13-18 Hours	6.00	20.00	4.00	10.00	0.00	28.00	30.00	2 00
19-24 Hours	3.13	25.00	0.00	9.38	0.00	28.13	34.36	0.00
25-30 Hours	0.00	50.00	0.00	0.00	10.00	20.00	20.00	0.00
More 30 Hours	17.39	52.17	8.70	8.70	4.35	0.00	4.35	4.34
Science Methods Course								
Yes	8.12	11.54	3.42	8.12	6.41	35.47	23.93	2.99
No	19.78	21.98	5.49	18.68	1.10	0.00	31.87	1.10

A* Blackwell, B* Tulsa, C* Perry, D* Extension Classes, E* Pilot, F* Student Teachers, G* Enid
H* Graduate Science Methods Course Summer 1965 Oklahoma State University

VITA

Sallylee Hughes Hines

Candidate for the Degree of

Doctor of Education

Title: A STUDY OF CERTAIN FACTORS WHICH AFFECT THE OPINIONS OF ELEMENTARY SCHOOL TEACHERS IN THE TEACHING OF SCIENCE

Major Field: Secondary Education

Biographical:

Personal Data: Born at Camden, Arkansas, September 5, 1932, the daughter of Frances M. and Olin L. Hughes.

Education: Attended elementary school at Camden and Conway, Arkansas; graduated from Conway High School, Conway, Arkansas; received the Bachelor of Science Degree from Arkansas State Teachers College, Conway, Arkansas, with a major in Chemistry and minors in Biology and Mathematics, in May, 1953; received the Master of Education Degree from the University of Arkansas with a major in secondary education in January, 1957; selected as a participant in the Arkansas Experiment in Teacher Education in 1954; awarded a National Science Foundation Summer Institute for the summers of 1956 and 1958; awarded a National Science Foundation Summer Fellowship for the summers of 1959, 1960, and 1961; awarded a National Science Foundation Academic Year Institute for 1960-61; completed the requirements for the Doctor of Education Degree in July, 1966.

Professional Experience: One year teaching experience in Searcy, Arkansas, while participating in the Arkansas Experiment in Teacher Education; one year as Head of the Science Department and teacher in Crossett, Arkansas; nine years as supervisor of science education at the University of Arkansas, Fayetteville, Arkansas; appointed graduate assistant at the Oklahoma State University in 1964; returned to the University of Arkansas, September, 1965.