DOCUMENT RESUME

ED 244 791 SE 044 516

AUTHOR	Bonnstetter, Ronald J.; And Others
TITLE	Teachers in Exemplary Programs: How Do They Compare?
INSTITUTION	National Science Teachers Association, Washington, D.C.
SPONS AGENCY	National Science Foundation, Washington, D.C.
PUB DATE	83
GRANT	NSF-MST-8216472
NOTE	89p.; This monograph is based on the unpublished doctoral dissertation of Ronald J. Bonnstetter, "Characteristics of Teachers Associated with an Exemplary Program Compared with Science Teachers in General," 1983, University of Iowa.
AVAILABLE FROM	NSTA Publications Department, 1742 Connecticut Ave., NW, Washington, DC 20009.
PUB TYPE	Reports - Research/Technical (143)
EDRS PRICE	MF01/PC04 Plus Postage.
DESCRIPTORS	Elementary School Science; Elementary Secondary Education; *Performance Factors; Science Course Improvement Projects; Science Education; *Science Instruction; Science Materials; *Science Teachers; Secondary School Science; *Teacher Attitudes; *Teacher Characteristics; Teacher Education; *Teaching Methods
IDENTIFIERS	National Science Foundation; Science Education Research

ABSTRACT

Questionnaires with over 400 items were administered to key teachers of the 1982 Search for Excellence in Science Education programs. It was hoped to compare the characteristics of teachers of exemplary programs with those possessed by teachers in general. Results are presented under the following headings: (1) qualifications of science teachers; (2) factors affecting instruction; (3) teacher knowledge and attitudes toward science; (4) instructional techniques and classroom activities; (5) sources of information concerning new developments in education and science; and (6) experience with selected federally funded science materials. Results indicate that key teachers of exemplary programs when compared to teachers in general are older, have more teaching experience, and are more likely to have graduate degrees and recent experience with college credit courses. They are more likely to find other teachers, inservice programs, professional organization meetings, and journals as sources of information. In addition to rating themselves as "very well qualified," they cite few problems with materials, facilities, or space. Their curricula tend to be locally developed, and they use more hands-on manipulatives and laboratories and lecture less than teachers in general. It is suggested that these and other findings provide the rudimentary elements to start the process of designing a model of excellence in science education. (Forty-one data tables are included in appendices.) (JN)

TEACHERS IN EXEMPLARY PROGRAMS: HOW DO THEY COMPARE?

by

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ACKNOWLEDGEMENT

Funding for the 1982 Search for Excellence in Science Education and the FOCUS ON EXCELLENCE series has been provided by the National Science Foundation and the University of Iowa.

The 1982 FOCUS ON EXCELLENCE, Volume 1, series includes separate monographs on:

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This monograph has been prepared with support from the National Science Foundation (MST-8216472). However, any opinions, findings, conclusions, or recommendations expressed herein are those of the staff for the Search for Excellence project and do not necessarily reflect the views of the National Science Foundation.

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PROLOGUE: A NEED FOR MODELS AND UNDERSTANDING

While we read often of problems in our schools and we have seen many case studies and reports of current teaching practices, we have few real-world models of excellence in science education. The Search For Excellence In Science Education, sponsored by the National Science Teachers Association and funded by the National Science Foundation, seeks to provide examples which are more than models of excellent programs. We hope to provide models of change, innovation, maintenence, and program evolution as well.

Although many exemplary programs are described in the Focus On Excellence series, many questions have been raised about teachers who inspired, created, and maintain these exemplary science programs. What are the characteristics of these teachers and how do they compare to science teachers in general? We have been asked this many times. We hope this volume provides a description of teachers which will aid in promoting excellence in science education through stimulating additional research into the nature of good teaching and teachers; and a desire on the part of individuals to attain the heights of excellence reached by the teachers in these programs.

Preservice teacher education programs in general do not appear to be properly preparing our new teachers. This lack of adequate preparation for teaching may also be related at least in part to a lack of appropriate classroom models. Perhaps science teacher preparation programs will respond as well.

The route to success is considerably more direct by knowing what does work. Then, we can design our preservice and inservice programs to capitalize on these proven attributes.

These exemplary programs neither exactly model the desired state of science education nor do the teachers always employ the most appropriate teaching strategies as described by the Project Synthesis research team. But, further research to identify more precisely the influence of various behaviors on learning combined with the knowledge gained from these exemplars must surely lead to a state of science education vastly improved over the typical situation described in the NSF Status Studies of 1978.

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A CRISIS IN SCIENCE EDUCATION

"For the first time in the history of our country, the educational skills of one generation will not surpass, will not equal, will not even approach, those of their parents."
A Nation At Risk, p. 11

The findings of the National Commission on Excellence in Education indicate that few of the most academically able students are entering teaching, teacher preparation programs are inadequate, the working environment of teachers is unacceptable, and the United States is facing a serious shortage of teachers in key fields. The shortage of science and mathematics teachers may well be the most serious of all. The Commission in 1981 surveyed 45 states and found teacher shortages for mathematics in 43, shortages of earth science teachers in 33 states, and shortages of physics teachers in every state. The findings also show that half of the newly employed mathematics, science, and English teachers are not qualified to teach these subjects and, at present, less than one-third of the high schools in the United States offer physics which is taught by a qualified teacher. Paul Hurd, addressing the National Academies of Science and Engineering Convocation on Science and Math Precollege Education, stated: "We are raising a new generation of Americans that is scientifically and technologically illiterate."

Goodlad, after visiting over 1000 classrooms, paints a dismal view of todays schools (1983). The dominant teaching procedures he encountered included: lecturing, monitoring seatwork, and quizzing with teacher-centered lecture the single most prevalent classroom activity. Situations almost completely lacking were student-to-student interaction, small cooperative student work groups, or any attempt at alternative approaches to educational goals.

Goodlad found tremendous curriculum similarity between schools. The continuity in topics, textbook content, factual orientation and knowledge tested all placed an emphasis on learning by recall, not on inquiry. The problems extended well beyond curriculum and teaching stategies and even affected the attitudes of teachers and students alike. In schools that were perceived as least satisfying, Goodlad found teachers frequently expressing frustration with the administration and viewing the building principal as unsupportive. In contrast, "Teachers often respond eagerly to alternative methods of teaching when they are given support, encouragement and protection" (p. 553).

Yager (1983), in a presentation to the AAAS National Conference, presented a compilation of recent research findings he felt were signs of a crisis in science education.

Nearly all science teachers "present" science via lectures and/or question and answer techniques; such lectures and question/answer periods are based upon the information that exists in textbooks chosen.

Over 90 percent of the science teachers view their goals for teaching in connection with specific content; further, these goals are static, i.e. seldom changing, givens.

Over 90 percent of all science teachers use a textbook 95 percent of the time; hence the textbook becomes the course outline, the framework, the parameters for student's experience, testing, and a world view of science.

Laboratories are largely verification of what students have been told in class or what they have read in textbooks; there is little evidence that students ever experience one real "experiment" throughout the school program.

Paul Dehart Hurd has stated that students today have not had direct experience with science. By experience he means experiencing and experimenting. Brandwein (1981) feels that many students graduate without a single experience with even one real scientific experiment. The National Assessment of Educational Progress (NAEP) data for 1977 and 1981 support these conclusions as well.

NAEP for both years revealed only half of 17 year olds have ever read a science article in a newspaper or magazine when not required while only a third have ever read a book about science or scientists. More than half of 17 year olds say science class makes them feel unhappy and less than half find the things studied in science interesting. Seventy percent say science classes make them feel unsucessful, half say science classes make them feel uncomfortable, and slightly more than half say science classes make them feel stupid.

These same 17 year olds more than half the time say they seldom or never get to choose topics to study and 75% say they never choose the way they want to learn science. Most say they never select the order of science topics studied and half feel they are never permited to work at their own rate.

It is obvious that students have feelings as negative about science classrooms as those Goodlad himself had after visiting 1016 classrooms. Is it surprising that few students take optional science courses or indicate an interest in science careers? Certainly, we would expect such negative views of science and science teaching to lead to declining test scores.

If we are ever to solve this dilemma and truly achieve science literacy for the general population, we must have, as Goodlad suggests, appropriate classroom models and a supporting and encouraging atmosphere for learning science.

PROJECT SYNTHESIS

In searching for these appropriate models, 23 American science educators developed criteria for a new science education framework. Project Synthesis examined the status of precollege science education and synthesized both an "actual" and a "desired" condition for science education. In analyzing the actual state, the synthesis effort tied together four extensive studies, each from a different perspective, providing a comprehensive picture of the actual state of science education. These data bases include three NSF funded studies and one Office of Education project. By studying foundation reports, societal indicators, and philosophical articles, the Project Synthesis research team identified valid directions for science education.

The first of the NSF studies summarized the published and unpublished science education literature in "The Status of Pre-College Science, Mathematics and Social Science Education: 1955-75" (Helgeson,et al, 1977). The second study was conducted at the Research Triangle Institute and directed by Iris Weiss (1978). Her national, random, stratified survey of administrators, supervisors, teachers and other school personnel gathered information concerning curricula, course offerings, teaching methods, enrollments, individualized materials, teaching assignments, support services and demographic information about teachers and teaching practices. The third, "Case Studies in Science Education", was an in-depth-study of what goes on in science classrooms as reported by trained ethnographic researchers who spent significant time in 11 school districts (Stake and Easley, 1978). The National Assessment of Educational Progress served as the fourth component of this comprehensive picture of science education. The NAEP data offered insights into science knowledge, skills, attitudes and educational experiences of pre-college students.

A RESPONSE TO THE CRISIS: A SEARCH FOR EXCELLENCE

> "It is our duty to do one of two things, either to ascertain the facts, whether by seeking or by personal discovery, or, if this is impossible, to select the best and most dependable theory which human intelligence can supply, and use it as a raft to ride the seas of life." (from Plato's Phaedo)

While the actual state of science education seemed bleak as described by these studies, we were convinced that excellent teachers, programs, and schools existed. Our desire for evidence of excellent and appropriate models led to the 1982 Search for Excellence in Science Education. Sponsored by the National Science Teachers Association and the University of Iowa Science Education Center and funded by the National Science Foundation, the Search for Excellence in Science Education Steering Committee was charged with the responsibility of identifying exemplary pre-college science programs.

The 1982 search focused on elementary science, biology, physical science, science as inquiry, and science/technology/society. Criteria for the Search For Excellence were derived from the desired condition goals of Project Synthesis. The Council of State Science supervisors endorsed the effort and was a full partner in this program. With their help, a Search for Excellence committee was formed in each state, headed frequently by the state science consultant. State chairs announced the program in each state and processed all nominations in an effort to identify science programs which most closely approached the desired state criteria. One hundred sixty-five nominations of excellence were made throughout the United States. Members of the Project Synthesis research team then analyzed these nominations and identified fifty programs that best met the established criteria. Biology, science/technology/society, and science as inquiry each had ten exemplars chosen. Eight physical science and twelve elementary programs completed the field of fifty.

Key teachers for each exemplary program were identified by the contact person and requested to complete and return an extensive questionnaire documenting teaching experience, educational preparation, the extent of professional involvement, and views of science. A total of 216 key teachers from the 50 exemplar programs were identified and used in this special study of teachers. Comparisons of these key teachers to science teachers in general were made using data reported by Iris Weiss in 1978 (see appendix 1, page 45).

These exemplary programs and their teachers represent a ready data pool describing some of the best science programs in the nation. These data should aid in determining what program and teacher characteristics lead to success. Until educators can ascertain distinct cause and effect relationships in sucessful classroom instruction, we must identify and model the best and most successful programs and teachers. Although this study in no way implies that teachers of exemplary programs are themselves exemplary, the substantial difference between the characteristics of these teachers and science teachers in general correlates with and helps explain many exemplary program characteristics. Without a doubt, classroom actions of teachers and their views of science influence student outcomes.

Describing characteristics of key teachers of exemplary programs represents a major component which must be documented if we hope ever to provide a path to excellence in science education. The continued collection of data regarding teacher characteristics coupled with complete program and student descriptions will lead to greater understanding and insight into the teaching-learning environment. Such documented evidence will have considerable bearing on future research, teacher education programs, curriculum development, and college science teaching.

The data collected are not intended to be prescriptive. Rather, we hope they are descriptive of good practice - but, the descriptions provided in this study can not be removed from context, transplanted, and expected to create excellence. Each behavior described is influenced by the educational environment, the physical setting, and by the values and expectations of the entire school community. Excellent programs were designed by teachers and administrators with a concern for the total education environment taken as a simultaneous and dynamic whole.

In addition, the teacher effect on student learning can not be attributed to any one factor, but involves the interaction of many of these same factors. Describing and imitating teachers of exemplary programs is only part of a formula for successful science education.

THREE QUESTIONNAIRES

Questionnaires with over 400 questions provided information to answer six major questions. In answering some of these questions characteristics of teachers of exemplary programs were compared to those possessed by teachers in general. We asked:

1. How do qualifications and need for assistance of teachers of exemplary programs compare with those of other science teachers?

2. What other factors do teachers of exemplary programs feel affect their teaching? Do science teachers in general agree?

3. To what degree do teachers of exemplary programs display a knowledge of the nature of science? What attitude toward science do they display?

4. How do the methodologies and classroom activities used by teachers of exemplary programs compare with those used by other science teachers?

5. How do primary sources of information concerning new developments in education and science for teachers of exemplary programs compare to sources used by science teachers in general?

6. How does experience with selected science curriculum materials among teachers of exemplary programs compare to the experience of other science teachers?

Key teachers completed three questionnaires. The first was identical to a questionnaire developed by Iris Weiss at the Research Triangle Institute. These key teacher characteristics were compared with the national norms developed by the Research Triangle Institute for its Report of the 1977 National Survey of Science, Mathematics and Social Studies Education (Weiss, 1978). Her multistage, stratified random sample status study of every K-12 science teacher in the United States and the District of Columbia provided information on classroom materials and practices as well as teacher characteristics. The Weiss component of the instrument used in this study was supplemented by the addition of a series of questions related to teachers and their programs. The supplemental questions, designed by several Project Synthesis researchers, provide additional information needed for a more complete picture of the exemplary programs and their teachers. A third and final questionnaire, the Scientific Attitude Inventory (SAI), (Moore and Sutman, 1970), was administered to assess teacher understanding of the nature of science as well as their individual views of science and both positive and negative scientific attitudes.

Questionnaires were sent to contacts of all exemplary programs with a letter describing the process to be followed in identifying key teachers and requesting that completed questionnaires be returned. Key teachers were defined as "those teachers teaching the program as intended. The smaller programs, composed of one class or housed in one building, were asked to have each key teacher complete a questionnaire. The number of key teachers selected for the larger programs was based on size. For example, the Stones and Bones program of Los Angeles Unified School District was asked to identify approximately 20 key teachers, 19 completed surveys were returned; Jefferson County Colorado returned 23 of the 20 to 30 surveys requested; and the school contact for the Ames Elementary Program, located in seven different buildings with 79 teachers, was asked to identify between seven to ten key teachers for use in the survey of teachers. Ultimately nine Ames teachers completed questionnaires.

Also, survey data were supplemented by examining a portion of the original nomination material including the nomination questionnaire. The Likert scaled nomination questionnaire was designed to examine program focus in response to specific aspects of the Project Synthesis desired state. A set of questions was developed for each program area based on the corresponding desired state goals.

The data gathered for this study represent all key teachers of the 1982 Search for Excellence in Science Education programs. This data gathered from key teachers is presented as a percentage of the total The primary comparison data, from the Report of the 1977 National Survey of Science, Mathematics, and Social Studies Education, also represent a population--all science teachers in the United States. Any difference in response between the two populations has the potential of being significant. Therefore the use of response percentages is much more appropriate than classical tests for significance. All items of the questionnaire have been analyzed by grade level and program area and responses for The Scientific Attitude Inventory were analyzed by gender as well.

RESULTS AND DISCUSSION

Qualifications of Science Teachers

How do qualifications and need for assistance of teachers of exemplary programs compare with those of other science teachers?

Teachers were asked to give their perceptions of their personal qualifications for teaching their present courses and to provide insights into various aspects of teaching in which they felt a need for additional assistance. Whenever possible comparisons are made with other available survey data. Data tables have been included in the appendices for reference purposes.

Teacher Characteristics

It is interesting to note the similarities as well as the differences that exist between the Search for Excellence in Science Education (SESE) teachers and the national teacher data national sample (NS) collected by the Research Triangle Institute. One of the first similarities can be found by comparing teacher gender at both the elementary and the secondary level. Secondary level SESE gender composition is almost identical to the national sample while the SESE elementary programs included a slightly larger male component.

	NS K-6	SESE K-6	NS 7-12	SESE 7-12
MALE	17	26	68	69
FEMALE	83	74	32	31
Total	839	114	832	102

A number of questions related to teaching experience indicate that SESE teachers have had more teaching experience than found in the national sample. Data indicate that SESE teachers have spent a substantial period of time teaching in their present position. The SESE elementary teachers have spent almost ten years in their present school district and their secondary counterparts have remained stable for 14 of their 16.5 years of teaching. SESE secondary teachers have spent more time in their present job than the average teacher included in the national sample has spent on an entire career (see appendix 2, page 45).

Undergraduate Educational Preparation

A large number of SESE secondary teachers completed their undergraduate degrees without obtaining teaching certification. Eleven percent of the elementary teachers and 29 percent of the SESE secondary teachers originally did not prepare for teaching. Many of the secondary teachers that did not originally obtain undergraduate certification graduated with degrees from science departments. In many cases these people spent time working in science-related fields prior to entering the educational realm. This non-teaching science-related experience of the secondary teachers may partially explain why their average age (42) is somewhat higher than expected based on total years of teaching. No comparative data are available to indicate whether this professional involvement outside of education is unique to the SESE programs.

	Percent of Teachers		
	Elementary Education	Secondary Education	Other than Education
SESE K-6 (N= 113)	84	5	11
SESE 7-12 (N= 102)	3	67	29

Percent With Degrees Beyond Bachelor's

Weiss found what was considered sizable numbers of teachers having earned one or more degrees beyond the bachelor's. However, our findings indicate that the SESE teachers are even more likely to hold advanced degrees than the national sample.

NS K-6	SESE K-6	NS 7-12	SESE 7-12
29	54	52	76
N= 840	114	832	102

Percent With College Science Concentration

The trend of more secondary teachers holding advanced degrees than elementary teachers is the case in both surveys. Data show that 68 percent of the advanced degrees held by SESE secondary teachers represent a science concentration while only 11 percent of the elementary teachers had such a concentration.

	Undergrad	Graduate
SESE K-6 (N= 113)	17	11
SESE 7-12 (N= 102)	93	68

Teachers Taking a College Credit Course Within Two Years

Over 80 percent of the secondary SESE teachers have completed more science courses than is required for most undergraduate science degrees (see appendix 3, page 46). In addition, 47 percent of the secondary and 65 percent of the elementary SESE teachers have taken a college course for credit within the last two years.

NS K-6	SESE K-6	NS 7-12	SESE 7-12
50%	65%	43%	47%

The perceptions of elementary SESE teachers concerning their qualifications to teach major subjects is compared against the national sample. The most significant difference is found in the science category. While 16 percent of the national sample perceive that they are not qualified to teach science, only one Search for Excellence elementary teacher perceived a weakness. The entire elementary Search for Excellence group perceived themselves as being better qualified in all four major subject matter areas than did the national sample (see appendix 4, page 46). A feeling of adequacy also is present among secondary SESE teachers. While 13% of the NS secondary teachers feel unqualified, only five percent of the SESE secondary teachers is teaching a course where they feel unqualified. The national survey indicated that teachers who perceived an inadequacy in one of their present courses were referring to science classes and not courses being taught outside their field. The SESE teachers also referred to science related courses. The areas of inadequacy mentioned by SESE teachers include courses in physics, computer math, advanced biology and medical technology (see appendix 5, page 47).

Professional Involvement

Over three-fourths of the secondary and over a third of the elementary SESE teachers has attended at least one national professional meeting in the last ten years. The majority of the SESE teachers are relatively current in their attendance at national science related meetings. Only the teachers of science as inquiry programs stand out for their lack of involvement in national science-related meetings. But, this subgroup does include one elementary program and several programs from economically poor school systems (see appendix 6 and 7, pages 47,48).

The survey data indicate a tremendous professional involvement among the SESE teachers. Five percent of the elementary and 21 percent of the secondary exemplary program teachers are involved in science clubs (see appendix 8, page 48). A large percentage also have coaching responsibilities. Over one-third of the SESE teachers indicated involvement in other extra-curricular assignments. These include student council, math teams, and work with gifted and talented programs. In addition to these extra-curricular assignments, 72 percent of the secondary teachers made presentations to local science teacher meetings and inservice functions. Fifty-two percent of the secondary SESE teachers also made presentations at state, regional or national science teacher meetings. Involvement in making professional presentations extends across all five of the secondary programs. The elementary SESE teachers have also made professional presentations but to a lesser extent (see appendix 9 and 10, page 49).

Needs for Assistance

The questionnaire included a list of areas and asked the teacher to specify for each whether they (1) usually do not need assistance, (2) would like assistance from a resource person but receive little or none, or (3) perceive a need for assistance and receive adequate assistance. Appendix 11, page 50, compares the elementary SESE teachers against the national sample while appendix 12, page 51, presents the secondary needs comparison.

The area of greatest need stated by the national sample at all levels includes learning new teaching methods, obtaining information about instructional materials, implementing discovery/inquiry approaches, and using manipulative or hands-on materials. In addition, the national sample of elementary teachers perceived a need for subject-matter information, while the national sample at the secondary level perceived a need for greater articulation of instruction across grade level. There is a reduction of perceived needs by the SESE teachers in almost every category. The same holds true when comparing the perception of teachers receiving adequate assistance. The areas in which the Search for Excellence teachers received the greatest assistance closely correspond with the perception where the greatest need for assistance existed and was not being met of the national sample. For example, 63 percent of the SESE elementary teachers received adequate assistance in obtaining information about instructional materials and only seven percent feel an unmet need. Correspondingly, forty-four percent of the needs of teachers from the national sample went unattended and only 23 percent felt they received adequate assistance.

Learning New Teaching Methods

Forty-five percent of the NS elementary teachers and 44 percent of the secondary desired assistance with learning new teaching methods. However, they receive little or no help. A drastic difference can be seen in the elementary program comparison. Although a similar percentage of the national sample and of the SESE teachers felt that they do not need assistance, there was an overwhelming agreement among the search for excellence teachers that, once a need is perceived, it was met. The secondary SESE teachers also were having their needs to learn new teaching methods met to a much greater extent.

Obtaining Information About Instructional Materials

The national sample considered this to be one of the major needs in their teaching. The SESE teachers indicate that obtaining information concerning instructional materials is the major area for which their needs are being presently met.

Implementing Discovery/Inquiry Approach

Many of the currently available curriculum materials require the implementing of a discovery/inquiry approach. Only six percent of the SESE elementary teachers feel that their needs in this area are being met. Over one-third of the national sample perceive a need for assistance in implementing discovery/inquiry methodology but are receiving little or no assistance. The difference between the national sample and the SESE teachers is not as dramatic but still indicates that this need is satisfied to a much greater extent.

Using Manipulative or Hands-on Materials

Over 30 percent of the teachers in the national sample indicate that they would like assistance in using manipulatives while only 4 percent of the Search for Excellence elementary teachers and 18 percent of the SESE secondary teachers perceive such a need. Combine this information with the fact that manipulative materials are used less than once a week in more than half of all NS science classes and one may start to understand the reason.

Obtaining Subject Matter Information

Thirty-four percent of the national sample are in need of subject matter information and are not receiving it. Only six percent of the Search for Excellence teachers perceive such an unsatisfied need while 51 percent indicate a need but are receiving adequate assistance.

Other Areas of Needed Assistance

In all remaining areas, including: establishing instructional objectives, lesson planning, actually teaching lessons, maintaining equipment, working with small groups, maintaining discipline, maintaining live animals & plants, and articulation of instruction across grade levels, the SESE teachers are having their needs met to a greater extent than their national sample counterparts.

Factors Which Affect Instruction

What other factors do teachers of exemplary programs feel affect teaching? Do science teachers in general agree?

Teachers were given a list of problems and asked to rate the seriousness of each. The SESE teachers considered their exemplary program and the national sample used their major subject matter area in rating each of the factors as a serious problem, somewhat of a problem, or not a significant problem (see appendix 13 and 14, pages 52-55).

The survey data suggest that the SESE teachers are far less likely to consider a given factor a serious problem. The elementary instructors are even less likely to find these factors a serious problem than are the secondary SESE teachers. A rank order of the most serious problems among the national sample include: (1) lack of materials for individualizing instruction, (2) insufficient funds, (3) inadequate facilities, (4) inadequate reading ability. All four of these problem areas are perceived as serious by more than 20 percent of the national sample. The most serious problem mentioned by the SESE teachers (classes too large) was marked by only 16 percent. The rank order of severity based on the SESE teachers includes; (1) class sizes, (2) insufficient funds, (3) not enough time to teach science, and (4) lack of teacher planning time. The only duplication between the two groups is an agreement of insufficient funding. The other three serious problems mentioned by the SESE teachers are more directly related to their classroom instruction than are the major problems mentioned by the teachers in the national sample.

The **belief that science is less important than other subjects** is viewed in a very similar manner by both elementary samples. The secondary SESE teachers, however, view this factor as being much less significant.

Compliance with federal regulations indicates the inverse of the first factor. The secondary populations are in agreement while the elementary teachers view compliance to be a much less significant problem.

Inadequate facilities, as previously mentioned, is viewed by the national sample as being a serious problem by both elementary and secondary teachers. Twenty-eight percent of the elementary and 23 percent of the secondary national sample viewed inadequate facilities as a serious problem affecting science instruction. In contrast, only four percent of the elementary and nine percent of the secondary SESE teachers consider their present facilities to be a serious problem affecting science instruction.

Insufficient funds for purchasing equipment and supplies is not viewed as a significant problem by either survey group at the secondary level. The elementary programs, however, depict a major discrepancy in their views. Twenty-nine percent of the national sample view this as a serious problem while only nine percent of the SESE teachers concur. Only 30 percent of the national sample would conclude that insufficient funds for the purchasing of equipment and supplies is not a significant problem while 71 percent of the SESE teachers are so inclined.

Lack of materials for individualizing instruction may also be related to the insufficient fund factor. The lack of materials for individualizing instruction ranks as the most serious problem for the national elementary sample with 30 percent and second among secondary teachers with 28 percent. The elementary SESE programs have apparently met a great deal of the need for individualization as indicated by a meager five percent considering this a problem and 74 percent stating that materials for individualizing instruction is not a significant problem. The meeting of this need among the SESE secondary programs is not as clearly delineated. Twenty percent of the secondary teachers identified in the Search for Excellence view the lack of materials for individualizing instruction as a serious problem with only 39 percent considering it not significant.

Outdated teaching materials are considered more of a problem by the elementary national sample than by the secondary. Eighty-two percent of the SESE elementary teachers and 72 percent of the secondary do not have a problem with outdated teaching materials.

Insufficient numbers of textbooks was not considered a problem in either survey. Even so the SESE teachers consider this far less of a problem than the national sample. Over 80 percent of the SESE teachers did not consider insufficient numbers of textbooks as a significant problem.

Inadequate reading ability was considered the most serious problem by the national sample. Only 15 percent of the SESE secondary teachers considered reading ability to be a serious problem. Only 27 percent of the secondary SESE teachers did not view reading ability as a significant problem.

Lack of teacher interest in science is not considered a serious problem in either survey population although the secondary SESE teachers were less likely than other groups to view teacher interest as a problem.

Teachers inadequately prepared to teach science is considered less of a problem among the SESE teachers at both the elementary and secondary level then for NS teachers. The elementary teachers are more inclined to consider this a problem than the secondary, for example, 14 percent of the secondary and 53 percent of the elementary SESE teachers indicate such an inadequacy.

Lack of teacher planning time is viewed as a serious problem by the SESE secondary teachers and the national sample elementary teachers. Seventeen percent of the SESE teachers considered the lack of teacher training time to be a serious problem and 11 percent of the teachers in the national sample agreed. Twenty-one percent of the teachers in the elementary national sample considered the lack of teacher planning time to be a serious problem while only 11 percent of the SESE teachers hold this view.

Not enough time to teach science is considered more of a serious problem by the SESE secondary and elementary teachers than those in the national sample.

Class size being too large is a serious problem reserved for secondary programs. Over 20 percent of both the SESE and the national sample secondary teachers consider class size to be a serious problem.

Difficulty in maintaining discipline was not viewed as a serious problem by any of the respondent groups although the SESE teachers are more likely to consider discipline not to be a serious problem with three-fourths so stating.

Inadequate articulation of instruction across grade levels is still less often viewed as a serious problem by SESE teachers. The SESE secondary teachers are far less likely than national sample teachers to consider articulation a serious problem.

Inadequate diversity of science electives is again far less likely to be a significant problem in the SESE programs than the national sample.

Low enrollment in science courses completes the list of factors considered for potential influence on science instruction. Again the generalization can be made that the SESE teachers are far less likely to consider low enrollment in science courses a significant factor affecting science instruction.

Sources of Inspiration

The SESE teachers were given a list of potential sources of teaching and curriculum inspiration. On each item they were to respond positively or negatively to the effect that the item had on their teaching inspiration. The item "other teachers as a source of inspiration" had the largest percentage of positive respondents among the secondary teachers and the second highest among the elementary choices (see appendix 15, page 56).

The rank order of the first five sources of inspiration among elementary SESE teachers includes: (1) local subject specialists/coordinators, (2) other teachers, (3) local inservice programs, (4) college courses, (5) journals and other professional publications and (6) involvement in project development. A similar rank ordering among secondary teachers includes the following factors as sources of inspiration: (1) other teachers, (2) journals and other professional publications, (3) college courses, (4) involvement in project development, (5) meetings of professional organizations, and (6) local inservice programs. No comparative data are available for sources of inspiration for other groups.

Time Spent on Science

The questionnaire surveyed teachers concerning the average number of minutes spent on each of the four major elementary subject matter areas. The SESE Teachers indicate greater time spent on math and science. The time spent on science in the SESE elementary programs is 29 minutes per day compared to 20 minutes reported by the national sample (see appendix 16, page 57).

The vast majority of the secondary search for excellence programs are offered for a full academic year. Course durations other than quarter, semester or full-year are due to summer and on-going programs (see appendix 17, page 57).

Involvement in Community Service Organizations

Many teachers of the exemplary programs are involved in community service organizations. Forty-one percent of the K-6 and 37 percent of the 7-12 SESE teachers are involved in community service organizations within their teaching community. Examples include: Lions, Kiwanis, youth groups, and many church related organizations. Three-quarters of the SESE teachers live in the community in which they teach.

Science Supervisor in District

Eighty percent of the K-6 and 60 percent of the 7-12 Search for Excellence teachers indicated having a science supervisor in their district. No comparative data of a national sample are available.

Enthusiasm for Teachi·g Science

Teachers of exemplary programs were asked to compare their current enthusiasm for teaching science with their enthusiasm as a beginning teacher. They were asked to respond on a Likert-type scale from 1-5 with one being lower and five being higher. The vast majority of these teachers indicate that their present enthusiasm is much greater than as a beginning teacher.

	Not Enthusiastic	Very Enthusiastic
K-6	3	85
7-12	9	67

Support for the Exemplary Programs and the Teachers

SESE teachers also were asked to rate the perceived support for themselves and their programs. A one through five Likert-type scale was employed with one being low and five high. All levels of the SESE teachers rated their support from these various groups as being about average. The secondary program teachers rated parents, teachers, and their school principal as being a four or five over 80 percent of the time. Even the support shown by the school board or individual board members for both elementary and secondary was well above average. These percentages might well be higher if not for an apparent lack of universal understanding of the concept of "school boards." A number of respondents indicated that they were unfamiliar with this level of administration (see appendix 18, page 58).

Time Spent by Exemplary Teachers

The majority of the elementary teachers are teaching science less than two hours a day while the secondary teachers are instructing from four to six hours per day. Twenty-four percent of the elementary teachers are specialists and spend a considerable amount of time instructing science. Forty-six percent of the elementary teachers spend less than two hours each week preparing science lessons; 45 percent of the secondary teachers spend in excess of eight hours per week in preparation (see appendix 19, page 59).

The contrast between these data and the scheduled planning time proves of interest. Eighty percent of the elementary teachers have four or less hours per week designed for all of their planning. Seventy-six percent of the elementary teachers indicate that they are spending four hours or less on science preparation alone. A similar discrepancy exists at the secondary level.

When asked how many hours per week the teachers spend working with other professionals planning science, the majority indicated less than two hours. Seven percent of the elementary and almost one-third of the secondary teachers spend over two hours per week working with other professionals planning science programs.

The majority of the SESE program teachers are instructing classes with average or mixed ability students. The exception is the inquiry program area with 52 percent of the program teachers indicating that their classes are composed of high ability students. Twenty percent of the physical science teachers indicate 20 percent low ability students due to several programs with multilevel courses (see appendix 20, page 60).

Teachers Knowledge and Attitudes Toward Science

To what degree do teachers of exemplary programs display a knowledge of the nature of science? What attitude toward **science do they** display?

Key teachers in each program completed the Scientific Attitude Inventory (SAI), to assess teacher understanding of the nature of science as well as their individual views of science. The sixty Likert-type items offer four possible responses ranging from strongly disagree to strongly agree. No neutral response is provided. Scores per scale have a possible range of 0-15. A score of 15 depicts a maximum response to positive statements and a maximum rejection of a negative attitude. The converse yields a score of zero. Therefore, a score of 7.5 indicates a neutral response to the attitude. A maximum score of 90 is possible on the intellectual and on the emotional scales making a possible total score of 180.

Results of Scientific Attitude Inventory

The total scores for the Search for Excellence secondary teachers is higher than for elementary teachers. This holds true for both the emotional and the intellectual subsections. When breakdowns are made by program, the physical science teachers score higher on the total than any of the other secondary programs. A breakdown of secondary programs by gender indicates very little difference in total scores (see appendix 21, 22 and 23, pages 61-66).

The most interesting aspect of the SAI is found in the 4B subscale. The score on 4B is substantially lower than any of the other subdivisions. These low scores indicate a lack of understanding of the nature of science and technology. Inquiry program teachers and secondary level Search for Excellence females scored lowest on the 4B subscale. Out of a possible score of 15, secondary females scored 5.8 and inquiry teachers scored 5.9. These scores indicate that many of the teachers of exemplary programs were incorrectly agreeing that, basically, science is a technology-developing activity, devoted to serving mankind, and that its value lies in its practical uses. The low score on this subscale may be of considerable concern if we truly wish the nature of science to be communicated in classroom teaching.

Instructional Techniques and Classroom Activities

How do the methodologies and classroom activities used by teachers of exemplary programs compare with those used by other science teachers?

Each of the teachers of exemplary programs were asked to answer a series of questions concerning the methods employed in their teaching including lecture, discussion, individual assignments and field trips. A separate question asked about the availability and use of a number of audiovisual materials. In addition, various examples of equipment and supplies were listed. The teacher indicated the availability and use of each of these items (see appendix 24 and 25, page 67 and 68).

Use of Teaching Techniques

Comparisons are made with the national sample K-6 and the 7-12 grade groupings. The SESE teachers are less likely to use lecture daily and more likely not to use lecture at all.

Seventy percent of the elementary exemplary program teachers indicated that discussion is used almost daily compared to 48 percent of the national sample. The national secondary sample indicate a greater use of discussion than the SESE secondary teachers as indicated by 54 percent of the national sample and only 49 percent of the Search for Excellence teachers.

Student reports and projects are used to a similar degree by both the national sample and the SESE teachers. A similar situation exists when comparing library work. Only five percent of the national sample teachers indicate that library work is assigned on a weekly basis compared to 21 percent of the SESE teachers. The national elementary sample was less likely to use library work (32 percent for SESE teachers in comparison to 21 percent for the teachers in the national sample).

Neither the national sample nor the recipients of the SESE questionnaire involved students in working at the chalkboard to any great extent. Over one-third of the groups indicate that this technique is not used.

Fourteen percent of the SESE elementary teachers use individual assignments on a daily basis compared to only nine percent of the national sample. A similiar pattern is seen in the secondary data.

The response to the use of manipulatives shows the greatest difference between the two survey groups, especially at the elementary level. Twelve percent of the national sample indicate that they never use this technique and only nine percent use manipulatives on a daily basis. In contrast all, of the SESE teachers are using hands-on-manipulatives or laboratory materials to some extent. Almost 90 percent are using them on a weekly basis. The secondary SESE teachers also indicate a greater use of this technique. Thirty-three percent of the secondary SESE teachers are using hands-on-manipulatives or laboratory materials on a daily basis. An additional 56 percent are using this technique at least once a week.

Televised instruction is not in great use either for the national sample or the SESE teachers. The only response that stands out is the comparison between the 71 percent of the national sample teachers that have never used televised instruction in contrast to only 41 percent of the SESE teachers. A similar overall lack of programmed instruction use is also seen in the national sample data as well as the SESE data.

The four year lapse between data pools and the tremendous surge in computer use and awareness may to some extent account for the increased use of computer assisted instruction (CAI) by the SESE teachers. The impact of computers at the elementary level compared to the secondary is still small even though 17 percent of the elementary SESE teachers signify that the computer is used at least once a month opposed to the one percent of the national sample. Greater CAI can be seen at the secondary level. Fifty-seven percent of the SESE teachers have never used a computer for instruction as opposed to 92 percent of the national sample. Over one-third of the SESE teachers are using CAI in some capacity compared to six percent of the national sample.

The use of tests and quizzes is comparable between the two groups. Tests and quizzes are notably more frequent at the secondary level where 58 percent of the national sample and 45 percent of the SESE teachers use this technique at least once a week.

The use of contracts is another technique which does not have widespread usage. More SESE teachers at both grade levels are using contracts than is the case for teachers from the national sample. Eighty percent of the secondary teachers from the national sample and 73 percent of the elementary sample have never used this technique. Sixty-eight percent of the SESE elementary teachers and 73 percent of the secondary have not used contracts with their students.

SESE teachers also are more likely to use simulations to a greater extent than their counterparts. Over 50 percent of the secondary and 61 percent of the elementary SESE teachers use simulations to some degree in their teaching.

Field trips and excursions also are more likely to be found in the exemplary programs. Seventy-two percent of the secondary SESE teachers use field trips and excursions to some degree in their exemplary programs. Almost 90 percent of the elementary SESE teachers make use of field trips as opposed to 77 percent of the national sample.

More than half of the elementary and secondary national sample have never had a guest speaker visit their class. Eighty percent of the elementary SESE teachers and 74 percent of the secondary use guest speakers to some extent. The use of teacher demonstrations is quite common in both survey groups.

Use of Audiovisual Aids

Teachers were asked the frequency of use of a number of audiovisual aids in their classrooms and a comparison with national norms is included. In these questions, teachers reveal whether audiovisual aid was needed in their instruction, its availability, and frequency of use (see appendix 26 and 27, pages 69 and 70).

Both survey groups use films to a similar degree. Sixteen percent of both the elementary and secondary national sample employ films at least once a week. Thirteen percent of the secondary SESE teachers and 21 percent of the elementary provide films on a weekly basis. Comparable usage of film strips and film loops is also found. Although usage of film loops is very similar, the category of "needed but not available" demonstrates an interesting contrast. Twenty-two percent of the elementary and 23 percent of the secondary national sample teachers would use filmloops if they were available while only nine percent of the elementary and three percent of the secondary SESE teachers have such a problem. The same contrast of availability can be seen in the use of tapes.

Secondary classes are far more likely to use slides than are elementary, especially among the SESE teachers. Nineteen percent of the secondary SESE teachers use slides at least once a week compared to only 2 percent of the national sample. Twenty percent of the elementary SESE teachers use slides once a month or more compared to five percent of the national sample. Again it is interesting to note the lack of need perceived by the Search for Excellence teachers as witnessed by only four percent of the secondary teachers viewing a need for slides that is not being met compared to 16 percent of the national sample. The same contrast is present in the elementary data with six percent of the SESE teachers having an unmet need and 22 percent of the national sample. The elementary programs are more likely to use records than are secondary classes. An additional 19 percent of the teachers in the national elementary sample would use records if they were available. Only six percent of the Search for Excellence teachers feel that this need is unmet.

Although widely used at both the elementary and secondary levels, overhead projectors are used to a greater extent by SESE teachers. It would be interesting to know how the overhead projectors are being employed in light of the limited use of lecture in the exemplary programs.

Thirteen percent of the elementary and 11 percent of the secondary national sample would use a standard TV if it were available. Only five percent of the elementary and four percent of the secondary SESE teachers have not had this need met.

Closed circuit TV is not widely used in either sample. The secondary programs, especially the SESE teachers, use closed circuit TV to a greater extent.

A similar situation exists in the use of videotape recorder/players. Both the national sample and the SESE teachers perceive an unmet need in this category. Seventeen percent of the elementary SESE and 16 percent of the national sample would use videotape players if available. Ten percent of the secondary Search for Excellence teachers and 17 percent of the teachers in the national sample would use videotape players if they were available. Even when available the use of videotape players is infrequent (less than once a month).

Use of Selected Equipment and Supplies

Each teacher was asked to describe the need for several specific pieces of equipment or supplies and to elaborate on the availability and extent of use (see appendix 28 and 29, pages 71 and 72). Two generalizations stand out. First the SESE teachers are much better supplied with equipment. From seven to 26 percent of the national sample would like to use much of this equipment if it were available. Zero to 12 percent of the elementary SESE teachers consider availability a problem. The second generalization is that the SESE teachers used these items to a much greater extent. This heavy usage of equipment corresponds with the greater use of hands-on teaching techniques depicted previously.

Selected Facilities and Equipment

The SESE teachers are far more likely to have available and use the selected facilities and equipment listed in Appendix 30 and 31. Comparisons are again only appropriate at the elementary level. The SESE teachers have a considerably greater need for computer or computer terminals than perceived by the national sample. This contrast may be to a certain extent explained by the four year differential in the two surveys. The tremendous availability of each of the selected pieces of equipment or facilities indicate a tremendous administrative support for elementary science (see appendix 30 and 31, pages 73 and 74).

Metric Concepts Treatment

The way teachers handle the use of metric concepts in their classes also was studied. The SESE teachers are far more likely to introduce the metric concepts as they are needed in contrast to the national norm of having a special metric unit (see appendix 32, page 74).

Adequacy of Facilities Equipment and Supplies

The SESE teachers are more satisfied andd have less need for improvement in every category listed. Even though the extent of problems with equipment and supplies is viewed as being of lesser severity among the SESE teachers, there are still some areas of major concern. Thirty-eight percent of the elementary SESE teachers feel a need for greater storage space, equipment and supplies. Similar space requirement problems were indicated for classroom preparation and small groups. All groups of teachers surveyed indicated a need for money to buy supplies on a day to day basis. The availability of laboratory assistants or paraprofessional help was also considered a major need by 50 percent of the SESE teachers. This still indicates less of a problem than found in the national sample (see appendix 33, page 75).

Type of Rooms Used by Elementary Science

Almost three-quarters of the Search for Excellence elementary teachers are instructing science in a classroom with no science facilities. Only 36 percent of the national sample have this situation. Over 50 percent of the national sample use a classroom with portable science materials. The general consensus among elementary Search for Excellence teachers that their facilities were very good or satisfactory leads one to believe that the philosophy of these teachers is such that science need not be taught with science facilities.

	NS K-6*	SESE K-6*
Laboratory or special science Room	4	5
Classroom with portable science materials	54	13
Classroom with no science facilities	36	74

Totals: NS = 558, SESE=114.
*Due to missing data NS values may not add to 100 percent.

Sources of Information

How do primary sources of information concerning new developments in education and science for teachers of exemplary programs compare to sources used by science teachers in general?

Teachers were given a list of possible sources of information concerning new developments in education and were asked to rate the utility of each. Sources were rated as (1) useful, (2) somewhat useful, and (3) very useful (see appendix 34 and 35, pages 76 and 77).

Teacher

The vast majority of teachers in both groups find other teachers an extremely useful source of information concerning new developments in education. The elementary SESE teachers and the national sample are virtually identical in their percentage breakdown while 69 percent of secondary SESE teachers and only 45 percent of the national sample teachers consider other teachers a useful source.

Principals

The teachers in the national sample consider principals a better source of information concerning new developments in education than do the SESE teachers. Elementary teachers in both cases are more likely than secondary teachers to rate principals as useful sources of educational information.

State Department Personnel

Approximately 60 percent of both the national sample teachers and SESE teachers indicate that state department personnel are not useful as a source of information concerning new developments in education.

College Courses

Ninety percent or more of the national sample and the SESE teachers are in agreement that college courses are a useful source of information concerning new developments in education. The SESE elementary teachers are more likely to find college courses very useful than are their secondary counterparts. Over 50 percent of the elementary SESE teachers consider college courses very useful. Forty-six percent of the national secondary sample consider college courses useful compared to 43 percent of the SESE secondary teachers.

Local Inservice Programs

The SESE teachers are far more likely to consider inservice very useful than were the national sample. Eighty-one percent of the secondary and over 95 percent of the elementary SESE teachers perceive value or usefulness in their local inservice programs.

Federally Sponsored Workshops

The SESE teachers rate federally sponsored workshops as being more useful as a source of information concerning new developments in education than the national sample. Thirty-nine percent of the secondary and 30 percent of the elementary teachers consider such workshops to be useful.

Teacher Union Meetings

Very few surveyed educators consider teacher union meetings to be of much value as a source of educational information. Secondary teachers are more emphatic about this than are elementary teachers.

Meetings of Professional Organizations

Fifty-eight percent of the secondary SESE teachers consider such meetings to be very useful as a source of educational information. The SESE elementary teachers are also more likely to consider professional organization meetings very useful in contrast to the national elementary sample.

Journals and Other Professional Publications

Over three-fourths of the secondary and one-half of the elementary SESE teachers consider journals and other professional publications as very important sources of educational information. Only one-half of the secondary and 42 percent of the elementary national sample were so inclined.

Publishers and Sales Representatives

Over 40 percent of the SESE teachers consider publishers and sales representatives as not useful as a source of new developments in education. A little over 50 percent of both surveyed groups consider this source somewhat useful but few of either group find this source very useful.

Usefulness of Journals in Teaching

The SESE teachers are gleaning a great deal more from journals than the national sample teachers. Eighty percent of secondary SESE teachers use one or more journals in the teaching of their exemplary classes. Forty-seven percent of the elementary teachers find journals helpful in their teaching compared to only 22 percent of the national elementary sample.

	K-6	7-12
SESE	47%	80%
NS	22%	50%

SESE teachers also were asked to name one or two journals that they found especially helpful in their teaching of science. Fifty-five percent of the SESE elementary teachers that gave the name of a journal chose Science and Children as one of their top choices. Ranger Rick was second with 15 percent of those responding. The top three journals selected by the SESE secondary program teachers are listed in appendix 36, page 78. It is interesting to note that the The Science Teacher is found in the top three selections of all secondary programs (see appendix 37, page 79).

The diversity of journal selection was also interesting. Fifty-one different journal selections were made by SESE teachers. Greater diversity of selection was found in the secondary SESE population when compared to the SESE elementary teachers.

Federally-Funded Materials

How does experience with selected science curriculum materials among teachers of exemplary programs compare to the experience of other science teachers?

SESE teachers were asked to indicate if they had ever attended an NSF institute. Those teachers that indicated involvement were then asked to identify the type of institute attended. Each teacher was also given a list of federally-funded curriculum materials and asked to identify their extent of knowledge and use. Finally, teachers were asked to identify their sources of information concerning curriculum materials.

NSF Institutes

SESE teachers were heavily involved in NSF Institutes. Sixty-eight percent of the SESE secondary teachers have attended one or more NSF institutes compared to only 40 percent of the national sample. The margin of difference is even greater at the elementary level with 27 percent of the SESE teachers and only seven percent of the national sample being involved in one or more NSF institutes. The most frequently attended in both groups were summer institutes. Several significant differences exist between the national sample and SESE teachers at both the elementary and the secondary level. Eight of the ten institutes listed have four times greater attendance by the SESE teachers than that found nationally (see appendix 38, page 80).

Curriculum Material Experience

Seventy-six percent of the SESE elementary teachers indicated that they are presently using materials from one or more of these projects. Less than 25 percent of the national sample were using any of the materials at the time of the survey. In addition, teachers were asked to name those curriculum materials presently being used in their teaching. The vast majority of the SESE elementary teachers that are presently using federally-funded curriculum projects listed more than one of these projects. For example, teachers from one of the exemplary programs listed six federally-funded curriculum projects that they were presently integrating into their elementary science program. The most commonly mentioned projects used in program integration include Elementary Science Study (ESS), Science Curriculum Improvement Study (SCIS), and to a lesser extent Science - A Process Approach (SAPA).

A fictitious curriculum material entitled Science Explorations for the Future was included in the list as a validity check. Ninety-seven percent of the SESE teachers indicated that they had never heard of this project while 10 percent of the national sample indicated awareness and two percent actually stated that they had taught the material (see appendix 39, page 81). The same fictitious material was listed in the secondary questionnaire. Ninety-four percent of the SESE secondary teachers indicated no knowledge of the project while six percent stated awareness. Nine percent of the secondary national sample indicated an awareness of this fictitious material. An additional one percent stated that they had used the material in their teaching.

The SESE secondary teachers demonstrate greater awareness and use of almost every project listed (see appendix 40, page 82). The major curriculum materials presently in use by the SESE teachers include Biological Science: An Ecological Approach (BSCS Green), Individualized Science Instruction Systems (ISIS), Earth Science Curriculum Project (ESCP), and Intermediate Science Curriculum Study (ISCS). A similar pattern of multiple curriculum project listings in present use is found among secondary SESE teachers as well.

Sources of Curriculum Information

Other teachers are by far the major source of information concerning curriculum materials for both the national sample and the SESE teachers. Several other sources of information concerning curriculum material are significantly higher among the SESE teachers. Those include: local subject specialists/coordinators, local inservice programs, and involvement in project development. Local subject specialists/coordinators and local inservice programs are especially important to the SESE elementary teachers. Forty-six percent of the SESE secondary teachers also indicate journals and other professional publications as a major source of curriculum material information (see appendix 41, page 84).

GENERALIZATIONS AND INTERPRETATIONS

The goals of our profession must have agreement before an analysis of contributing variables can occur. An accepted desired state for science education developed by the Project Synthesis researchers now allows for a more systematic approach in identifying key characteristics of success. By identifying programs which approach the desired state, it is possible to identify and document the interaction of numerous factors. The examination of programs, the key teachers involved in them, and documentation of student outcomes will help create a transportable model of excellence.

Qualifications of Science Teachers

Teacher Characteristics

In creating a model of SESE teachers it is interesting to note those characteristics which differentiate this study population from teachers in general. One of the first characteristics examined in an effort to create a profile of SESE includes an examination of their age, experience, and subject-matter knowledge. Examination of Appendix 3 through 7 show that SESE teachers are older, more experienced, and better educated than teachers in general. It is interesting to speculate what influence these three variables have on the success of their programs. Increased age and experience may imply greater professionalism and add validity to the notion that teaching may be an art that takes time to nurture. The longevity of the SESE teachers in their present districts may also imply that a successful program can not be established overnight. Like a successful athletic program, the key features of these exemplars take time to evolve. This evolution of key features includes numerous support structures: administrative, community, parent, and fellow teachers. The SESE teachers extended teaching experience may also explain why the SESE teachers perceived themselves as being better qualified to teach than did the national sample. Weiss found that the national sample teachers' perceptions concerning their qualifications correlates with the amount of time spent teaching in these areas. Greater feelings of qualification on the part of SESE teachers may also relate to their greater experience.

The extent of the educational preparation of SESE teachers is also an important characteristic. The most important aspect of the educational preparation of the SESE teachers is seen when examining their most recent involvement in a college level credit course. The involvement of SESE teachers exceeds that reported by teachers in the national sample and is even more impressive in light of the additional years of teaching. One might conclude that many of the SESE teachers view their educational preparation as a life-long learning experience. One can only hope that this characteristic plays an important role in the model presented in their classroom. Another key characteristic of the SESE teachers is their professional involvement. In addition to their teaching, SESE teachers are making presentations at state, regional, and national meetings; many are deeply involved in their local inservice programs; and supporting extracurricular activities including the advising of science clubs. Involvement many times sparks enthusiasm for both students and teachers.

This teaching model of involvement, dedication, and enthusiasm is bound to have a positive impact on student performance.

Needs for Assistance

There is an overwhelming agreement among the SESE teachers that, once a need has been identified, it easily is met. The fact that their needs are being met correlates with the tremendous adminstrative support provided, the education and enthusiasm of the teachers, and strong community support. If teachers are receiving proper administrative support and sense that the lines of communication are adequate, one would expect to find this characteristic. It appears that this support, common among SESE programs, has not developed in the same manner in all SESE programs. There are numerous examples of individual teachers creating the enthusiasm and public relations necessary to gain program support. There are also numerous examples of administrations which have established a cooperative atmosphere within the school district through the use of extensive committee structures and/or effective inservice programs.

Factors Which Affect Instruction

When SESE teachers were asked to consider selected influences on their science instruction, as indicated in Appendix 18 and 19, they were far less likely than teachers in general to feel any of the factors as serious problems. This also may relate to the administrative support given these programs. An examination of sources of inspiration for the SESE teachers has several interesting attitudinal implications. The elementary SESE teachers appear to have had very positive experiences with local subject-matter specialists and local inservice programs. Local inservice was also one of the top choices among secondary SESE teachers as well. Personal experience with attitudes of teachers toward inservice programs would indicate that this reaction by SESE teachers should not be one of the top choices as a source of teaching inspiration. The implication is that the SESE inservice programs are doing something different from the standard inservice experience. The involvement of secondary SESE teachers in local project development as a source of inspiration also demonstrates a personal commitment and involvement in their program. The large percentage of SESE teachers indicating that fellow teachers serve as a source of inspiration would suggest that many of these programs possess a very supportive peer approval and team component. A number of respondents were concerned that the questionnaire did not include students as a potential source of inspiration and many went ahead and named students as a source.

Another important characteristic that is affecting instruction in these programs is the amount of time spent on science. The students in the elementary SESE programs are receiving the equivalents of over 12 weeks additional science instruction. Data from self-contained classrooms of the national sample indicated that the K-3 grade range was receiving science 17 minutes per day and grades 4-6 were receiving 28 minutes of science. Although no such breakdown is available for the SESE programs, Appendix 16, page 57 shows that 51 percent of the teachers instruct in the

K-3 grade range. The number of upper elementary teachers is not the reason for more time being spent on science in the SESE classrooms. In addition, the SESE teachers are spending more time on mathematics and social studies and less on reading. It appears that many of these teachers have found ways of integrating several subjects into a cohesive whole. We heard of teachers instructing reading by using scientific concepts as a vehicle; teachers merging science with social studies, and one school where much of the total school program involves a garden.

Elementary teacher preparation programs should look closely at these successful SESE teachers to understand more clearly how science can be made more relevant and interesting to our elementary students.

Teachers Attitudes Toward Science

The Scientific Attitude Inventory (SAI) was used to assess how well teachers understand the nature of science as well as their individual views of science. The most interesting finding from the SAI relates to the teachers' lack of ability to differentiate beween science and technology. A similar finding by Moore (1971) resulted in his conclusion that his study group lacked an understanding of the differences between science and technology. Novick and Duvdvani (1976) made a similar discovery among a group of ninth grade Israeli students but came to a different conclusion. They felt that their results "may reflect a current image of science to be valued both for its theoretical aspects and for its service to mankind" (p. 14). Another possibility is that the discriminating ability of the subsection related to science and technology lacks construct validity. Assuming that the construct validity is not in question, the only logical conclusion is that teachers in exemplary programs appear to lack an understanding of the difference between science and technology. Science education must not allow changing world views and values to influence the working definitions of science and technology. The inability of SESE teachers to discriminate clearly between science and technology may be a problem with science teachers in general and point to a flaw in both pre-service and inservice science teacher education programs. It may point to their lack of concern with the nature of science as a major component in their classrooms. Representation of the nature of science must be a major goal for all science educators; science classes should reflect science as the dynamic changing process it is, and teachers must be models of active inquiry if we are to truly have a model science program.

Instructional Techniques and Classroom Activities

The dominant teaching methods employed by the SESE teachers ar self-reported to be classroom discussion and hands-on-manipulatives. The SESE teachers appear to be using much less lecture in their teaching than is found nation-wide. The SESE teachers appear to be better supplied with equipment as well. The procurement of needed equipment may relate to the tremendous support provided from various levels of administration as previously mentioned. It is interesting to speculate as to the reasons for the large number of hands-on experiences used in the SESE programs. Personal experience would suggest that teachers are reluctant to use an activity unless they themselves have had the opportunity to perform the task and not simply intellectualize its usefulness. The obvious question, then, is what experience have the SESE teachers had that may have influenced their involvement?

Sources of Information

Questionnaire data and site visitation information suggest that the type of inservice employed may partially explain this involvement. The SESE teachers are far more likely to consider inservice useful than teachers from the national sample. Many of the SESE inservice effects are highly specific, focusing on particular strategies with a definite activity or set of materials in mind; not a one shot affair but an on-going program of teacher and curriculum development. The SESE teachers are personally involved in the inservice delivery and the nature of the inservice is directed toward providing information that is immediately usable by the classroom teacher. Personal experience with inservice would indicate that the stereotype inservice program is designed with two rather different objectives. First, for non-SESE teachers, many inservice programs are designed to be theoretical not practical. Second, these teachers also find that many inservices are designed to provide the teaching faculty with their annual inspirational message. For these reasons many inservices fail to provide the teachers with usable experiences or a sense of personal involvement and are, therefore, not viewed positively. SESE teachers feel their inservice is useful, practical, and classroom-oriented.

Journals and other professional publications are another very important source of information and inspiration mentioned by well over half of the SESE teachers. It is interesting to note that the sponsoring agency of the Search for Excellence, NSTA, also is the publisher of the top journals mentioned at both the elementary and secondary level. Regardless of the particular journal mentioned, it is still worth noting the tremendous usage of professional journals by SESE teachers in comparison to teachers from the national sample. Coupling the unique use of inservice with the heavy involvement in professional organizations, use of professional journals, and resulting positive feelings toward inservice and local program development provides a clearer picture as to why the SESE teachers may feel more comfortable with the use of hands-on-manipulatives.

Federally Funded Materials

The characteristic professional involvement by the SESE teachers extends to National Science Foundation Institutes as well. More than twice the percentage of SESE teachers compared to the national norm have been involved in one or more NSF Institutes. Eight of the ten institutes listed in Appendix 38 have four times greater attendance by SESE teachers than found nationally. Summer institutes and inservice institutes were by far the most popular program. As one would expect, experience and knowledge with federally-funded curriculum materials is greater among SESE teachers. Over three-fourths of the SESE elementary teachers are presently using one or more of the federally-funded materials. A large number of SESE teachers listed two or more curriculum projects presently in use. This finding leaves little doubt that many of the SESE programs are using a curriculum integration approach to their program design. The vast majority of the programs have created their own curricula or have extensively supplemented them with numerous activities from many of the nationally funded curriculum studies, primarily ESS and SCIS at the elementary level.

This study provides the rudimentary elements necessary to start the process of designing a model of excellence in science education. Several generalizable teacher characteristics may be gleaned from this study. Key teachers of exemplary programs when compared to teachers in general: are older; have more teaching experience; are more likely to have graduate degrees; have more recent experience with college credit courses. They are more likely to find other teachers, subject specialists, inservice programs, professional organization meetings and journals as good sources of information. These teachers read two or more professional journals regularly, and have high enthusiasm for teaching. They rate themselves as "very well qualified." Teachers of exemplary programs cite few problems with materials, facilities, supplies, space or assistance; they feel they get assistance when they need it, from both building and district administration. Their curricula tend to be locally developed, not textbook centered, and they use more hands-on-manipulatives and laboratories and lecture less than teachers in general. Inservice training for staff is important to them and they maintain close communication with local colleges and universities. The SESE teachers are extremely professional as defined by their involvement in program development, professional organizations, and extra-curricular student activities as well as maintaining community leadership roles.

What Does It All Mean

So, teachers in programs which stand out as different are themselves different from teachers in general. We don't find it surprising that programs which encourage student action, decision making, creativity, and excitement are themselves organized, led, and directed by teachers with similar characteristics. What we do not know for certain is which came first: enthusiastic teachers or outstanding programs: nor do we know how they learned their teaching skills. We do know, however, that recent findings of the National Commission on Excellence in Education regard most present teacher preparation programs as inadequate. Many are stating that pre-service teacher education programs in general do not appear to be properly preparing new teachers for programs such as those we have found. This lack of adequate preparation for teaching may well be related, at least in part, to a lack of appropriate classroom models. Through such models we might gain better knowledge of what does work in the classroom and design our pre-service and inservice programs to capitalize on these proven attributes.

While these exemplary programs neither fully model the ideal desired state nor do the teachers always employ the most appropriate teaching strategies, they are doing something different and it shows. Through the analysis of exemplary programs, key teachers, and desired student outcomes, science education may be able to identify more precisely the influence of various factors on learning. From this, we may establish models and guidelines for effective practice in classrooms.

Obviously, some discretion must be used. Although the data on page 34 show clearly some differences between SESE teachers and teachers in general it is equally as obvious that merely making changes in those teachers is not what makes the difference in their classrooms. Certainly, no one would expect to merely change the male/female ratio of teachers, give them a little more experience, make them older, and put a journal in their hands and expect innovative teaching to result. On the other hand, the dynamic interaction of all of these variables may well be what makes the difference. Just as surely, it is easy to see how attending professional meetings on a regular basis, making presentations at those professional meetings, having a science supervisor who provides input, and being six times as likely to offer hands-on materials to students with fifty percent more time each week could lead to excellence. And, these differences may well be contagious and pervasive. As students enjoy what they are doing more in class, the teacher is certainly going to be rewarded and will tend to do more of what makes students excited.

Is it mere coincidence that teachers in exemplary programs find inservice more useful than teachers in general? Or is it that inservice for outstanding teachers is a different type of inservice? Equally intriguing could be the possibility that teachers in exemplary programs-teachers who are enthusiastic about teaching science finding success-are more concerned about inservice and see it as an avenue to their own success as well.

Perhaps inservice could be designed with some of our findings in mind. For instance, teachers in exemplary programs indicate that their major sources of information were local subject specialists, other teachers, and journals of professional publications. They also ranked local inservice and college courses as well as professional meetings high in inspirational value. Some of their narratives indicate they have watched other teachers or local specialists teach science and then use that same model in their own classrooms.

Also, the generalizations on page 35 apply as well. From their inservices and from other teachers, teachers in exemplary programs have thought well beyond the ordinary curriculum decisions made by teachers. These teachers are concerned not just with the written curriculum but with providing a stimulating environment-an accepting atmosphere where they expect different students to achieve differently. While you can not mandate many of the statements on page 33 you can provide an atmosphere where they are free to take place and you can certainly encourage and model them.

What opportunities do teachers take to work with community leaders, administrators, and parents? How many administrators encourage teachers to carry on classroom activities outside the classroom walls? What experience have teachers had with being models of active inquiry when their own education has been rather passive? Do teachers feel it is acceptable to provide for feelings, reflections, and assessments rather than to be more concerned with covering ground? What training have teachers had in asking questions and learning how to respond to those questions in ways that encourage students to move on in more creative ways? How flexible can we expect a teacher to be in their own time, schedule, and curriculum when their school lacks that same flexibilty? Are questions such as these even dealt with in preservice and inservice courses?

How can a pre-service teacher in a fragmented, course oriented preparation ever view the dynamic hole that is a classroom? We need to seriously rethink pre-service teacher education preparation for both elementary and secondary teachers. We need to provide more experiences in working with students of every age level regardless of the age levels you intend to teach. Pre-service teachers need more background in science (but not just science). These prospective teachers need to experience more science as experiments and less as didactic and passive lectures or confirmatory labs. They need to see science in action and experience it themselves. Instructors in preservice science teacher preparation programs need to model the same behaviors they expect their students to demonstrate in classrooms. Lecture on inquiry will never be terribly effective.

We must also consider the role of administrators in encouraging exemplary classroom programs. Now, we provide inservice and preservice science education to teachers, expecting teachers to make changes by themselves. But, the evidence from the Search for Excellence in Science Education for 1982 reveals strongly that administrators were a significant force in whatever changes did occur. The administration is part of the team in these exemplary programs; not an antagonist. Teachers need to learn how to work with administrators and gain their support, respect, and encouragement. At the same time, teachers need to learn how to work with parents, community leaders, and the business world. When these various interests are working together we may find significant and appropriate changes taking place in science education; changes leading to the betterment of science education, our citizens, and our society.

As a beginning, we suggest you study the list on page 33 and ask yourself, seriously, about what might be said in your own classrooms. As you reflect on these statements consider their impact on students. Then, if you truly desire change, look beyond the list to the **Focus on Excellence** monograph series (also available from NSTA). This series describes the fifty outstanding school science programs for 1982. They are rich in detail and anecdote and provide names and addresses for further contact. We encourage you to write, call, or visit them: they have much to offer and our schools have much to gain. Excellence can be achieved and teachers do make a difference. With your help, your science program might be nominated as exemplary.

A VIEW OF EXCELLENCE

From the questionnaire, narrative data gathered from each program, and interviews with teachers it can easily be said that the Search for Excellence in Science Education teachers:

1. Provide a stimulating environment.
2. Create an accepting atmosphere.
3. Expect different students to achieve differently.
4. Put in far more than minimal time.
5. Have high expectations of themselves.
6. Challenge students beyond ordinary school tasks.
7. Are themselves models of active inquiry.
8. Do not view classroom walls as a boundary.
9. Frequently use societal issues as a focus.
10. Work easily with community leaders, administrators, and parents.
11. Are extremely flexible in their time, schedule, curriculum, expectations and view of themselves.
12. Are concerned with developing effective communication skills.
13. Provide systematically for feelings, reflections, and assessments.
14. Require considerable student self-assessment.
15. Ask questions, expecting to hear new, and often unpredicted, answers.
16. Expect students to question facts, teachers, authority, and knowledge.
17. Encourage pragmatism.
18. Stress science literacy.
19. Want students to apply knowledge.
20. Do make a difference.

HOW DO TEACHERS IN EXEMPLARY PROGRAMS COMPARE?

	K-6		7-12	
	SESE	NS	SESE	NS
Male	26%	17%	69%	68%
Female	74%	83%	31%	32%
Experience (years)	12.7	10.5	16.6	11.7
Years in District	9.9		14.0	
Age	39		42	
Degree beyond B.S.	54%	29%	77%	52%
College course in last 2 years	65%	50%	47%	43%
Feel well qualified to teach:				
Present courses			96%	86%
Science	68%	22%		
Math	54%	49%		
Social studies	52%	39%		
Reading	63%	61%		
Attended at least one national Professional meeting in the last 5 years	34%		58%	
Made presentation at local level	44%		70%	
Have science supervisor	80%		60%	
"Hands-on" daily	57%	9%	30%	18%
Lecture (percent of class time)	18%	20%	20%	36%
Discussion	70%	48%	50%	54%
Inservice very useful	67%	38%	32%	22%
Journals helpful in teaching	47%	22%	80%	50%
Attended NSF-funded institutes	27%	7%	71%	40%

PROFILE OF TEACHERS IN EXEMPLARY PROGRAMS

Time spent per day by elementary teachers on:

	SESE	National Sample
Science	29 min.	20 min.
Math	51 min.	44 min.
Social Studies	27 min.	25 min.
Reading	77 min.	86 min.

Enthusiasm for science teaching

4 or 5 on scale of 1-5	Elementary 85%	Secondary 63%
1 or 2 on scale of 1-5	Elementary 3%	Secondary 9%

Top Journals:

SESE Elementary

Science and Children
Ranger Rick

SESE Secondary

The Science Teacher
The American Biology Teacher

Sources of Inspiration: (in order)

SESE Elementary

1. local subject specialist or coordinator
2. other teachers
3. local inservice
4. college course
5. involvement in project development

SESE Secondary

1. other teachers
2. journals and other professional publications
3. college courses
4. meetings of professional organiz ions
5. involvement in project development

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APPENDICES

Data Tables

Teachers In Exemplary Programs:

How Do They Compare?

APPENDIX 1

KEY TEACHERS SURVEYED IN EACH PROGRAM AREA

Program Area	Number of Programs	Number of Key Teachers	
		Elementary	Secondary
Inquiry	10	1	21
Physical Science	8	0	20
Biology	10	0	35
Science/Technology/Society	10	2	26
Elementary Science	12	111	0
Totals	50	114	102

APPENDIX 2

AVERAGE NUMBER OF YEARS TEACHING AND AVERAGE AGE

	Total Years Teaching	Average Age	Years at Present School	Years at Present Job	Years in Present District
SESE K-6	12.7	39*	6.9	8.3	9.9
NS** K-6	10.5				
SESE 7-12	16.5	42*	11.0	12.1	14.0
NS 7-12	11.7				

N Values NS K-12= 1669, SESE K-6= 113, SESE 7-12= 102.
*Calculations based on categorical data.
**NS refers to values taken from National Sample (Weiss Data)

APPENDIX 3

SEMESTER HOURS COMPLETED IN SCIENCE BY GRADE LEVEL AND PROGRAM IN PERCENTS*

	Semester Hours				
	0-20	21-50	51-75	76-100	100+
SESE K-6 (N= 111)	61	24	10	4	2
SESE 7-12 (N= 102) ...	2	11	20	39	29
Inquiry (N= 22)	9	18	9	27	36
Physical Science (N= 19)	0	16	32	37	16
Biology (N= 35)	0	6	26	37	31
S/T/S (N= 28)	4	11	14	46	25

*Percent totals may vary by one percent due to rounding error.

APPENDIX 4

ELEMENTARY TEACHERS' PERCEPTIONS OF THEIR QUALIFICATIONS TO TEACH MAJOR SUBJECTS

	Percent of Teachers					
Subject	Not Well Qualified		Adequately Qualified		Very Well Qualified	
	NS*	SESE	NS	SESE	NS	SESE
Mathematics	4	3	46	43	49	54
Science	16	1	60	32	22	68
Social Studies	6	6	54	42	39	52
Reading	3	7	32	33	63	61

N Values NS = 1667, SESE= 114
*Due to missing data NS values may be less than 100 percent.

APPENDIX 5

PERCENT OF SECONDARY SCIENCE TEACHERS CURRENTLY TEACHING ANY COURSES THAT THEY FEEL UNQUALIFIED TO TEACH

NS		SESE	
Yes	No	Yes	No
13	86	5	95

N Values NS = 1121, SESE= 102

APPENDIX 6

NUMBER OF NATIONAL PROFESSIONAL MEETINGS ATTENDED IN THE LAST TEN YEARS (IN PERCENT)

	0	1-5	6-10	More than 10
SESE K-6 (N= 112)	63	34	2	1
SESE 7-12 (N= 102)	21	58	14	8
Biology (N= 35)	23	60	14	3
Physical Science (N= 19)	26	42	5	26
S/T/S (N= 28)	29	61	4	7
Inquiry (N= 22)	27	59	5	9

APPENDIX 7

PERCENT ATTENDANCE AT NATIONAL SCIENCE-RELATED PROFESSIONAL MEETINGS BY YEAR

Number of Meetings	0	1-5	6-10	More than 10
SESE K-6 (N= 113)	62	31	4	4
SESE 7-12 (N= 102)	23	57	12	8
Biology (N= 35)	17	60	9	14
Physical Science (N= 19)	11	79	11	0
S/T/S (N= 28)	21	61	11	7
Inquiry (N= 22)	27	54	14	4
Discipline Areas (N= 15)	7	73	13	7

APPENDIX 8

PERCENT INVOLVED IN EXTRA CURRICULAR ASSIGNMENTS

	SESE	
	K-6	7-12
Coaching	11	21
Debate	0	1
Cheerleaders	0	2
Science club	5	21
Other clubs	9	17
Honor society	0	5
Other	38	32
N Values	113	102

APPENDIX 9

PERCENT OF SESE TEACHERS MAKING PROFESSIONAL PRESENTATIONS

Number of presentations	0		1-5		6-10		10 +	
	K-6	7-12	K-6	7-12	K-6	7-12	K-6	7-12
Local science teacher meetings and inservice functions...	55	29	23	43	7	13	14	16
State, regional or national science teacher meetings......	88	48	12	32	1	12	0	9

N Values K-6= 113, 7-12= 102

APPENDIX 10

PERCENT OF SESE TEACHERS MAKING PROFESSIONAL PRESENTATIONS

BY PROGRAM

presentations	0		1-5		6-10		10 +	
	*Local	**Other	Local	Other	Local	Other	Local	Other
Inquiry (N= 21)........	23	36	55	41	5	14	18	9
Physical Science (N= 20)........	26	37	42	37	5	11	26	16
Biology (N= 35)........	29	57	37	34	26	6	9	3
Science/ Technology/ Society (N= 26)	32	54	39	18	7	18	21	11
Elementary Exemplars (N= 117)........	55	88	23	12	7	1	14	0

*Local science teacher meetings and inservice functions.
**State, regional or national science teacher meetings.

APPENDIX 11

ELEMENTARY TEACHER NEEDS FOR ASSISTANCE

	Percent of Teachers					
	Usually Do Not Need Assistance		Would Like Assistance But Receive Little or None		Receive Adequate Assistance	
	NS	SESE	NS	SESE	NS	SESE
Establishing instructional objectives	63	68	19	2	10	31
Lesson planning	75	78	14	4	6	18
Learning new teaching methods.	30	31	45	6	17	63
Actually teaching lessons	68	77	20	5	5	18
Obtaining information about instructional materials	27	30	44	7	23	63
Obtaining subject matter information	39	43	34	6	19	51
Implementing discovery/inquiry approach	41	54	34	6	17	40
Using manipulative or hands-on materials	48	58	32	4	12	38
Maintaining equipment	52	52	29	7	11	41
Working with small groups of students	56	77	31	8	4	15
Maintaining discipline	80	90	9	4	3	7
Articulation instruction across grade levels	55	69	29	7	5	23
Maintaining live animals and plants	55	56	30	5	8	39

N values NS=558, SESE=114.

APPENDIX 12

SECONDARY TEACHER NEEDS FOR ASSISTANCE

	Percent of Teachers					
	Usually Do Not Need Assistance		Would Like Assistance But Receive Little or None		Receive Adequate Assistance	
	NS	SESE	NS	SESE	NS	SESE
Establishing instructional objectives	69	79	15	3	11	18
Lesson planning	83	94	8	0	5	6
Learning new teaching methods.	37	44	44	26	15	29
Actually teaching lessons	82	88	9	3	5	9
Obtaining information about instructional materials	31	29	44	28	22	42
Obtaining subject matter information	54	55	27	18	15	28
Implementing discovery/inquiry approach	51	59	37	21	9	21
Using manipulative or hands-on materials	54	63	34	18	8	20
Maintaining equipment	50	43	33	35	13	22
Working with small groups of students	58	71	32	26	6	3
Maintaining discipline	81	91	7	5	9	4
Articulation instruction across grade levels	70	63	35	24	9	14
Maintaining live animals and plants	58	70	26	16	10	15

N Values NS=1121, SESE=102.

APPENDIX 13

PERCENT OF ALL TEACHERS INDICATING EFFECT

OF FACTORS ON SCIENCE INSTRUCTION

Factor	Serious Problem		Somewhat of a Problem		Not a Significant Problem	
	NS*	SESE	NS	SESE	NS	SESE
Belief that science is less important than other subjects	7	5	39	36	51	58
Compliance with Federal regulations..................	3	2	14	13	74	85
Inadequate facilities........	26	7	42	34	29	60
Insufficient funds for purchasing equipment and supplies	28	15	38	34	31	51
Lack of materials for individualizing instruction..	29	13	39	33	29	55
Out-of-date teaching materials	13	5	31	18	52	77
Insufficient numbers of textbooks	9	5	15	14	71	82
Lack of student interest in science	9	7	32	19	55	74
Inadequate student reading abilities....................	24	11	43	41	29	49
Lack of teachers interest in science..................	4	5	30	25	62	70
Teachers inadequately prepared to teach science....	6	5	36	27	53	67
Lack of teacher planning time	18	14	38	47	40	39

continued

APPENDIX 13 (Continued)

Factor	Serious Problem		Somewhat of a Problem		Not a Significant Problem	
	NS*	SESE	NS	SESE	NS	SESE
Not enough time to teach subject	15	14	33	41	50	45
Class sizes too large	15	16	34	43	49	41
Difficulty in maintaining discipline..................	5	2	24	24	68	75
Inadequate articulation of instruction across grade levels	9	5	40	31	45	65
Inadequate diversity of science electives............	8	3	29	16	54	81
Low enrollments in science courses	3	3	11	14	77	84

N Values NS = 1679, SESE= 231
*Due to missing data NS values may be less than 100 percent.

APPENDIX 14

PERCENT OF TEACHERS INDICATING EFFECT

OF FACTORS ON SCIENCE INSTRUCTION

Factor	Serious Problem				Somewhat of a Problem				Not a Significant Problem			
	NS*		SESE		NS		SESE		NS		SESE	
	E**	S***	E	S	E	S	E	S	E	S	E	S
Belief that science is less important than other subjects	7	7	7	4	43	34	42	31	47	57	51	65
Compliance with Federal regulations..................	4	3	3	2	16	10	9	14	69	83	88	84
Inadequate facilities........	28	23	4	9	43	41	28	38	26	35	68	55
Insufficient funds for purchasing equipment and supplies	29	26	9	22	36	41	20	48	30	32	71	30
Lack of materials for individualizing instruction..	30	28	5	20	39	41	21	41	28	30	74	39
Out-of-date materials........	16	9	4	5	29	35	13	22	51	54	82	72
Insufficient numbers of textbooks	10	6	4	7	14	16	16	14	69	75	81	80
Lack of student interest in science	3	20	1	14	25	47	5	30	68	31	94	56
Inadequate student reading abilities.....................	16	43	6	15	43	44	24	59	36	12	70	27
Lack of teachers interest in science.....................	4	1	8	3	36	19	39	13	54	77	54	84
Teachers inadequately prepared to teach science....	8	2	9	2	21	25	44	12	34	70	47	86
Lack of teacher planning time	21	11	11	17	39	38	47	47	34	49	42	36

continued

APPENDIX 14 (Continued)

Factor	Serious Problem NS E	NS S	SESE E	SESE S	Somewhat of a Problem NS E	NS S	SESE E	SESE S	Not a Significant Problem NS E	NS S	SESE E	SESE S
Not enough time to teach subject	19	7	15	14	33	35	40	39	45	57	46	47
Class sizes too large	11	21	10	24	31	39	42	44	55	39	48	31
Difficulty in maintaining discipline..................	4	8	3	1	21	31	23	22	71	61	75	76
Inadequate articulation of instruction across grade levels	8	11	3	7	36	48	24	39	48	38	74	54
Inadequate diversity of science electives............	8	10	3	4	23	41	11	20	57	48	87	77
Low enrollments in science courses	2	6	1	5	6	21	7	22	79	70	93	74

N Values NS Ele= 558, Sec.= 1121, SESE Ele.= 114, Sec.= 102.
*Due to missing data NS values may be less than 100 percent.
** E= Elementary (K-6)
*** S= Secondary (7-12)

APPENDIX 15

SOURCE OF INSPIRATION

	Percent of Teachers	
	SESE K-6	SESE 7-12
Teachers	78	83
Local Subject Specialists/Coordinators	79	29
Local In-service Programs	69	36
Journals and other Professional Publications	42	71
College Courses	58	60
Involvement in Project Development	34	51
Meetings of Professional Organizations	24	49
Principals	29	17
Fed. Sponsored Workshops	14	31
Project authors	9	13
State Department personnel	5	15
Publishers and Sales Representatives	4	9
Teacher Union Meetings	2	2

N Values K-6= 113, 7-12= 102.

APPENDIX 16

AVERAGE NUMBER OF MINUTES PER DAY SPENT IN ELEMENTARY SCHOOL SUBJECTS*

	Average Number of Minutes**		Standard Error	
	NS K-6	SESE K-6	NS K-6	SESE K-6
Mathematics	44	50	.38	1.43
Science	20	29	.28	1.51
Social Studies	25	27	.53	1.68
Reading	86	77	1.18	4.60

*Only teachers who indicated they teach one class of students were included in the analysis.
**Data is based on teacher estimates of time spent, not on precise measurements or requirements.

APPENDIX 17

SECONDARY COURSE DURATION BY PROGRAM IN PERCENTS

Program	Year	Semester	Quarter	Other
Inquiry (N= 21)...........	71	24	0	5
Physical Science (N= 20)..	80	20	0	0
Biology (N= 35)...........	80	9	11	0
Science/Technology/ Society (N= 26)...........	85	15	0	0
All SESE Secondary Exemplars (N= 102)........	79	16	4	1
NS Secondary science teachers* (N=1121)..................	87	6	4	1

*Due to missing data values may add to less than 100 percent.

APPENDIX 18

RATING OF SUPPORT FOR THE EXEMPLARY PROGRAM

AND THE TEACHERS

	Percent Rating*			
	1 or 2		4 or 5	
	K-6	7-12	K-6	7-12
By parents	4	8	77	81
By other teachers	4	5	74	82
By your school principal	2	3	81	84
By district administration or superintendent	6	14	80	60
by school board or individual board members	6	21	72	56

*1-5 likert-type scale with 1=low and 5=high.

APPENDIX 19

PERCENT OF TIME SPENT BY EXEMPLARY PROGRAM TEACHERS

Hours	0		0-2		2-4		4-6		6-8		8-->	
	K-6	7-12	K-6	7-12	K-6	7-12	K-6	7-12	K-6	7-12	K-6	7-12
Hours/day teaching science.......	0	0	77	6	8	9	12	72	4	11	0	2
Hours/week preparing science lessons.......	0	0	46	4	30	14	12	18	5	20	8	45
Hours/week designed as planning...	6	2	36	11	38	12	10	52	6	13	6	11
Hours/week working with other profes-sionals planning science.......	47	22	46	46	5	20	2	8	0	2	0	3

APPENDIX 20

CLASS ABILITY COMPOSITION OF CLASSES BY PROGRAM*

(IN PERCENTS)

	High Ability	Low Ability	Average or Mixed Abilities
Inquiry (N= 21).................	52	0	48
Physical Science (N= 20)........	15	20	65
Biology (N= 35).................	14	0	83
Science/Technology/ Society (N= 26)................	23	0	77
SESE K-6 (N= 114)...............	12	3	85
NS K-6 (N= 558).................	9	16	56
SESE 7-12 (N= 102)..............	24	4	71
NS 7-12 (N=1121)................	23	15	60

*Total percent may be less than 100 due to missing data.

APPENDIX 21

SCIENTIFIC ATTITUDE INVENTORY

MEAN SCORES OF EXEMPLARY PROGRAM TEACHERS

BY GRADE LEVEL

Scale	SESE K-6	S.D.	SESE 7-12	S.D.
1 A	10.4	2.3	12.1	2.1
1 B	9.8	2.5	10.9	3.0
2 A	11.3	2.4	12.0	2.1
2 B	11.8	2.0	11.8	2.3
3 A	10.2	2.6	11.1	2.5
3 B	13.8	1.7	13.9	1.8
4 A	10.0	2.2	10.7	2.2
4 B	6.2	2.9	6.7	3.0
5 A	10.5	2.2	11.5	1.9
5 B	12.1	1.9	12.7	1.9
6 A	10.3	3.4	12.8	2.3
6 B	11.6	2.5	12.5	2.3
1 AB	20.2	3.7	23.0	4.2
2 AB	23.2	3.5	23.9	3.8
3 AB	24.0	3.4	25.0	3.5
4 AB	16.1	3.4	17.4	3.6
5 AB	22.6	3.4	24.2	3.2
6 AB	22.1	5.2	25.3	4.0
A	62.5	9.9	70.2	8.8
B	65.3	7.9	68.6	9.0

continued

APPENDIX 21 (Continued)

Scale	SESE K-6	S.D.	SESE 7-12	S.D.
Intellectual (1A - 3B)	67.3	8.6	71.9	9.4
Emotional (4A - 6B)	60.6	8.2	66.9	7.4
Total	127.8	13.9	138.8	15.3

N Values SESE K-6= 114, SESE 7-12= 102.

APPENDIX 22

SCIENTIFIC ATTITUDE INVENTORY

MEAN SCORES OF EXEMPLARY PROGRAM TEACHERS

BY PROGRAM

Scale	Inquiry	S.D.	Physical Science	S.D.	Biology	S.D.	S/T/S	S.D.
1 A	12.0	1.8	12.1	2.1	12.3	2.1	12.0	2.2
1 B	10.9	2.6	11.7	2.4	10.9	2.9	10.3	3.6
2 A	12.0	2.2	12.4	1.7	12.1	2.1	11.7	2.4
2 B	11.5	2.1	12.1	2.2	11.9	1.8	11.8	3.1
3 A	11.1	2.8	11.7	2.2	11.1	2.5	10.7	2.6
3 B	14.0	1.2	14.3	.9	13.9	1.8	13.6	2.4
4 A	10.7	1.8	10.9	2.2	10.7	2.3	10.7	2.2
4 B	5.9	2.8	6.4	4.0	6.4	2.7	7.6	2.9
5 A	11.2	1.8	12.1	1.5	11.3	2.1	11.3	2.2
5 B	13.0	1.6	12.7	2.2	12.8	1.8	12.4	2.2
6 A	13.2	1.9	12.6	2.7	12.9	2.2	12.5	2.6
6 B	13.0	2.1	13.0	1.9	12.2	2.3	12.1	2.8
1 AB	22.9	3.6	23.8	3.3	23.2	3.7	22.4	5.5
2 AB	23.6	3.1	24.5	3.5	24.1	3.2	23.4	5.1
3 AB	25.1	3.2	25.9	2.5	25.0	3.3	24.3	4.4
4 AB	16.6	3.1	17.3	4.1	17.1	3.2	18.3	3.9
5 AB	24.2	2.7	24.9	2.8	24.2	3.3	23.7	3.9

APPENDIX 22 (Continued)

Scale	Inquiry	S.D.	Physical Science	S.D.	Biology	S.D.	S/T/S	S.D.
6 AB	26.1	3.4	25.6	3.9	25.0	3.7	24.7	5.0
A	70.4	8.1	71.7	8.0	70.4	8.9	68.9	9.9
B	68.3	7.7	70.1	7.4	68.1	7.1	67.8	12.5
Intellectual (1A - 3B)	71.6	8.1	74.2	7.1	72.2	8.3	70.1	12.4
Emotional (4A - 6B)	67.0	6.4	67.7	6.1	66.3	6.6	66.7	9.9
Total	138.6	12.6	141.8	11.3	138.5	12.6	136.7	21.2
N Values	21		20		35		26	

APPENDIX 23

SCIENTIFIC ATTITUDE INVENTORY

MEAN SCORES OF SECONDARY EXEMPLARY PROGRAM TEACHERS

BY GENDER

Scale	Female	S.D.	Male	S.D.
1 A	11.9	2.1	12.1	2.2
1 B	10.8	2.9	10.8	3.0
2 A	12.3	1.7	11.9	2.3
2 B	11.8	1.9	11.9	2.4
3 A	11.0	2.2	11.1	2.6
3 B	14.0	1.4	13.8	1.9
4 A	10.8	2.0	10.6	2.3
4 B	5.8	2.7	7.2	3.1
5 A	11.7	1.9	11.4	2.0
5 B	13.3	1.6	12.4	2.0
6 A	13.2	2.1	12.5	2.4
6 B	13.3	2.0	12.2	2.4
1 AB	22.8	4.0	22.9	4.3
2 AB	24.0	2.8	23.9	4.0
3 AB	25.0	2.5	24.9	3.9
4 AB	16.5	3.3	17.8	3.8
5 AB	25.0	3.0	23.8	3.3
6 AB	26.5	3.3	24.7	4.1
A	70.9	7.2	69.6	9.8
B	69.0	6.4	68.4	9.6

continued

APPENDIX 23 (Continued)

Scale	Female	S.D.	Male	S.D.
Intellectual (1A - 3B)	71.8	6.8	71.7	10.3
Emotional (4A - 6B)	68.0	5.5	66.3	8.0
Total	139.9	10.7	138.0	16.8

N Values Female= 36, Male= 81.

APPENDIX 24

USE OF VARIOUS TECHNIQUES IN TEACHING

ELEMENTARY SCIENCE

	Never		Less Than Once A Month		At Least Once A Month		At Least Once A Week		Just About Daily	
	NS	SESE	NS	SESE	NS	SESE	NS	SESE	NS	SESE
Lecture	23	29	5	7	11	19	32	31	20	18
Discussion	1	0	2	0	7	4	35	26	48	70
Student reports/project	16	13	23	36	33	30	12	16	6	6
Library work	32	21	24	46	22	24	12	8	1	2
Students working at chalkboard	36	39	24	34	16	13	12	11	3	3
Individual assignments.	21	15	16	19	24	26	20	27	9	14
Students use hands-on manipulative or lab materials	12	0	17	1	24	10	28	32	9	57
Televised instruction..	67	65	10	23	3	9	9	3	0	0
Programmed instruction.	72	74	8	14	3	5	3	6	1	2
Computer-assisted instruction	88	78	1	17	0	2	0	4	0	0
Tests or quizzes	26	17	14	26	33	46	18	12	0	0
Contracts..............	77	68	6	22	3	6	2	4	1	1
Simulations	53	39	22	34	7	21	5	5	1	1
Field trips, excursions	23	11	59	69	8	18	1	1	0	2
Guest speakers	54	20	34	69	1	9	1	2	0	1
Teacher demonstrations.	5	2	18	20	33	31	27	35	9	13

N Values NS= 558, SESE= 114.

APPENDIX 25

USE OF VARIOUS TECHNIQUES IN TEACHING

SECONDARY SCIENCE

	Never		Less Than Once A Month		At Least Once A Month		At Least Once A Week		Just About Daily	
	NS	SESE	NS	SESE	NS	SESE	NS	SESE	NS	SESE
Lecture	4	7	4	3	7	17	46	53	36	21
Discussion	1	0	2	4	5	6	36	41	54	49
Student reports/project	11	9	40	32	25	26	17	26	4	8
Library work	20	20	53	36	18	18	5	21	1	4
Students working at chalkboard	36	47	35	23	17	21	9	9	1	1
Individual assignments	10	6	23	20	17	8	22	31	24	34
Students use hands-on manipulative or lab materials	3	1	11	1	18	9	49	56	18	33
Televised instruction .	71	41	17	31	8	22	2	5	0	0
Programmed instruction.	68	63	19	21	6	10	1	6	4	1
Computer-assisted instruction	92	57	5	32	1	4	0	4	0	2
Tests or quizzes	2	9	3	1	29	40	58	45	5	5
Contracts..............	80	73	11	15	2	7	2	2	1	4
Simulations	73	45	19	33	5	7	0	13	0	1
Field trips, excursions	41	28	52	56	5	7	0	8	0	1
Guest speakers	52	26	44	54	1	19	0	1	0	1
Teacher demonstrations	2	6	15	22	38	41	36	22	6	9

N Values NS= 1121, SESE= 102.

APPENDIX 26

USE OF AUDIOVISUAL AIDS IN ELEMENTARY CLASSES

(IN PERCENTS)

	Not Needed		Needed But Not Available		Less Than Once A Month		At Least Once A Month		At Least Once A Week	
	NS	SESE	NS	SESE	NS	SESE	NS	SESE	NS	SESE
Films	6	8	10	3	25	21	38	46	16	21
Filmstrips	5	10	9	2	32	29	34	38	13	21
Film loops	39	36	22	9	19	36	5	17	1	2
Tapes	36	33	16	3	22	33	10	22	6	10
Slides	33	35	22	6	28	40	4	15	1	5
Records	34	56	19	6	23	28	10	10	5	1
Overhead projectors .	20	16	4	1	39	26	18	31	10	27
Standard TV	52	65	13	5	14	26	5	3	7	3
Closed circuit TV ...	62	79	16	10	6	10	2	1	2	0
Videotape recorder/ player	54	54	16	17	12	17	5	10	3	3

N Values NS= 558, SESE= 114.

APPENDIX 27

USE OF AUDIOVISUAL AIDS IN SECONDARY CLASSES

(IN PERCENTS)

	Not Needed		Needed But Not Available		Less Than Once A Month		At Least Once A Month		At Least Once A Week	
	NS	SESE	NS	SESE	NS	SESE	NS	SESE	NS	SESE
Films	4	6	7	10	27	26	49	45	16	13
Filmstrips	11	15	6	2	33	30	37	40	12	12
Film loops	35	51	23	3	23	26	12	15	2	6
Tapes	46	32	12	1	27	35	9	16	2	16
Slides	29	13	16	4	36	33	13	31	2	19
Records	55	67	8	0	25	26	9	6	1	1
Overhead projectors .	17	10	2	0	26	19	26	22	27	50
Standard TV	71	75	11	4	10	15	4	3	0	3
Closed circuit TV ...	66	69	17	11	11	11	3	3	1	5
Videotape recorder/ player	55	22	17	10	18	43	7	18	1	6

N Values NS= 1121, SESE= 102.

APPENDIX 28

USE OF EQUIPMENT AND SUPPLIES IN ELEMENTARY CLASSES

	Not Needed		Needed But Not Available		Use Less Than 10 Days		Use between 10 and 50 Days		Use More Than 50 Days	
	NS	SESE	NS	SESE	NS	SESE	NS	SESE	NS	SESE
Hand-held calculators	65	60	17	10	4	17	1	9	1	4
Microscopes	23	21	24	7	29	33	12	32	1	7
Cameras	57	65	22	12	7	18	3	4	0	2
Models (e.g., the solar system, parts of organisms, etc.) .	18	10	26	6	19	23	20	49	6	12
Games and puzzles ...	15	14	25	4	19	39	23	24	9	19
Magnifying glass	7	4	14	10	36	20	23	54	13	21
Meter sticks, rulers	13	7	11	0	24	24	29	46	17	23
Balance, scale	23	11	18	2	26	38	16	42	8	8
Batteries, bulbs	28	38	17	0	27	16	14	40	4	6
Magnets	12	25	10	1	40	20	19	47	10	7
Rocks	13	27	9	2	34	12	23	49	12	12
Living plants	6	11	7	2	18	9	34	42	28	37
Living animals	16	17	14	6	22	10	22	36	17	31

N values NS =558, SESE=114.

APPENDIX 29

USE OF EQUIPMENT AND SUPPLIES IN SECONDARY CLASSES

	Not Needed		Needed But Not Available		Use Less Than 10 Days		Use between 10 and 50 Days		Use More Than 50 Days	
	NS	SESE	NS	SESE	NS	SESE	NS	SESE	NS	SESE
Hand-held calculators	57	28	16	13	7	26	5	15	12	18
Microscopes	32	27	4	0	17	24	34	44	10	6
Cameras	61	62	18	9	9	22	4	5	3	2
Models (e.g., the solar system, parts of organisms, etc.) .	16	26	12	4	25	31	32	30	12	9
Games and puzzles ...	36	38	14	4	32	42	12	14	3	1
Magnifying glass	19	40	3	3	44	38	24	10	6	7
Meter sticks, rulers	9	9	2	0	27	19	39	57	21	15
Balance, scale	9	18	2	1	32	29	35	32	18	19
Batteries, bulbs	34	42	4	1	31	24	21	22	8	10
Magnets	41	56	3	0	39	31	9	7	6	5
Rocks	57	54	3	1	18	33	15	9	5	2
Living plants	39	34	5	3	16	15	27	34	10	13
Living animals	45	40	7	4	18	17	19	25	8	12

N values NS=1121, SESE=102.

APPENDIX 30

USE OF SELECTED FACILITIES AND EQUIPMENT IN ELEMENTARY SCIENCE CLASSES

	Not Needed		Needed But Not Available		Used by class	
	NS	SESE	NS	SESE	NS	SESE
Computer or computer terminals	82	59	6	22	1	19
Greenhouse	50	66	34	18	6	16
Telescope	51	53	32	13	8	35
Darkroom	73	84	14	13	1	4
Weather Station	48	52	32	19	8	30
Calculators..........	65	60	17	10	7	30
Microscopes..........	23	21	24	7	28	72
Cameras..............	57	65	22	12	9	23
Models...............	18	10	26	6	46	84

N Values NS= 558, SESE= 114

APPENDIX 31

USE OF SELECTED FACILITIES AND EQUIPMENT IN SECONDARY SCIENCE CLASSES

	Not Needed		Needed But Not Available		Used by class	
	NS	SESE	NS	SESE	NS	SESE
Computer or computer terminals	78	34	15	20	5	46
Greenhouse	50	50	36	26	11	24
Telescope	63	72	21	8	16	20
Darkroom	74	76	13	7	11	18
Weather Station	65	63	23	11	11	26

N Values NS= 1121, SESE= 102

APPENDIX 32

METRIC CONCEPTS TREATMENT BY GRADE LEVEL FOR A SELECTED CLASS*

	Percent of Teachers			
Use of Metric Concepts	NS K-6 (N= 558)	SESE K-6 (N=114)	NS 7-12 (N= 1121)	SESE 7-12 (N= 102)
Not Used	37	22	8	4
Special Metric Unit Only	21	8	10	2
Special Metric Unit and Used Throughout Course	16	23	42	36
Introduced as Needed	20	46	37	57

*Due to missing data percents may be less than 100 percent.

APPENDIX 33

PERCENT OF TEACHERS INDICATING THAT IMPROVEMENT IS NEEDED IN SPECIFIED AREAS

	Not Relevant to This class				Very Good				Satisfactory				Improvement Needed			
	NS		SESE		NS		SESE		NS		SESE		NS		SESE	
	E	S	E	S	E	S	E	S	E	S	E	S	E	S	E	S
Facilities-building and classroom fixtures	13	1	3	1	10	25	30	49	34	34	49	31	34	39	17	19
Equipment-nonconsumable, nonperishable items such as microscopes, scales, etc.	10	1	3	2	11	24	40	44	23	36	42	35	50	36	13	18
Supplies-materials that must continually be replenished such as chemicals, dry cells, glassware, duplicating masters, etc.	14	2	5	2	10	30	51	45	21	41	32	41	45	24	9	11
Money to buy supplies on a day-to-day basis	14	5	25	3	5	13	22	26	18	29	28	31	53	52	24	38
Storage space for equipment and supplies	6	0	5	2	8	25	19	37	34	33	45	38	45	40	38	22
Space available for classroom preparation	5	0	1	1	10	26	26	43	37	38	48	35	40	33	24	2[illegible]
Spaces for small groups to work	5	2	0	2	9	15	20	33	35	30	45	28	44	50	31	35
Availability of lab assistants or para-professional help	30	12	43	112	2	6	8	19	9	13	25	19	52	67	23	50

N Values NS Ele.=558 Sec.=1121, SESE Ele.=113 Sec.=102.

APPENDIX 34

ELEMENTARY TEACHERS'

RATINGS OF THE USEFULNESS OF A NUMBER OF SOURCES OF INFORMATION ABOUT NEW DEVELOPMENTS IN EDUCATION

	Percent of Teachers*					
	Not Useful		Somewhat Useful		Very Useful	
	NS **	SESE***	NS	SESE	NS	SESE
Teachers	5	4	38	38	57	58
Principals	14	23	56	60	27	17
Local Subject Specialists/Coordinators	26	5	45	28	25	66
State Department personnel	61	67	30	26	5	6
College Courses	8	3	53	43	35	54
Local In-service Programs	9	4	48	29	38	67
Self Sponsored Workshops	29	30	37	39	21	30
Teacher Union Meetings	37	70	29	26	4	4
Meetings of Professional Organizations	28	27	46	45	19	28
Journals and other Professional Publications	17	1	32	47	42	52
Publishers and Sales Representatives	28	44	56	52	12	4

*Due to missing data NS values may be less than 100 percent.
**NS N value= 558
***SESE N value= 114

APPENDIX 35

SECONDARY TEACHERS'

RATINGS OF THE USEFULNESS OF A NUMBER OF SOURCES

OF INFORMATION ABOUT NEW DEVELOPMENTS IN EDUCATION

	Percent of Teachers*					
	Not Useful		Somewhat Useful		Very Useful	
	NS **	SESE***	NS	SESE	NS	SESE
Teachers	6	1	47	30	45	69
Principals	45	49	42	46	11	6
Local Subject Specialists/Coordinators	48	25	34	37	14	39
State Department personnel	64	57	26	30	5	13
College Courses	7	11	45	47	46	43
Local In-service Programs	31	20	44	48	22	33
Fed. Sponsored Workshops	32	24	32	38	28	39
Teacher Union Meetings	65	83	22	15	5	2
Meetings of Professional Organizations	26	11	46	31	24	58
Journals and other Professional Publications	7	1	40	24	52	75
Publishers and Sales Representatives	32	42	55	52	9	9

*Due to missing data NS values may be less than 100 percent.
**NS N value= 1121
***SESE N value= 102

APPENDIX 36

TOP THREE JOURNALS FOUND HELPFUL IN TEACHING SCIENCE BY PROGRAM

	Percent selecting
Science as Inquiry (N= 17)	
The Science Teacher	35
The Scientific American	18
The Physics Teacher	12
Physical Science (N=12)	
The Science Teacher	33
The Physics Teacher	17
Discover	8
Biology (N=29)	
The American Biology Teacher	35
Scientific American	21
The Science Teacher	13
Science/Technology/Society (N= 20)	
The Science Teacher	15
Science 82	10
Environment	10

APPENDIX 37

JOURNALS HELPFUL IN TEACHING SCIENCE BY GRADE LEVEL

Elementary Teacher Selection by Percent	
Science & Children	55
Ranger Rick	15
World	6
National Geographic	4
The Science Teacher	4
Secondary Teacher Selection by Percent	
The Scien Teacher	18
The American Biology Teacher	16
Scientific American	14
Science 82	8
The Physics Teacher	7
Science	6
Science & Children	3
Chemistry Education	3

N Values SESE Elementary= 51, SESE Secondary= 90.

APPENDIX 38

PERCENT OF KEY TEACHERS ATTENDING VARIOUS NSF INSTITUTES

	*NS K-12	SESE K-12	SESE K-6	SESE 7-12
Academic Year Institutes	3	15	2	13
Administrators Conferences	0	0	0	0
Cooperative College-School Programs	2	19	4	15
Inservice Institutes	7	41	5	36
Resource Personnel Workshops	1	8	3	5
Summer Institutes	15	54	8	46
Leadership Development Projects	2	12	4	8
School System Projects	1	27	10	17
Teacher Centered Projects	3	36	14	22
Chautauqua Short Courses	0	2	1	1
N Values	1667	216	114	102

*NS K-6 a[illegible]-12 not available.

APPENDIX 39

ELEMENTARY SCIENCE TEACHERS' EXPERIENCE

WITH SELECTED CURRICULUM MATERIALS

Elementary Science	Have Never Seen		Have Seen But Not Used		Have Used in Teaching		Using Presently	
	NS	SESE	NS	SESE	NS	SESE	NS	SESE
BSCS Ele. Science Project...	76	69	17	23	>1	8	0	6
Conceptually Oriented Program in Elementary Science (COPES)..........	80	80	13	17	>1	4	0	2
Elementary Science Study (ESS)....................	56	13	27	15	11	72	7	57
Environmental Studies for Urban Youth (ESSENSE)....	89	95	3	4	1	2	>1	>1
Human Sciences Program (BSCS)	80	78	11	17	2	6	>1	>1
Individualized Science (IS).	73	74	18	21	2	5	0	4
MINNEMAST Minn. School Math and Science Teaching Project..................	78	77	14	21	1	3	0	2
Science-A Process Approach (SAPA)..................	61	49	20	17	12	34	7	19
Science Curriculum Improvement Study (SCIS)........	57	22	21	16	16	62	12	50
Science Explorations for the Future*..................	80	97	10	3	2	0	0	0
Unified Science and Math for Ele. Schools (USMES).	85	89	7	7	2	4	0	3
University of Illinois Astronomy Program.........	92	97	1	2	1	1	1	>1
Percent indicating present use of these materials.							24	76

*Fictitious curriculum material; added as a validity check.

APPENDIX 40

SECONDARY SCIENCE TEACHERS' EXPERIENCE WITH SELECTED CURRICULUM MATERIALS

Secondary Science	Have Never Seen		Have Seen But Not Used		Have Used in Teaching		Using Presently	
	NS	SESE	NS	SESE	NS	SESE	NS	SESE
Biological Science: An Ecological Approach (BSCS Green)............	30	14	47	39	23	45	11	14
Biological Science: An Inquiry into Life (BSCS Yellow)...........	29	16	47	50	24	31	9	9
Biological Science: Molecules to Man (BSCS Blue).......	33	15	53	55	14	30	6	8
Biological Science: Interaction of Exp. and Ideas.	69	50	27	30	4	18	1	4
Biological Science: Me Now..	86	75	13	22	1	2	0	1
Biological Science: Me and My Environment...........	79	68	19	28	2	4	7	1
Biological Science: Patterns and Processes...........	54	29	32	46	14	24	2	3
Biomedical Interdisciplinary Curriculum Project.......	89	91	10	9	0	0	0	0
Chemical Bond Approach (CBA)	65	58	31	39	4	3	1	0
Chemical Education Materials Study (CHEM Study).......	52	25	38	50	10	24	4	7
Environmental Studies for Urban Youth (ESSENCE)....	90	91	10	9	0	0	0	0
Human Sciences Program (BSCS)	73	65	25	33	2	2	0	0
Huntington II...............	96	89	3	9	>1	2	>1	1

continued

APPENDIX 40 (Continued)

Secondary Science	Have Never Seen		Have Seen But Not Used		Have Used in Teaching		Using Presently	
	NS	SESE	NS	SESE	NS	SESE	NS	SESE
Individualized Science Instruct. Systems (ISIS).	59	23	34	50	7	23	1	12
Intro. Physical Science (IPS)	32	16	41	48	27	53	8	8
Earth Science Curriculum Project (ESCP)...........	47	32	35	38	17	26	8	11
Outdoor Biology Instructional Strategies (OBIS)........	89	68	9	17	2	14	1	4
Physical Science II (PSII)..	65	55	32	35	3	8	1	3
Physical Science Study Committee Physics (PSSC).	56	29	34	45	10	26	3	3
Intermediate Science Curriculum Study (ISCS)..	60	45	27	37	13	18	7	10
Project Physics Course (Harvard)................	62	39	29	43	9	18	6	2
Science Explorations for the Future*..................	90	93	9	7	1	0	1	0
Technology-People-Environment (ECCP)...................	86	78	9	15	1	7	0	1
The Man-Made World (ECCP)...	86	69	12	19	2	12	0	0
Time, Space and Matter: Sec. School Science Project...	71	65	24	23	5	11	1	1
University of Illinois Astronomy Program.........	95	89	3	5	2	5	1	1
Percent indicating present use of these materials.							43	60

N Values NS= 1121, SESE= 102.
*Fictitious curriculum material; added as a validity check.

APPENDIX 41

PERCENT OF TEACHERS RECEIVING INFORMATION ABOUT CURRICULUM MATERIALS FROM DIFFERENT SOURCES, BY GRADE LEVEL*

Source	NS K-6	SESE K-6	NS 7-12	SESE 7-12
Teachers	66	57	64	72
Principals	33	18	10	4
Local Subject Specialists/Coordinators	31	75	22	37
State Department personnel	2	5	3	9
College Courses	57	41	54	41
Local Inservice Programs	40	57	19	29
Fed. Sponsored Workshops	8	11	21	32
Teacher Union Meetings	0	0	2	1
Meetings of Professional Organizations	12	6	15	33
Journals and Other Professional Publications	25	14	27	46
Publishers and Sales Representatives	25	4	39	36
Project Authors	5	3	13	16
Involvement in Project development	5	12	9	20
N Value=	270	114	91	102

*Percentages based on teachers who specified one set of curriculum material with which they were most familiar.