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ABSTRACT

This report presents the set of evaluation guidelines and instruments prepared for the evaluation of the Comprehensive Program for Science Teacher Education at the University of South Dakota. The participants in the study were inservice secondary science teachers enrolled in the Comprehensive Program. The participants were pre- and post-tested in: science subject matter competency; understanding of science; attitudes toward mathematics, science, science teaching, and laboratory work; and the nature of the science classroom and laboratory activities which the participants feel should be used for secondary school science instruction. The data resulting from these tests are reported and analyzed, along with an extensive profile of the participants' teaching experience. Among the conclusions derived from the data were: little change was noted on the participant attitude measures used as pre- and post-tests; in general, participants were pleased with the program; the participants entered the program in generally good agreement with science educators as to the types of activities which should be used for secondary science instruction, and the program strengthened this agreement; and the participants showed significant progress in subject matter competencies by the completion of the program. (MLH)

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A TECHNICAL REPORT

EDUCATIONAL RESEARCH & SERVICE CENTER

SCHOOL OF EDUCATION
UNIVERSITY OF SOUTH DAKOTA
VERMILLION, SOUTH DAKOTA

019 841

COMPREHENSIVE PROGRAM FOR SCIENCE TEACHER EDUCATION EVALUATION REPORT NUMBER ONE UNIVERSITY OF SOUTH DAKOTA

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OVERVIEW

A. Introduction

The accompanying set of evaluation guidelines and instruments have been prepared for the purpose of evaluating the Comprehensive Program for Science Teacher Education at the University of South Dakota. An extensive profile of measures has been established (some are under development) so that a total evaluation as well as an evaluation of each phase can be obtained. The evaluation is viewed as being developmental and will be modified as is dictated by the evaluation needs of the Comprehensive Program. It must also be emphasized that information from the evaluation will receive major consideration in program decision-making.

The following general procedural information is provided to facilitate the reader in understanding the report of the results which follows.

B. Program Evaluation Procedures and Instrumentation

1. Participants

Pretest data recorded in this report was collected on participants in the following components.

a. Beginning participants in the Sequential Biology Component
b. All participants in the Sequential Chemistry Component
c. All participants in the Unitary CHEMS Component
d. All participants in the Unitary General Science Component
e. All participants in the 1971-72 Academic Year Component

Pretest data was collected from the previously mentioned program components in the following selected areas (instrument used is shown in parentheses).

a. Participants' science subject matter competency (specific instruments were developed)
b. The nature of the science classroom and laboratory activities which the participants feel should be used for secondary school science instruction (<u>Science Classroom Activities Checklist: Teacher Perceptions</u>)
c. Participants' understanding of science (<u>Test on Understanding Science</u>)
d. Participants' attitudes toward mathematics, science, science teaching, and laboratory work (<u>Semantic Differential Test in Science</u>)

Posttest data in the areas mentioned previously with reference to pretesting was collected on those participants who had completed a component. Those participants who are still in process (e.g. Sequential) will have posttest information collected when they complete the total program but will also have pre- and posttest information collected for each specific sequence. The only Sequential Component posttest information recorded in this report will be related to the 1971 Summer Sequence.

Basic descriptive information about participants and their teaching situation was collected prior to program participation by means of a teacher questionnaire. Besides providing basic descriptive information (age, sex, grades taught, etc.), this questionnaire provides information on the age of curricular materials used and other variables which have bearing on program impact when viewed over time.

Information on the operation of the Comprehensive Program Components was collected from participants by means of questionnaires. Basic information on housing, communication and other operations-type information was collected. Questionnaires were developed to account for specific differences in the operation of components, however, much of the information collected was common to the total program.

2. Participants' Students

Data was collected from participants' students prior to the participant entering the program. This data was collected in the following areas (instrument used is shown in parentheses).

a. The nature of the science activities which the participants do use for their science instruction. This information will also be collected on participant's students in the spring of the year following completion of the program. (Science Classroom Activities Checklist: Student Perceptions.)
b. Students' attitudes toward science and other science related areas. This information will also have a follow-up, as in 2a above. (Semantic Differential Test in Science)

Student data collection in areas such as understanding of science, science subject matter competency, and science process skills are under consideration, but have not been implemented.

All student data is in the process of being analyzed, but is not recorded in this report.

3. Data Analysis

All data was coded, condensed where necessary, and put on cards for analysis by computer. Descriptive information was generated using the University of South Dakota Cross-Tabulation Program. Significant differences between participants' pre- and post-test scores were determined using the University of South Dakota t-Test for Matched Pairs Program.

C. Organization of the Report

The analysis and discussion of the data which follows will be presented in three sections. These are, in their order of presentation (1) Descriptive Information on Participants, (2) Evaluation of Program Objectives, and (3) Program Processes Evaluation. A fourth section is presented which provides information on staff and participant rank ordering of program objectives. The fifth and final section provides a brief summary.

D. Code for Program Components

1=Sequential Biology Component
2=Sequential Chemistry Component
3=Unitary CHEMS Component
4=Earth Science Section of the General Science Component
5=Physical Science Section of the General Science Component
6=Academic Year Component

I. DESCRIPTIVE INFORMATION ON PARTICIPANTS

This information is based on a questionnaire that was sent to each teacher prior to participation in the Comprehensive Program. The program components represented by participant data are (1) beginning participants in the Summer Biology Sequential (n=3), (2) beginning participants in the Summer Chemistry Sequential (n=13), (3) Unitary CHEMS (n=29), (4) Unitary General Science - Earth Science Section (n=25), (5) Unitary General Science - Physical Science Section (n=25), and (6) 1971-72 AYI (n=20).

1. States Represented and Number of Participants Per State

Figure 1, p. 180 provides information on the areal distribution of participants by state. The data demonstrates that the Comprehensive Program at the University of South Dakota is taking a regional focus. The program is evolving toward the goal of 100% regional participation. Note that this data reflects some participants who were part of a component that was not included in our first (1971-72) Comprehensive Program proposal (e.g. General Science Institute). The General Science Component is an integral part of the Comprehensive Proposal for 1972-73.

2. Age of Participants

The mean age of the participants in the total program was 32.67 years (S.D. 9.38). The range in age was from 23 years to 61 years. The Sequential and AYI Components had, on the average, younger participants ($\bar{x} \cong 30$). Unitary Component participants were generally somewhat older ($\bar{x} \cong 34$).

3. Sex of Participants

Eighty percent of the participants were males. This percentage held fairly constant across all components.

4. Grade Levels at Which Participants Teach

Table 1, p. 181 provides information on the grade levels at which the participants in the various program components taught. One of the most striking characteristics is the number of participants who taught at both the "junior high" and "high school" levels. Over eighty percent of the participants either taught full-time, or have some teaching responsibilities, below grade ten.

5. Subjects Taught

Table 2, p. 182 provides information on the subject area or combination of areas which participants taught. Seventy percent of the participants teach more than one subject and approximately 35% teach in more than two areas. It appears that the nature of our Comprehensive Program, as it is evolving, allows for this type of diversity.

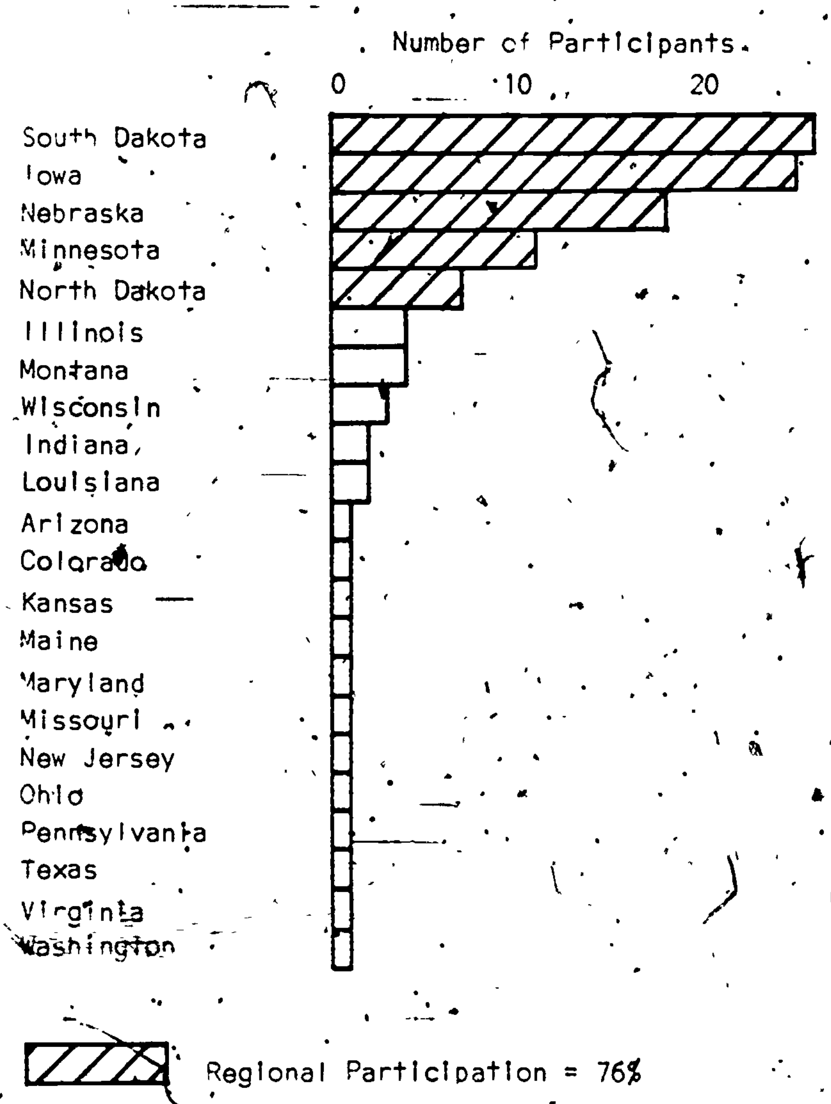
FIGURE I

AREAL DISTRIBUTION OF PARTICIPANTS

COMPREHENSIVE SCIENCE EDUCATION PROGRAM

UNIVERSITY OF SOUTH DAKOTA

1971



	Institute *				
	SB	SC	UC	UGS	AYI
South Dakota	1	3	4	15	3
Iowa	2	5	5	9	4
Nebraska		2	5	6	5
Minnesota		1	2	6	2
North Dakota		1	1	1	4

* SB = Sequential Biology Institute

SC = Sequential Chemistry Institute

UC = Unitary Chemistry Institute

UGS = Unitary General Science Institute

AYI = Academic Year Institute 1971 - 72

TABLE 1

Grade Levels at Which Participants Taught
Recorded by Program Component

	Program Components						
	1	2	3	4	5	6	Total
5	0	0	0	0	1	0	1
6	0	0	0	1	0	0	1
7	0	0	0	5	1	0	6
8	0	0	0	2	2	0	4
9	0	1	1	1	1	1	5
10	1	0	0	0	0	2	3
11	0	0	0	0	0	1	1
12	0	0	0	0	0	0	0
5-9	0	0	0	6	3	0	9
7-9	0	0	1	7	7	0	15
7-12	2	8	17	2	9	10	48
10-12	0	4	9	1	1	6	21
Total	3	13	29	25	25	20	115

6. Organizational Structure of the Participants' School System

The major organizational structures of the 112 participants' (those who responded) home school systems were (1) K-6, 7-8, 9-12 (28%); (2) K-8, 9-12 (23%); (3) K-5, 6-8, 9-12 (20%); and (4) K-6, 7-9, 10-12 (19%). The organizational structure of the school system has significant effects on course offerings and instruction, particularly in science and mathematics. The increasing incidence of middle schools (e.g. K-5, 6-8, 9-12), and the resultant departmentalization for science and mathematics instruction at lower grade levels, has definite implications for in-service and pre-service teacher education. The proposal for 1972-73 contains components directed toward this area of concern.

TABLE 2

Subject Areas* Participants Taught Recorded By Program Component**

	1	2	3	4	5	6	Total
Chemistry	0	1	3	0	0	1	5
Earth Science	0	0	0	2	0	0	2
General Science	0	0	1	5	5	0	11
Life Science	0	1	0	0	0	0	1
Physical Science	0	1	0	2	2	1	6
Mathematics	0	0	1	1	0	0	2
Biology	0	0	1	0	0	5	6
General Science & Physics	0	0	1	0	0	0	1
General Science & Physics, Chemistry, Biology	0	1	0	0	0	0	1
General Science & Physics, Chemistry	0	3	5	0	2	3	13
General Science & Physics, Biology	0	0	2	0	0	1	3
General Science & Chemistry, Mathematics	0	0	0	0	0	1	1
General Science & Physics, Mathematics	0	0	0	0	1	0	1
General Science & Chemistry, Biology	0	0	2	0	0	1	3
General Science & Chemistry	0	1	2	1	1	2	7
General Science & Biology	3	0	0	1	4	2	10
General Science & Mathematics; Other than Science & Math	0	0	0	8	7	0	15
General Science & Other than Science & Math	0	0	1	3	3	1	8
Chemistry & Biology	0	0	3	0	0	1	4
Chemistry & Physics	0	0	2	0	0	0	2
Chemistry & Math & Other	0	2	0	0	0	0	2
Chemistry & Math	0	2	3	0	0	0	5
Chemistry & Other	0	0	1	0	0	1	2
Physics & Math & Other	0	1	0	0	0	0	1
Physics & Other	0	0	1	0	0	0	1
Total	3	13	29	23	25	20	113

* Tables 5 and 7 are not completely consistent due to the nature of the responses the tables represent.

** See Code Sheet.

7. Years of Teaching Experience K-College

Twenty percent of the participants had teaching experience at the elementary school level (grades K-6). The mean number of years that these people had taught at the elementary school level was 6.36 years (S.D. 4.72).

Ninety-eight percent of the participants had experience at the secondary school level (grades 7-12). The mean number of years of experience at the secondary school level recorded by program component is provided in Table 3.

TABLE 3

Participants' Mean Years of Secondary School Teaching Experience Recorded By Program Component

	Program Component													
	1 (n=3)		2 (n=13)		3 (n=29)		4 (n=25)		5 (n=25)		6 (n=20)		Total (n=115)	
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
Years	5.00	1.41	3.77	1.53	6.79	8.04	7.17	5.02	8.35	6.81	4.50	1.44	6.40	5.90

Ninety-eight percent of the participants had not had experience teaching at the college level.

8. Attitude of Participants Toward Teaching Science

Participants rated how they felt about teaching science on a five point scale (like 5 to 1 dislike). Table 4 provides the mean rating of participants as to how they feel about teaching science.

TABLE 4

Participants' Mean Rating of Their Attitude Toward Teaching Science Recorded By Program Component

	Program Component													
	1 (n=3)		2 (n=13)		3 (n=29)		4 (n=25)		5 (n=25)		6 (n=20)		Total (n=115)	
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
Attitude Rating (like 5,4,3,2,1 dislike)	5	0.0	4.92	0.27	4.90	0.30	4.80	0.40	4.67	0.47	4.60	0.69	4.78	0.47

Participants in all components reflect a very positive attitude toward teaching science. This is further supported by the findings reported in the section Evaluation of Program Objectives.

9. Attitudes of Participants Toward Students They Teach (like 5 to 1 dislike)

The general attitude of the participants toward the students which they teach was assessed. They were asked to respond how they felt (scale indicated above) toward the students in each class (period) which they taught. The participants' feelings toward the students in all their classes were summed and a mean attitude toward students was derived.

TABLE 5

Participants' Attitude Toward Their Students Recorded By Program Components

	Program Components 1 (n=3) x̄	1 S.D.	2 (n=13) x̄	2 S.D.	3 (n=29) x̄	3 S.D.	4 (n=25) x̄	4 S.D.	5 (n=25) x̄	5 S.D.	6 (n=25) x̄	6 S.D.	Total (n=20) x̄	Total S.D.
Attitude Rating (like 5 to 1 dislike)	4.17	.24	4.26	.45	4.39	.62	4.41	.52	4.43	.48	4.14	.52	4.34	.54

Table 5 provides information on the attitude of participants toward the students which they taught. The participants in all the components had a positive attitude toward their students. There were 22 participants who expressed an attitude value of less than four on the five point scale. Only one participant expressed an attitude value of less than three.

10. Participants' Attitudes Toward the Textbook Materials They Were Using (like 5 to 1 dislike)

TABLE 6

Participants' Attitudes Toward the Textbook Materials They Used In Their Teaching Recorded by Content Area

	Content Area: Chemistry (n=39) x̄	Earth Science (n=19) x̄	General Science (n=36) x̄	Physical Science (n=33) x̄	Physics (n=15) x̄	Math (n=20) x̄	Biology (n=23) x̄
Attitudes Toward Textbook Materials (like 5 to 1 dislike)	3.95	3.21	3.47	3.55	3.67	3.30	3.65

As indicated in Table 6, the participants held a moderately positive view of the materials they used for their teaching. Earth Science, General Science and Mathematics materials hold the lowest ratings. This may be due to a somewhat lesser degree of emphasis on the implementation of newer curriculum project materials in these subject areas, as compared to biology, chemistry and physics.

11. Textbook Materials Used by Participants

Participants were asked to record the textbook materials they were using. These textbook materials have been tabulated. Only the most frequent textbooks reported will be attached to this report. A tabulation of all books being used has been compiled. This will be up-dated with information from subsequent participants.

The most frequent textbooks used by participants are tabulated by subject area in Table 7.

TABLE 7

Tabulation of Textbook Title Frequency by Subject

Subject	Title	Frequency
Biology	BSCS (Green) 1963 & 1970	8
	BSCS (blue) 1968	4
	BSCS (yellow)	1
	Otto, Towle - Modern Biology, 1965	6
	Green, Smallwood - Biology, 1968	2
	Total Teachers Reporting	36
Earth Science	Ramsey, Buekeley et. al. - Modern Earth Science, 1965	4
	McCraken, Delher et. al. - Basic Earth Science, 1964	3
	ESCP	2
	Total Teachers Reporting	19
Chemistry	Metcalfe, Williams, Castka - Modern Chemistry, 1962 & 1966	15
	Smoot, Price, Barret - Chemistry-A Modern Approach, 1968	6
	Total Teachers Reporting	45
General Science	Blanc, Fisher, & Gardner - Modern Science, 1967	6
	Brandwein, Stallberg, Burnett - Life Its Forms & Changes, 1968	3
	Total Teachers Reporting	42
Physical Science	Introductory Physical Science Group, 1967	12
	Brooks, Tracy, et. al. - Modern Physical Science, 1966	10
	Total Teachers Reporting	41
Physics	Dull, Metcalfe, Williams - Modern Physics, 1964, 1968	9
	Dull, Metcalfe, Williams, Modern Physics, 1960, 1963	4
	Harvard Project Physics	1
	Physical Science Study Committee (PSSC)	1
	Total Teachers Reporting	23

12. Publication Date of the Textbooks Used by Participants

The approximate mean publication date of the textbook materials being used by participants for their teaching was 1966. The mode was at 1966 also. There were materials being used, however, that were published in the late 1950's and one participant was using materials published in 1953.

13. Do Participants' Classroom Activities Include Laboratory Work?

Eighty five percent of the participants indicated that their students were provided with the opportunity to be involved in laboratory activities.

14. Amount of Time Provided For Laboratory Activities

The mean time that participants spent in the science laboratory per class per week was approximately 56 minutes. This would be the equivalent of about one class period per week. Further inspection of the data shows that the time allocated to work in the laboratory is not consistent across all grade levels and subject matter areas.

Those science courses that were taught primarily at the 7th to 9th grade levels spent less time in the laboratory per week than did those taught primarily in grades 10 and up. Whether grade level or subject taught is the significant variable is not determined. Participants spent approximately 30 minutes per class per week in doing laboratory work with their general science students. Physical science classes were noted as spending approximately 60 minutes per class per week (participants using IPS were found to spend approximately 120 minutes per class per week). Life science and earth science courses were found to involve laboratory work about 30 minutes per class per week.

Science courses taught in grades 10 or above spent more time in the laboratory than those taught at lower grade levels. Participants teaching biology indicated they spent about 65 minutes per class per week in the laboratory. Chemistry and physics courses were found to involve laboratory work about 70 minutes per class per week.

Inspection of the data indicated that there may be a negative correlation between the number of different preparations which a teacher has per day and the amount of time his students spend in the laboratory. This and other points will be pursued in subsequent analyses.

15. Participants' Rating of Their Laboratory Facilities (5 excellent to 1 non-existent)

The mean participant rating for their school's laboratory facilities was 3.50 (S.D. 1.23). General Science participants and AYI Biology participants rated their schools' science facilities somewhat lower than participants from other components. It may be true that if participants begin to use the laboratory more, their feelings toward the adequacy of their present facilities will be less positive.

16. Participants' Rating of Their Laboratory Equipment and Materials (5 excellent to 1 non-existent)

The mean participant rating of their schools' laboratory equipment and materials was 3.52 (S.D. 1.04). The General Science participants and AYI Biology participants rated their schools' science equipment and materials somewhat lower than did participants in other components. If participants begin to use the laboratory more, their feelings toward the adequacy of their equipment and materials may change.

17. Do Participants' Students Use A Laboratory Guide?

Approximately 67% of the participants responded that their students do use a laboratory guide. The average publication date for laboratory guides used by participants' students was 1966. This fact, plus a scanning of the titles, leads one to conclude that the teachers are using laboratory guides which accompany their textbooks.

II. EVALUATION OF PROGRAM OBJECTIVES

Analysis and Discussion of the Data

The analysis and discussion will be carried on with reference to the particular area which is being evaluated.

A. Subject Matter Competency

The assessment of participants' development in subject matter competency will be presented under the heading of each program component. This is done because specific instruments were generally used for each individual component due to the needs of the participants and the nature of the subject matter being studied. The instruments used were generally developed by the Component Directors and their staff. The instruments are directed toward assessing the major subject matter competencies which teachers should have in order to teach the subject or subjects being emphasized in the program component. The instruments were administered on a pre and post- component basis.

Code for Program Components

1 = Sequential Biology Component
2 = Sequential Chemistry Component
3 = Unitary CHEMS Component
4 = Earth Science Section of the General Science Component
5 = Physical Science Section of the General Science Component
6 = Academic Year Component

1. Biology Sequential Component and Academic Year Component (Biology Section)

The subject matter competency of the new participants entering the Biology Sequential Component and the participants in the Biology Section of the AYI Component were assessed on a pretest basis using a graduate exam developed by the U.S.D. Biology Department. The exam consists of 125 items divided in the following subscales (A) Animal Anatomy and Development, (B) Plant Morphology and Anatomy, (C) Genetics, (D) Cell Physiology, (E) Ecology and (F) General Biology.

Table 8 provides pretest data for the two program components. Posttest data will be collected as participants complete their respective programs. With the completion of posttest data, analysis will be made to determine participant gains in subject matter competency. Individual participant's pretest scores are also used in determining areas of weakness and strength so that course work can be prescribed.

Subject matter competency examinations are presently being developed to assess the subject matter competencies being developed during specific sequences of the Biology Sequential Component. The first of these will be used to assess the 1972 summer sequence.

2. Chemistry Sequential and Academic Year Component (Chemistry Section)

The subject matter competency of the new participants entering the Chemistry Sequential Component and the participants in the Chemistry Section of the AYI Component were assessed on a pretest basis using a broad chemistry subject matter exam developed by the Director of the Summer Sequential. The data from this exam is being analyzed at the present time. With the completion of posttest data, analyses will be made to determine participants' gains in subject matter competency.

TABLE 8

Pretest Means and Standard Deviations For Subscales and Composite Scores on the USD Graduate Biology Examination

	Biology Sequentials Participants (n=3)		Biology AYI Participants (n=10)		Total (n=13)	
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
Animal Anatomy and Development (20 possible)	14.33	0.47	12.70	2.33	13.08	2.16
Plant Morphology and Anatomy (20 possible)	13.33	1.25	10.70	2.53	11.31	2.55
Genetics (20 possible)	11.33	0.47	11.60	1.96	11.54	1.74
Cell Physiology (20 possible)	14.33	1.25	12.30	1.42	12.77	1.62
Ecology (20 possible)	7.33	1.25	8.20	1.99	8.00	1.88
General Biology (25 possible)	17.33	1.25	15.90	1.81	16.23	1.80
Composite (125 possible)	78.00	0.82	71.40	6.93	72.92	6.70

a) 1971 Summer Sequence

The 1971 Summer Sequence of the Chemistry Sequential was directed at developing subject matter competencies in the areas of electricity and magnetism, inorganic chemistry, and organic chemistry. These were the major emphases, but not all participants were necessarily involved in all three areas. Instruments were developed for assessing subject matter competencies in each of these three areas and administered on a pre-and posttest basis. Information dealing with the inorganic chemistry area will not be presented due to problems in the collection of the data.

Table 9 provides information which shows that the Summer Sequential participants had a low level of subject matter competency in the area of electricity and magnetism at the beginning of the summer. At the completion of the 1971 Summer Sequence their subject matter competency in the area was significantly ($p < .001$) greater.

TABLE 9

Means, Standard Deviations, and t-Test For Matched Samples Comparing Electricity and Magnetism Pre- and Posttest Scores

	Chemistry Sequential Participants				
	Pretest (n=13)		Posttest (n=13)		Pretest-Posttest
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	t
Electricity and Magnetism Examination (possible score 72)	2.60	1.28	43.50	13.91	8.71*
Degrees of Freedom					12

*$t \geq 4.32$ to be significant at the .001 level

TABLE 10

Means, Standard Deviations and t-Test for Matched Samples Comparing ACS Brief Organic Test Pre- and Posttest Scores

	Chemistry Sequential Participants				
	Pretest (n=35)		Posttest (n=32)		Pretest-Posttest
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	t
Test Scores	18.29	9.14	38.81	9.12	25.21*
Degrees of Freedom					30**

*$t \geq 3.65$ to be significant at the .001 level

Table 10 provides information which shows that the Summer Sequential participants (there were some people assessed who were not part of the Summer Sequential Component) scored significantly higher ($p < .001$) on the posttest ACS Brief Organic Test than they had on the pretest.

Based on the information available it is reasonable to assume that the 1971 Summer Sequence resulted in Summer Sequential Component participants gaining significantly greater subject matter competency in the selected science areas emphasized.

**The n used for calculating the degrees of freedom was equal to the number of matched pairs. Consequently, it will not always be the same as the posttest n. This will be true for some other tables in this report, but an explanation will not be provided.

3. CHEMS Component

The CHEMS Component was directed at developing the chemistry subject matter competencies necessary for participants to teach CHEMS Chemistry. Emphasis was also placed on familiarity with CHEMS curricular materials, particularly with reference to laboratory activities.

The subject matter competency of the CHEMS participants was assessed on a pre- and post- participation basis using the 1968 version of The American Chemical Society - Advanced High School Chemistry Test. Table 11 provides information which shows that the CHEMS participants initially had a low level of competency in the general areas of chemistry measured by the test. A comparison of pre- and posttest scores (Table 11) shows that the participants had gained significantly ($p < .001$) in general chemistry subject matter competency by the completion of the CHEMS Component.

TABLE 11

Means, Standard Deviations, and t-Test for Matched Samples Comparing ACS Advanced High School Chemistry Test Scores

	CHEMS Participants				
	Pretest (n=29)		Posttest (n=29)		Pretest-Posttest
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	t
Test Scores (80 possible)	11.15	6.90	26.48	9.75	9.68*
Degrees of Freedom					26

*$t > 3.71$ to be significant at the .001 level

Based on the information available it is reasonable to infer that the CHEMS Component resulted in participants gaining significantly greater subject matter competency in the area of general chemistry.

4. General Science Component

The General Science Component was composed of 50 participants of which 25 worked with Earth Science Curriculum Project (ESCP) materials and 25 worked with Introductory Physical Science (IPS) curricular materials. There was a common mathematics component directed at providing the mathematics proficiency needed for working with either set of curricular materials.

TABLE 12

Means, Standard Deviations and t-Test for Matched Samples Comparing USD General Mathematics Test Pre- and Posttest Scores

Earth Science Participants

	Pretest (n=25)		Posttest (n=24)		Pretest-Posttest
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	t
Test Scores (150 possible)	87.76	27.14	113.33	18.76	8.03*
Degrees of Freedom					23

*t > 3.77 to be significant at the .001 level

A general mathematics test was developed which assessed the desired mathematics competencies necessary for teachers who would teach the curricular materials emphasized in the General Science Component. Table 12 shows that the Earth Science participants had a significantly greater ($p < .001$) general mathematics competency at the completion of the General Science Component, than they had when they began.

TABLE 13

Means, Standard Deviations and t-Test for Matched Samples Comparing USD General Mathematics Test Pre- and Posttest Scores

Physical Science Participants

	Pretest (n=25)		Posttest (n=25)		Pretest-Posttest
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	t
Test Scores (150 possible)	106.40	27.30	130.20	19.27	4.33*
Degrees of Freedom					24

*t > 3.74 to be significant at the .001 level

Table 13 shows that the Physical Science participants had gained significantly ($p < .001$) in general mathematics competency by the completion of the General Science Component.

The Physical Science participants began the program with a greater mathematics competency than the Earth Science participants. (Compare pretest mean Tables 12 and 13.) Based on the differences between the two groups on the pretest it may be reasonable to modify the General Science Component and offer a separate mathematics course for each group. Another alternative would be to offer two mathematics courses and place the participants in the courses based on their mathematics competency pretest scores.

a) Earth Science and Physical Science Subject Matter Competency

The Earth Science Concepts and Processes Test was developed under the direction of Dr. Victor Mayer at the Ohio State University for use with his NSF institute group. Permission was obtained to use this test with the Earth Science Section of the General Science Component.

TABLE 14

Means, Standard Deviations and t-Test for Matched Samples Comparing Earth Science Concepts and Processes Pre- and Posttest Scores

	Earth Science Participants				
	PreTest (n=25)		Posttest (n=23)		Pretest-Posttest
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	t
Test Scores (40 possible)	29.64	5.01	31.65	4.38	2.97*
Degrees of Freedom					22

*t > 2.82 to be significant at the .01 level

Table 14 provides information which shows that Earth Science participants had significantly greater ($p < .01$) subject matter competency in earth science at the end of the summer program than they had at the beginning. This two point gain may not represent the actual achievement. The test used is being analyzed for possible modifications.

The information provided in Table 15 shows that the Physical Science participants had significantly greater ($p < .001$) subject matter competency at the end of the summer program than they did at the beginning. The ceiling on this test was too low, consequently, the three point gain is probably not a true measure of achievement.

Based on the information available it is reasonable to infer that the General Science component resulted in participants gaining significantly greater subject matter competencies in general mathematics and the science areas studied.

TABLE 15

Means, Standard Deviations and t-Test for Matched Samples Comparing Physical Science Test Pre- and Posttest Scores

	Pretest (n=25)		Posttest (n=25)		Pretest-Posttest
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	t
Test Scores (22 possible)	16.56	3.42	19.56	2.47	5.33*
Degrees of Freedom					24

*t > 3.74 to be significant at the .001 level

B. Instructional Activities Which Participants Feel Should Be Used and Those They Do Use For Their Instruction

1. Classroom and laboratory activities which participants feel should be used for science instruction.

Each participant responded to the Science Classroom Activities Checklist: Teacher Perceptions (SCACL:TP) pre- and post program participation. This instrument is directed at determining the nature of the science classroom and laboratory activities which the teacher feels "should" be used for secondary school science instruction. The checklist is scored according to whether the teachers' responses are correct in terms of the nature of the activities which are thought to best implement the overall objectives of science education. The SCACL:TP is divided into seven subscales which are (A) Student Classroom Participation, (B) Role of the Teacher in the Classroom, (C) Use of Textbook and Reference Materials, (D) Design and Use of Tests, (E) Laboratory Preparation, (F) Types of Laboratory Activities, and (G) Laboratory Follow-up Activities.

Table 16 provides SCACL:TP pre- and posttest means and standard deviations for each component and for the total program. Posttest data will be collected on all the other components as the participants complete them.

Table 17 provides information which shows that the CHEMS participants' SCACL:TP posttest mean composite score was not significantly different from their mean pretest score. CHEMS participants' scores on Subscale F (Types of Laboratory Activities) did show a significant change from pre to post ($p < .05$). The change was toward the direction of lower scores on the Subscale and would indicate that participants felt laboratory activities should be more structured and less open. The CHEMS participants, however, entered the program in relatively good agreement with educators as to the types of activities which should be used for implementing science education activities, and in general, they maintained this agreement.

TABLE 16

Pre- and Posttest Means and Standard Deviations For Subscales and Composite Scores on the SCACL:TP By Separate Program Components and Total Program

	1 (n=3)		2 (n=13)		3 (n=29)		4 (n=25)		5 (n=24)		6 (n=10)		7 (n=10)		Total (n=114)	
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
SCACL:TP																
Subtest A Pretest 8*	8.00	0.00	6.69	1.07	7.45	0.67	6.92	0.84	7.08	1.04	6.70	1.10	7.00	0.77	7.08	0.94
Subtest A Posttest 8	I**	I	I	I	7.28	1.11	7.13	0.80	7.33	0.85	I	I	I	I	7.25	0.95
Subtest B Pretest 9	9.00	0.00	8.23	0.89	8.14	1.04	8.04	1.00	7.75	1.33	7.90	0.70	8.20	0.75	8.05	1.05
Subtest B Posttest 9	I	I	I	I	8.34	0.84	8.13	0.85	8.42	0.91	I	I	I	I	8.30	0.87
Subtest C Pretest 8	7.33	0.94	6.85	0.95	7.28	0.94	7.04	0.77	6.79	1.32	6.80	0.87	6.20	0.87	7.03	1.00
Subtest C Posttest 8	I	I	I	I	7.28	1.05	7.09	0.97	7.38	0.90	I	I	I	I	7.25	0.99
Subtest D Pretest 11	10.00	0.82	9.85	1.03	9.72	1.11	8.76	1.39	9.67	1.25	9.20	1.40	10.10	0.94	9.51	1.29
Subtest D Posttest 11	I	I	I	I	9.45	1.35	9.00	1.10	9.83	0.99	I	I	I	I	9.43	1.22
Subtest E Pretest 8	6.33	0.47	6.62	1.50	7.00	0.83	6.04	0.96	6.71	1.43	6.40	0.80	7.20	0.75	6.63	1.15
Subtest E Posttest 8	I	I	I	I	6.86	1.33	6.96	1.04	6.71	0.93	I	I	I	I	6.84	1.17
Subtest F Pretest 9	8.00	0.82	8.00	1.04	7.66	1.03	7.68	1.16	7.29	1.34	7.20	1.60	8.20	0.87	7.64	1.21
Subtest F Posttest 9	I	I	I	I	7.17	1.68	7.87	0.99	7.79	1.26	I	I	I	I	7.58	1.41
Subtest G Pretest 7	6.33	0.94	6.08	0.73	6.31	0.79	6.24	0.65	6.46	0.82	6.40	0.82	6.90	0.30	6.36	0.76
Subtest G Posttest 7	I	I	I	I	6.50	0.91	6.61	0.57	6.54	0.64	I	I	I	I	6.55	0.74
Composite Pretest 60	55.00	3.56	52.31	4.05	53.55	3.97	50.72	3.92	51.71	6.41	50.60	4.90	54.80	2.75	52.29	4.80
Composite Posttest 60	I	I	I	I	52.66	6.15	52.78	3.71	54.00	4.38	I	I	I	I	53.12	5.00

* Number possible ** The posttest has not been administered

TABLE 17

t-Test for Matched Samples Comparing Science Classroom Activities Checklist: Teacher Perceptions Pre- and Posttest Scores

	Component 3	Component 4	Component 5
t Subscale A	-1.04	0.65	1.10
t Subscale B	1.00	0.75	2.33**
t Subscale C	0.00	0.00	2.35**
t Subscale D	-1.61	1.00	0.66
t Subscale E	-0.47	4.53**	0.00
t Subscale F	-2.09*	0.89	1.60
t Subscale G	0.53	2.08**	0.40
t Composite	-1.13	2.72**	1.80
Degrees of Freedom	28	22	23

*$t > 2.05$ to be significant at the .05 level
**$t > 2.07$ to be significant at the .05 level

The Earth Science Section of the General Science Component did demonstrate significant change ($p < .05$) in their views of the classroom activities which should be used for science instruction (Table 17). The change was toward higher scores. An analysis of the subscales revealed that most of the change was in Subscale E (Laboratory Preparation) and Subscale G (Laboratory Follow-up Activities). The scores indicate a change on the part of the participants toward more open investigatory types of laboratory activities and follow-up.

Table 17 provides information which shows that the Physical Science participants' (General Science Component) SCACL:TP posttest mean composite scores were not significantly different from their mean pretest composite scores. Subscale analyses reveals, however, that they did demonstrate (Table 17) significant pre-posttest changes on Subscale B (Role of the Teacher in the Classroom) and C (Use of Textbook and Reference Materials). The scores reflect a change on the part of the participants toward a classroom with more student participation, less teacher domination, and one in which the students are encouraged to go beyond their textbooks in seeking information.

Inspection of Table 16 leads to the conclusion that all of the participants entered the program in generally good agreement with science educators as to the type of classroom and laboratory activities which should be used for science instruction. The program components contributed positively in several areas toward strengthening this agreement.

2. Classroom and Laboratory Activities Which Participants Do Use For Their Science Instruction

The types of classroom and laboratory activities which the Comprehensive Program participants do use for science instruction was assessed using the Science Classroom Activities Checklist: Student Perceptions (SCACL:SP). The SCACL:SP is a parallel instrument to the SCACL:TP discussed previously. The nature of the activities the student perceived their teachers to use was assessed previous to their teachers' participation in the Comprehensive

Program and will be assessed again after program participation. The pre-program scores are being tabulated at the present time.

C. Understanding of Science

Each participant responded to the Test on Understanding Science (TOUS), both previous to program participation and at the completion of the program. The TOUS test is divided into three subscales which are (1) The Scientific Enterprise, (2) The Scientist and (3) Methods and Aims of Science.

Table 18 provides TOUS pretest and posttest means and standard deviations for each component and for the total program.

TABLE 18

Pre- and Posttest Means and Standard Deviations for the TOUS by Separate Program Components and Total Program

	1 (n=3)		2 (n=13)		3 (n=29)		4 (n=25)		5 (n=25)		6 (n=10)		7 (n=10)		Total (n=115)	
	x̄	S.D.	x̄	S.D.	x̄	S.D.	x̄	S.D.	x̄	S.D.	x̄	S.D.	x̄	S.D.	x̄	S.D.
TOUS Subscale 1 Pretest	13.67	1.25	13.85	1.79	13.90	1.79	12.52	2.45	13.36	2.41	13.20	1.60	14.00	1.48	13.42	2.18
TOUS Subscale 1 Posttest	I*	I	I	I	14.28	1.82	13.35	2.33	13.92	2.10	I	I	I	I	13.88	2.10
TOUS Subscale 2 Pretest	13.33	1.25	12.92	2.09	12.93	2.03	12.44	2.16	11.76	2.58	13.20	1.17	14.00	2.41	12.70	2.25
TOUS Subscale 2 Posttest	I	I	I	I	13.17	2.17	12.65	2.46	12.80	2.10	I	I	I	I	12.90	2.25
TOUS Subscale 3 Pretest	15.00	2.94	16.92	2.76	16.10	2.75	14.20	3.20	15.52	2.80	16.40	3.07	17.30	2.83	15.76	3.07
TOUS Subscale 3 Posttest	I	I	I	I	16.31	2.60	14.57	3.44	16.40	2.37	I	I	I	I	15.82	2.93
TOUS Composite** Pretest	42.00	4.55	42.92	4.68	42.55	4.89	39.16	6.62	40.64	5.76	42.80	4.94	45.30	5.50	41.69	5.81
TOUS Composite** Posttest	I	I	I	I	43.76	5.35	40.57	7.11	43.12	5.69	I	I	I	I	42.60	6.18

* The posttest has not been administered ** Possible 60 points

The composite mean of the pretest scores for the participants that have completed components (CHEMS and General Science) is 40.78. A comparison of this TOUS mean pretest score to Table 19 indicates that the participants in these groups, on the average, ranked at about the 87th percentile when compared to the 1960 national sample of twelfth grade students. The post-component composite scores for these same groups have a mean of 42.60. This indicates that after having completed the program, the participants, on the average, ranked at the 93rd percentile when compared to the 1960 national sample of twelfth grade students. Probably the most meaningful aspect of this comparison is that the participants ranked above the 90th percentile when compared to a national sample of twelfth grade students.

Further study shows that all components demonstrated gains on the TOUS when pre-component and post-component scores are compared. Table 20 provides information which shows, however, that only the Physical Science section of the General Science Component showed significant gains (P <.01).

The need for further normative data and more study in this area is evident. Whether the reason for lack of significant growth is due to a good understanding of science on the part of participants when they enter the program, or whether we need to modify some components of our program to facilitate growth in this area is not clear at this point. It is clear, however, that participants in all components are showing a somewhat greater understanding of science measured by this test at the completion of the program components.

TABLE 20

t-Test For Matched Samples Comparing TOUS Pre- and Posttest Scores

	t for Subscale 1	t for Subscale 2	t for Subscale 3	t for Composite	Degrees of Freedom
Component 3	1.34	.80	.38	1.56	28
Component 4	1.75	.63	1.08	1.60	22
Component 5	1.48	2.01	2.24**	3.40**	23

* t ≥ 2.05 to be significant at the .05 level

** t ≥ 2.07 to be significant at the .05 level

Posttest data will be collected on the other components as they complete their program. Table 19, provides percentile ranks based on a nationwide sample of 3009 public and private school students tested in October, 1960 (this is the only normative data of which the author is aware).

TABLE 19**

TENTATIVE NORMS -- Test on Understanding Science (TOUS)

Percentile Ranks for High School Students*

TOUS Total Score	Grade 9#	Grade 10	Grade 11	Grade 12
48				99
47			99	
46		99	98	98
45			97	96
44		98	96	95
43		97	94	93
42		96	92	90
41	99	94	90	88
40	98	92	87	85
39	97	91	84	82
38	94	89	81	78
37	90	86	78	74
36	85	84	74	69
35	81	81	69	63
34	75	77	64	59
33	69	72	58	54
32	64	67	52	47
31	58	63	46	41
30	52	58	41	36
29	45	52	36	32
28	38	46	31	28
27	32	40	28	24
26	27	36	22	20
25	22	32	18	16
24	17	28	15	14
23	12	23	12	12
22	10	19	9	9
21	9	16	7	7
20	7	14	5	5
19	6	11	4	4
18	4	8	2	3
17		7		2
16	2	5	1	
15		4		1
14		3		
13		2		
Mean Score	29.47	28.58	31.57	32.25
Standard Deviation	6.03	7.66	7.02	7.38
Number of Students	198	1064	994	753

*Based on a nationwide sample of 3009 public and private school students tested in October 1960. The means and standard deviations are based on 2980 of the 3009 students: 9th Grade, 198 students; 10th Grade, 1055; 11th Grade, 985; 12th Grade, 742.

#Figures for Grade 9 should be used with caution, since they are based on a relatively small sample group.

**Taken from TEST ON UNDERSTANDING SCIENCE, Manual for Administering, Scoring, and Interpreting Scores, Educational Testing Service, 1961.

D: Attitudes of Participants and Their Students

1: Participants

Attitudes toward several aspects of science were and are being assessed using the Semantic Differential Test in Science developed by Dr. James Gallagher at the Educational Research Council of America. This instrument was developed for use with the Test Every Senior Project. The Semantic Differential Test in science was used in assessing the attitudes of Comprehensive Program participants both pre- and post- program and for assessing the attitudes of the participants' students.

The concepts evaluated by teachers and students were (1) Social Studies, (2) Mathematics, (3) Science, (4) Science Teachers (by students); Science Teaching (by participants), (5) Teachers, (6) School, (7) Laboratory Work, (8) Scientists and (9) Myself. These nine concepts were evaluated in terms of sixteen bi-polar scales. The bi-polar scales were classified into four categories - evaluation, potency, activity, and personality. A five point differential was used on all scales.

Student and teacher responses to each of the semantic differential concepts were assigned integral values ranging from one point for the least favorable response (e.g. bad) to five points for the most favorable response (e.g. good). Since each of the categories, evaluation, potency, activity, and personality, was comprised of four bi-polar scales, an average score for each category was determined for each individual. Mean category responses were calculated for all the students of any one teacher. Thus, on each concept, a teacher (participant) and/or his students received four scores ranging from one to five points, one score for evaluation, one for potency, one for activity, and one for personality. This was, and will be done on each participant previous to participation in the program and at the completion of participation. Group means were calculated for each Program Component. Follow-up data will also be collected on participants and their students.

For purpose of this report the four concepts evaluated were (1) Mathematics, (2) Science, (3) Science Teaching, and (4) Laboratory Work.

TABLE 21

Means and Standard Deviations for Semantic Differential Pretest Scores: <u>Mathematics</u> Grouped by Program Component

Program Components

	1 (n=3)		2 (n=13)		3 (n=29)		4 (n=24)		5 (n=22)		6 (n=10)		7 (n=10)		Total (n=111)	
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
Evaluation	4.17	.47	4.36	.32	4.29	.60	4.29	.50	4.36	.53	4.05	.60	4.47	.36	4.31	.53
Potency	2.50	0.0	3.31	.53	3.34	.47	3.20	.50	2.95	.36	2.85	.42	3.20	.77	3.15	.53
Activity	4.08	.42	3.77	.59	4.00	.53	3.91	.66	3.57	.67	3.97	.38	4.00	.39	3.87	.60
Personality	3.00	.35	3.06	.36	3.14	.30	3.23	.47	2.95	.37	3.15	.39	3.27	.44	3.12	.40

TABLE 22

Means and Standard Deviations For Semantic Differential Posttest Scores: Mathematics Grouped By Program Component

Program Components

	1 (n=3)		2 (n=13)		3 (n=29)		4 (n=24)		5 (n=27)		6 (n=10)		7 (n=10)		Total (n=111)	
	x̄	S.D.	x̄	S.D.	x̄	S.D.	x̄	S.D.	x̄	S.D.	x̄	S.D.	x̄	S.D.	x̄	S.D.
Evaluation	I*	I	I	I	4.30	.60	4.25	.58	4.34	.71	I	I	I	I	4.30	.64
Potency	I	I	I	I	3.20	.55	3.17	.40	3.15	.47	I	I	I	I	3.17	.48
Activity	I	I	I	I	3.80	.51	4.00	.55	3.67	.70	I	I	I	I	3.81	.61
Personality	I	I	I	I	3.04	.21	3.10	.51	3.19	.66	I	I	I	I	3.11	.50

* I=Program not completed as yet

Table 23 provides information which indicates that CHEMS participant attitudes toward mathematics changed significantly ($P < .05$) in the activity category and approximated a significant change in the potency category. Comparison of Tables 21 and 22 indicates that these changes were toward participants expressing generally lower attitudes toward mathematics. Further study will have to be made to determine if supplementary work in mathematics is needed as a part of the CHEMS Component.

Table 23 provides information which indicates no significant change in Earth Science participants' attitudes toward mathematics at the completion of the General Science Component. Pretest subject matter competency scores indicated that grouping the Earth Science and Physical Science Sections might be appropriate. The effect this grouping might have on attitudes could be very interesting.

Physical Science participants had significantly ($P < .05$) changed their attitudes toward mathematics by the completion of the General Science Component (Table 23). This change was significant ($P < .05$) in three out of four categories. Comparison of Tables 21 and 22 indicates that these changes were toward participants having more positive attitudes toward mathematics at the completion of the General Science Component.

TABLE 23

t-Tests for Match Pairs Comparing Semantic Differential: Mathematics Pre- and Posttest Scores Grouped By Program Component

	Program Component						
	1	2	3	4	5	6	7
	t	t	t	t	t	t	t
Evaluation	I*	I	0.00	0.22	2.43***	I	I
Potency	I	I	2.04	0.24	2.32	I	I
Activity	I	I	2.24	1.27	1.66	I	I
Personality	I	I	1.16	1.31	2.58***	I	I
Degrees of Freedom	I	I	27**	22***	23	I	I

* I = Program not completed as yet
** t ≥ 2.05 to be significant at the .05 level
*** t ≥ 2.06 to be significant at the .05 level

b. Science

TABLE 24

Means and Standard Deviations for Semantic Differential Pretest Scores: Science Grouped by Program Component

	Program Components														Total	
	1 (n=3)		2 (n=13)		3 (n=29)		4 (n=24)		5 (n=22)		6 (n=10)		7 (n=10)		(n=111)	
	x	S.D.	x	S.D.	x	S.D.	x	S.D.	x	S.D.	x	S.D.	x	S.D.	x	S.D.
Evaluation	4.83	.12	4.75	.33	4.68	.31	4.67	.42	4.74	.28	4.75	.35	4.72	.26	4.71	.33
Potency	3.00	.41	3.38	.50	3.53	.55	3.47	.54	3.26	.57	3.07	.37	3.35	.78	3.38	.58
Activity	3.91	.51	4.07	.51	4.31	.42	3.78	.77	3.84	.74	4.00	.32	4.45	.46	4.04	.64
Personality	3.33	.12	3.36	.48	3.45	.57	3.56	.57	3.31	.50	3.57	.45	3.60	.61	3.46	.54

TABLE 25

Means and Standard Deviations for Semantic Differential Posttest Scores: Science Grouped by Program Component

Program Components

	1		2		3 (n=29)		4 (n=24)		5 (n=27)		6		7		Total (n=80)	
	x̄	S.D.	x̄	S.D.	x̄	S.D.	x̄	S.D.	x̄	S.D.	x̄	S.D.	x̄	S.D.	x̄	S.D.
Evaluation	I*	I	I	I	4.65	.35	4.58	.47	4.68	.35	I	I	I	I	4.64	.39
Potency	I	I	I	I	3.38	.59	3.45	.49	3.42	.68	I	I	I	I	3.42	.60
Activity	I	I	I	I	4.06	.64	4.04	.50	3.99	.64	I	I	I	I	4.03	.60
Personality	I	I	I	I	3.32	.49	3.42	.58	3.49	.70	I	I	I	I	3.41	.60

* I = Program not completed as yet

Table 26 provides information which indicates that all participants entered the Comprehensive Program with fairly positive attitudes toward science.

Information provided in Table 26 indicates a significant (P <.05 level) change of CHEMS participants' attitudes toward science (activity category) by the completion of the Component. Comparison of Tables 24 and 25 reveals generally lower attitude scores toward science at the completion of the component. The depression of attitude scores however, generally was not significant. Participants completing the program revealed a generally positive attitude toward science, but the indication of decline will be scrutinized to see if a problem exists.

The Earth Science participants had changed their attitudes significantly (P<.05 level) toward science (activity category) by the completion of the component (Table 26). None of the other categories showed significant change. Comparison of Tables 24 and 25 reveals that the change was toward more positive attitudes in the activity category.

The Physical Science participants had not changed their attitudes significantly (Table 26) toward science at the completion of the General Science Component.

TABLE 26

t-Tests For Matched Pairs Comparing Semantic Differential: Science Pre- and Posttest Scores Grouped by Program Component

	Program Component						
	1 t	2 t	3 t	4 t	5 t	6 t	7 t
Evaluation	I*	I	0.35	0.37	0.89	I	I
Potency	I	I	1.56	0.53	0.00	I	I
Activity	I	I	2.32**	2.55***	0.21	I	I
Personality	I	I	1.16	0.73	1.17	I	I
Degrees of Freedom	I	I	28**	22***	23***	I	I

* I = Program not completed   **t ≥ 2.05 to be significant at the .05 level
***t ≥ 2.07 to be significant at the .05 level

c. Science Teaching

TABLE 27

Means and Standard Deviations for Semantic Differential Pretest Scores: Science Teaching Grouped By Program Component

Program Components

	1 (n=3)		2 (n=13)		3 (n=29)		4 (n=24)		5 (n=22)		6 (n=10)		7 (n=10)		Total (n=111)	
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
Evaluation	4.17	.42	4.75	.39	4.64	.34	4.48	.53	4.66	.38	4.70	.46	4.72	.47	4.62	.45
Potency	2.92	.31	3.46	.46	3.35	.46	3.24	.49	3.09	.33	3.27	.58	3.47	.50	3.28	.48
Activity	4.08	.31	4.29	.41	4.18	.48	4.02	.65	3.94	.63	4.27	.38	4.40	.30	4.14	.54
Personality	3.67	.51	3.79	.64	3.68	.65	3.81	.74	3.52	.68	3.95	.64	3.97	.54	3.74	.68

TABLE 28

Means and Standard Deviations for Semantic Differential Posttest Scores: Science Teaching Grouped By Program Component

Program Components

	1		2		3 (n=29)		4 (n=24)		5 (n=27)		6		7		Total (n=80)	
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
Evaluation	I*	I	I	I	4.65	.53	4.66	.43	4.63	.48	I	I	I	I	4.64	.48
Potency	I	I	I	I	3.30	.47	3.33	.55	3.22	.62	I	I	I	I	3.28	.55
Activity	I	I	I	I	4.19	.58	4.08	.51	4.09	.50	I	I	I	I	4.12	.53
Personality	I	I	I	I	3.53	.68	3.83	.64	.362	.65	I	I	I	I	3.65	.67

*I=Program not completed as yet

Table 29, page 205, provides information which shows no significant changes in attitudes toward science teaching by participants in the program components. The participants came into the program with very positive attitudes toward science teaching, and left the program with very much the same attitudes.

TABLE 29

t-Tests For Matched Pairs Comparing Semantic Differential: Science Teaching Pre- and Posttest Scores Grouped By Program Component

	Program Component 1 t	2 t	3 t	4 t	5 t	6 t	7 t
Evaluation	I*	I	-0.09	1.92	-0.12	I	I
Potency	I	L	0.83	1.36	-0.48	I	I
Activity	I	I	-0.07	0.79	0.82	I	I
Personality	I	I	1.31	0.16	-0.20	I	I
Degrees of Freedom	I	I	28**	22***	23***	I	I

* I=Program not completed as yet
**>t 2.05 to be significant at the .05 level
***>t 2.07 to be significant at the .05 level

d. Laboratory Work

TABLE 30

Means and Standard Deviations for Semantic Differential Pretest Scores: Lab Work Grouped by Program Component

Program Components

	1 (n=3) x̄	S.D.	2 (n=13) x̄	S.D.	3 (n=29) x̄	S.D.	4 (n=24) x̄	S.D.	5 (n=22) x̄	S.D.	6 (n=10) x̄	S.D.	7 (n=10) x̄	S.D.	Total (n=111) x̄	S.D.
Evaluation	4.50	.54	4.77	.36	4.68	.44	4.46	.78	4.59	.46	4.57	.51	4.67	.32	4.61	.54
Potency	3.00	.20	3.25	.54	3.22	.26	3.03	.53	3.03	.31	3.00	.43	3.35	.46	3.13	.43
Activity	4.17	.47	4.21	.49	4.46	.70	4.07	.65	4.09	.51	4.35	.42	4.32	.46	4.24	.60
Personality	3.75	.41	3.50	.60	3.50	.56	3.56	.69	3.50	.53	3.50	.51	3.75	.58	3.54	.59

TABLE 31

Means and Standard Deviations for Semantic Differential Posttest Scores
Lab Work Grouped By Program Component

Program Component

	1		2		3 (n=29)		4 (n=24)		5 (n=27)		6		7		Total (n=80)	
	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
Evaluation	I*	I	I	I	4.61	.44	4.56	.51	4.52	.42	I	I	I	I	4.57	.46
Potency	I	I	I	I	3.13	.31	3.16	.57	3.19	.49	I	I	I	I	3.16	.46
Activity	I	I	I	I	4.22	.51	4.15	.44	4.22	.54	I	I	I	I	4.20	.50
Personality	I	I	I	I	3.31	.52	3.42	.57	3.58	.64	I	I	I	I	3.43	.59

* I=Program not completed as yet

No significant changes (Table 32) in participant attitude toward laboratory work were found when pre- and posttest scores on the Semantic Differential test in Science were compared. The participants entered the program with positive attitudes toward laboratory work and these attitudes apparently remained very positive.

TABLE 32

t-Test For Matched Pairs Comparing Semantic Differential: Lab Work
Pre- and Posttest Scores Grouped By Program Component

Program Component

	1 t	2 t	3 t	4 t	5 t	6 t	7 t
Evaluation	I*	I	0.69	0.72	0.49	I	I
Potency	I	I	1.26	1.07	0.64	I	I
Activity	I	I	1.84	1.16	0.94	I	I
Personality	I	I	1.53	1.17	0.18	I	I
Degrees of Freedom	I	I	28**	21***	23***	I	I

* I=Program not completed as yet
** t 2.05 to be significant at the .05 level
*** t 2.07 to be significant at the .05 level

2. Participants' Students' Attitude Toward Science

The attitude of participants' students were obtained on the same concepts as those discussed for the participants. This data is presently being processed. Follow-up data will be compared to that collected prior to the teachers' program participation. The first follow-up data will be collected in the Spring, 1972.

III. PROGRAM PROCESS EVALUATION

A series of questionnaires were developed which obtained information relative to operation of the overall program and relative to the specific components. Information will be presented and discussed relative to the total program operation, but will also include discussion of specific components as it is needed. This information pertains to all program components except the Academic Year Institute. (This information has not been collected from the AYI at this point.)

Data was collected from beginning sequential participants (N=12) and those completing sequential programs (N=8). It was also collected from all participants in unitary components (N=78). The total number of respondents that provided data for this section was 98.

A. Information Prior to Arrival in Vermillion

1. Sources of information about program at U.S.D.

Approximately 53% of the participants received their information concerning the program from the brochure sent out by the University. About 35% received their information from the NSF brochure. The rest received their information from previous participants and other miscellaneous sources.

2. Number of institutes applied and acceptances

The mean number of institutes applied to by participants was approximately five. The mean number of acceptances received was two.

3. Reason for choosing U.S.D.

The two primary reasons for choosing U.S.D. were the University's geographic proximity to their home and the nature of the programs being offered.

4. Adequacy of information for making judicious decisions about the institute

Ninety-six percent of the participants felt the information provided them was adequate.

5. Adequacy of information after accepting institute, with particular reference to housing, the community and the University

Approximately 70% of the participants felt adequately informed about housing. Although the questionnaire solicited specific suggestions for improvement and none were received, attention will be given to correcting this matter.

Approximately 80% felt adequately informed about Vermillion. The very few critical comments indicated that the participant was not aware that Vermillion was such a small town and found this somewhat disappointing.

Almost all of the participants felt adequately informed about the University and the departments with which they would be working.

B. Participant and Institutional Commitment to Program

6. Could participants continue education without NSF assistance?

There was a difference in this area between the unitary programs and the sequentials. Thirty-six percent of the unitary participants indicated they could continue their education without NSF support whereas only 25% of the sequential participants felt they could do this.

7. Discussion of institute participation with school administrators

Over 80% of the participants discussed their institute participation with their school principal and approximately 75% also discussed it with their superintendent. All participants indicated that their principal supported their attending the institute. A small number (3%) indicated their superintendent was not in sympathy with their attendance.

8. Moral and/or financial support from school system as a direct or indirect result of U.S.D. Comprehensive Program participation

Almost all the participants indicated their schools would provide moral support for improving the science education program in their schools.

Approximately 60% of the participants indicated their schools would provide financial support (equipment, materials, facilities, released time, etc.) for the improvement of the science education program in their schools.

A questionnaire was mailed to the 52 participants who indicated confidence in financial support from their schools asking them to document the nature and the amount of this commitment. Thirty-three questionnaires (66%) were returned. The returned questionnaires indicated completed or anticipated expenditures of over $38,000.00 on the part of the schools to help the participants improve their science education programs. The primary items indicated were instructional materials and equipment related to the implementation of science curriculum projects. (Specific items and cost are indicated in the questionnaires, but not included in this document.) Some released time was indicated, but the schools' investment in this was not included in the figure provided above. Everything considered, the indication is that the schools feel a firm commitment to up-grading science education.

Approximately 8% of the participants received collateral support from their school while participating in the Comprehensive Program. This dollar amount was not ascertained and is not included in the dollar value provided earlier.

C. Course Related Activities

9. Field trips as a part of the program

Approximately 50% of the participants were involved in field trips as a part of their program. On a scale of 1 to 4 the field trips received a mean rating of 3 which indicated that the participants felt the trips were quite successful. When the participants were asked whether field trips should be a part of their institute program, 80% responded yes. Suggestions for types of field trips which participants felt would be useful were catalogued.

10. Desire more work with science course improvement project materials

Approximately 75% of the participants desire more work with science course improvement project materials. Further clarification of this indicated that based on their experiences with curricular materials at U.S.D., they would like more work of this kind. This response was particularly true of participants in Unitaries directed at familiarization with a particular curriculum project.

11. Value of introductory courses with graduate credit

All participants responded that the availability of introductory science courses which they could take for graduate credit had been very useful. All participants felt that the offering of these courses should be continued, but they split about 50-50 as to whether more introductory courses in addition to those already available should be offered.

12. Desire more work on teaching skills

Approximately 70% of the Unitary participants indicated they would like further opportunity to work on teaching skills such as questioning, or those developed through microteaching. Approximately 75% of those completing the sequential institute components desired further work in this area. A specific course directed at the development of teaching skills, such as those mentioned above, is being developed and will be provided to AYI participants during spring, 1972. It is anticipated that work of this type will be built into other components.

13. Is the degree a crucial part of the program?

The question as to whether the degree was a crucial part of their program was posed to participants who were either beginning or completing the sequential programs. The question was not asked of participants in Unitaries. Approximately 93% of those beginning programs indicated the degree was crucial and 100% of those completing indicated the degree was crucial.

D. Housing

14. Did participants live in Vermillion?

All the sequential participants on which data was collected lived in Vermillion and 94% of the Unitary participants lived in Vermillion. This data supports that the program is achieving its goal of having participants live in the community where the program is held to provide for maximum interaction.

15. Type of Housing

Fifty percent of the sequential participants who were completing their program lived in apartments in the community and 50% lived in University housing. Ninety-two percent of sequential participants who were beginning the program lived in University housing and 8% lived in apartments in the community.

Unitary institute participants were found to occupy all six types of housing indicated on the questionnaire. The majority of them, however, resided in either University housing (59%) or apartments in town (21%).

16. Adequacy of housing for participants' needs

Over 96% of all participants felt the housing was adequate to meet their needs.

17. Number of dependents per participant

The mean number of dependents per participant was approximately 2.35.

18. Participants' recommendations of housing for future program participants

Almost all participants indicated they would recommend the housing they had utilized for use by future participants. One problem area identified was that in some instances University housing had not been properly cleaned prior to participants' occupancy. This situation will be corrected.

19. Amount paid for rent.

Most participants paid $76 - $90 a month rent and paid their own utilities. There was some interesting variation in that sequential participants finishing their program averaged over $130 per month, whereas participants beginning the sequential program averaged $91 to $115 per month. It appears that there is a tendency for married participants not to bring their families along when they begin a sequential program, but for those farther along in the program to have their families with them.

E. Adequacy of Community Resources

20. Adequacy of local businesses to meet participants' needs

Approximately 75% of the participants felt that local businesses were adequate to meet their needs. Most complaints were typical of those lodged against smaller communities, such as absence of night life, inadequate selection when shopping, etc.

21. Adequacy of eating establishments

Approximately 50% of the participants indicated they normally ate at home (no qualitative judgments). The other fifty percent were nearly equally divided between local restaurants and the student union. Reactions were positive and no major complaints were registered.

22. Adequacy of Community activities to meet the needs of the participants' children

Of the participants who had children with them, approximately 90% felt the community adequately met the needs of their children. The only complaint registered more than once was that some participants were unable to get their children enrolled in the community swimming program. The reasons for this will be ascertained and the situation corrected if possible.

23. Adequacy of community activities to meet the needs of the participants' wives.

Over 95% of those participants who had their wives with them indicated that community activities were adequate to meet the needs of their wives. No problem areas were identified.

24. Rating on how pleased the participants were with the way they and their family had been treated in the community
(Rating: 4 = extremely pleased, 3 = quite pleased, 2 = somewhat pleased, 1 = not pleased)

The mean rating was approximately 3 which indicated that the participants were quite pleased with the way they had been treated in the community.

F. Activities Related to the NSF-USD Program

25. Ratings of Comprehensive Components

Participants of the various program components were asked to rate the program they were participating in on a scale of one to seven.

All institutes received greater than a six rating on a seven point scale. (Only the final year participants in the two sequential programs were asked to rate the program.) The ratings by institute were Sequential Biology 6.5 (N=4), Sequential Chemistry 6 (N=4), CHEMS 6.36 (N=28), General Science - Earth Science Section 6.29 (N=24), and General Science - Physical Science Section 6.04 (N=25).

26. Adequacy of institute social activities for participants

Over 85% of the participants felt that the institute social activities were adequate for their needs. Sequential Chemistry, CHEMS, and General Science - IPS Section each had a few people who felt the social activities were inadequate. This will be looked at further to determine if any changes are needed. Specific recommendations were solicited from participants, but none were provided.

27. Adequacy of social activities for family

All the sequential and unitary general science participants felt that institute social activities were adequate for their families. Approximately 80% of the CHEMS participants felt that social activities were adequate for their families. The CHEMS program will look at this situation further to see if changes are needed. Specific recommendations were solicited from participants, but none were provided.

28. Adequacy of opportunity for participants to interact with students in other programs

The people beginning the Biology Sequential and the General Science participants all felt that they had adequate opportunity to react with students from other programs.

Approximately 60% of the people in the CHEMS and 50% of the beginning participants in the Chemistry Sequential felt they had adequate opportunity to interact with participants from other programs. This situation will be looked at further to see if more opportunities for between-group participant interaction should be built into the CHEMS and Chemistry Sequential Components.

29. Participants' understanding of program evaluation

Approximately 95% of the participants indicated they understood the reasons for the over-all program evaluation.

30. Value of program evaluation

Approximately 95% of all participants felt the program evaluation was worthwhile.

31. Time involved in program evaluation

Approximately 30% of all participants felt that too much time was involved in program evaluation. The primary complaint was against the amount of classroom time required for collecting data from their students. It is doubtful that this testing time can be reduced, but the instruments will be delivered to the teachers earlier so that the testing will not come at the very end of the school year. This should help alleviate the problems since teachers feel very pressed for time as they near the completion of the school year.

32. Collecting data from participants' students

Approximately 40% of the participants indicated they had difficulty in collecting the data from their students. The two primary problems were that only a small sample was randomly selected from each of their classes and the fact that participants received the materials too late in the school year. The latter problem is easily solved and the first one will be worked on prior to the next data collection.

33. Adequacy of directions for collecting data from participants' students

Eighty percent of the participants felt that the directions they used for collecting data from their students were adequate. The major problem seemed to be in randomly selecting students from classes. This procedure can be simplified, but probably not to everyone's satisfaction.

G. General Participant Information

34. Do participants return to school they taught at prior to program participation?

Sixty-three percent of the participants completing the Sequential Programs and 93% of those beginning the Sequential Programs returned to the school they taught at prior to program participation. Seventy-eight percent of the people in the CHEMS component and over 90% of the people in the General Science Component returned to the school they taught at prior to program participation. The specific reasons for teachers leaving schools are being catalogued and may provide some useful longitudinal information.

35. What subjects, grade levels, and in what size schools do participants desire to teach?

Participants were asked to respond to the question, "What subjects, what grade level(s), and in what size schools they would teach if they had complete choice in the matter and salary was not a factor?" Information on this question will be presented under each program component.

a.) General Science Component

Approximately eighty percent of the General Science Participants indicated they would like to continue teaching general science or some combination of subjects which included general science. Mathematics was the most frequent companion (20%) when participants listed more than one subject.

Approximately 85% of the General Science participants would choose to work at least some of the day with students ninth grade level or below. Approximately 60% indicated they would prefer to work exclusively with these younger students.

The General Science participants, if given their choice, would choose to work in schools having student enrollments of approximately 650 students. Further analysis reveals that those in the Earth Science Section prefer an average school size of 800 students, whereas the participants in the Physical Science section prefer, on the average, a school of about 475 students.

b.) CHEMS Component

Seventy-five percent of the CHEMS participants would like to teach chemistry or some combination of subjects including chemistry. There was no one particular subject which was picked most frequently as a companion when participants listed more than one subject.

Seventy-five percent of the CHEMS participants would choose to work at least some of the day with students of tenth grade level or above. Approximately 50% indicate they preferred to work exclusively with tenth grade students or older.

The CHEMS participants would prefer, on the average, to teach in schools with enrollments of 550 students.

H. Sequential Institutes

The Biology Sequential people all prefer to teach biology or biology plus some other subject. The Chemistry Sequential participants all prefer to teach chemistry or chemistry plus some other subject. This seems to be true of participants beginning the program and those completing it. The number of participants for which we have this type of data is too small, however, to make a strong generalization.

Almost all Sequential participants, those beginning (n=12) and those completing the program (n=8), indicate they would prefer to teach at the grade levels 10 through 12. Although the number of respondents was small, it appeared this trend was stronger in those participants completing the program.

Sequential participants, if given their choice, would choose to work in schools having a student enrollment of approximately 1000 students. Further analysis reveals, however, that this may depend on whether you look at participants who are beginning the program or those completing it. It also may depend on the subject area of the participant. Beginning participants indicate the ideal size school for them has approximately 600 students, whereas those participants completing programs indicate they would rather teach in a school of approximately 1500 students. There also appears to be a tendency for chemistry teachers to prefer somewhat larger schools than biology teachers. A note of caution should be included here in that the above statements are based on relatively small samples and the statements could be very biased.

IV. RANKING OF PROGRAM OBJECTIVES

Comprehensive Program participants and staff were asked to rank order program objectives. This was done for each program component.

A questionnaire was developed which listed a series of objectives which were to be rank ordered. The list of objectives was developed from the Program proposal and then modified based on inputs from staff and participants. Participants and staff were asked to rank order the objectives beginning with one (1) as the most important and to progress to what they felt was the least important objective. Participants were asked to do this in terms of what they felt were their greatest needs. Staff were asked to rank order in terms of what they felt were the participants greatest needs. No two objectives could be given the same value rating.

Table 33 provides information on how participants and staff rank ordered program objectives. The mean rank ordering for the total participants and the total staff is provided. The information is also broken down according to program component.

Observation of Table 33 indicates that participants and staff are in fairly good agreement as to the relative ranking of objectives. Subject matter competency is rated by participants and staff as by far the most important objective for the Comprehensive Program. Developing an understanding of the nature of science, using science instructional activities consistent with contemporary objectives of science education, the implementation of new curricular materials in the schools of the region, and participants functioning as a source of innovation in their schools were other objectives which received high ratings from participants and staff.

The rank order for some objectives was quite different from one component to another. This is not unexpected when the nature of the components and the needs to which the different components are addressed is considered.

The importance which was assigned to various objectives has been taken into consideration in Comprehensive Program Evaluation. They are also being taken into account in program development.

Code for Program Components

1 = Sequential Biology Component
2 = Sequential Chemistry Component
3 = Unitary CHEMS Component
4 = Earth Science Section of General Science Component
5 = Physical Science Section of General Science Component
6 = Academic Year Component

TABLE 33

Rank Ordering of Program Objectives By Participants and By Staff Listed For Total Program and For Each Component

	1		2		3		4 and 5		6		Total	
	Part. (n=28)	Staff (n=3)	Part. (n=28)	Staff (n=3)	Part. (n=30)	Staff (n=3)	Part. (n=48)	Staff (n=3)	Part. (n=25)	Staff (n=1)	Part. (159)	Staff (13)
1. To increase the subject matter competency of teachers.	1 (2.93*)	1 (1.33*)	1 (1.96*)	1 (1.67*)	1 (2.70*)	1 (1.00*)	1 (2.73*)	1 (1.00*)	1 (2.13*)	1 (1.00*)	1 (2.53)	1 (1.23)
2. To develop in teachers an understanding of the nature of science.	4 (5.41)	6 (5.33)	2 (4.48)	4 (5.33)	8 (7.13)	2 (2.33)	4 (5.73)	6 (6.33)	4 (6.54)	2 (2.00)	6 (5.85)	2 (4.62)
3. To encourage the exchange of ideas, concepts and goals between experienced and pre-service teachers.	8 (7.00)	13 (10.00)	11 (9.09)	12 (10.67)	7 (6.83)	11 (9.00)	9 (6.85)	11 (11.00)	9 (7.38)	9 (9.00)	8 (7.29)	11 (9.91)
4. Contribute toward teachers using science instructional activities consistent with contemporary objectives of science education.	5-6 (5.96)	2-3 (4.00)	5 (6.54)	8 (7.00)	2 (4.13)	6-7 (7.33)	2 (4.19)	3 (4.00)	5 (6.08)	11 (11.00)	2 (5.17)	5 (6.00)
5. Contribute toward the implementation of newer curricular materials in the teachers' schools.	7 (6.11)	7 (6.33)	6 (6.59)	3 (4.67)	3 (4.60)	3 (2.67)	3 (5.15)	5 (5.00)	6 (6.17)	5 (5.00)	3 (5.62)	3 (4.69)
6. Contribute toward the teachers functioning as a source of innovation upon returning to his school system.	2 (5.14)	4 (4.67)	7 (6.67)	2 (4.00)	4 (5.10)	8 (7.67)	5 (5.54)	4 (4.67)	7 (6.29)	3 (3.00)	5 (5.69)	4 (5.08)
7. Contribute toward the development of teachers who will motivate secondary school students toward careers in science, science teaching, and related careers such as engineering and medicine.	12 (8.07)	11-12 (9.00)	8 (7.16)	6-7 (6.67)	9 (7.67)	4-5 (6.33)	10 (7.73)	8 (7.33)	8 (7.33)	6 (6.00)	9 (7.62)	7-8 (7.23)

* Mean ranking assigned

TABLE 33 (Con't)

	1		2		3		4 and 5		6		Total	
	Part. (n=28)	Staff (n=3)	Part. (n=28)	Staff (n=3)	Part. (n=30)	Staff (n=3)	Part. (n=48)	Staff (n=3)	Part. (n=25)	Staff (n=1)	Part. (159)	Staff (13)
. Result in participants completing an MNS degree.	3 (5.25)	10 (8.33)	3 (4.57)	5 (6.33)	13 (10.63)	13 (13.00)	13 (10.81)	13 (11.67)	2 (4.83)	13 (13.00)	10 (7.76)	12 (10.08)
. To encourage the exchange of ideas, concepts and goals between institute ~~participants~~.	5-6 (5.96)	9 (8.00)	4 (5.43)	9 (7.67)	5 (6.03)	6-7 (7.33)	6 (5.79)	7 (7.00)	3 (4.48)	4 (4.00)	4 (5.66)	7-8 (7.23)
0. Contribute toward teachers developing instructional ~~skills (e.g.~~ questioning skills, skills in developing objectives, etc.)	10 (7.44)	8 (7.00)	9 (7.56)	10 (8.67)	6 (6.77)	10 (8.67)	7 (6.04)	10 (9.00)	11 (8.33)	8 (8.00)	7 (7.04)	10 (8.55)
1. To develop in teachers an understanding of how science related to society (past, present, ~~and future~~).	11 (7.70)	2-3 (4.00)	12 (9.67)	11 (10.00)	11 (8.33)	4-5 (6.33)	11 (7.88)	9 (8.33)	12 (8.79)	7 (7.00)	11 (8.38)	9 (7.42)
2. To develop in teachers an understanding of the problems involved in maintaining a quality environment.	9 (7.19)	5 (5.00)	13 (9.17)	13 (11.67)	12 (9.30)	12 (11.00)	12 (8.52)	12 (11.33)	10 (8.21)	10 (10.00)	13 (8.61)	13 (10.17)
3. To develop in teachers a basic proficiency in Mathematics.	13 (11.00)	11-12 (9.00)	10 (7.74)	6-7 (6.67)	10 (7.97)	9 (8.33)	8 (6.35)	2 (3.33)	13 (11.45)	12 (12.00)	12 (8.45)	6 (7.08)

V. SUMMARY

Data was collected and analyzed related to the following four primary areas:

I. Descriptive Information on Participants

II. Evaluation of Program Objectives

III. Program Process Evaluation

IV. Rank Ordering of Program Objectives

Some major points discerned from these four areas were:

1. The Comprehensive Program has made significant progress toward serving only the North Central Plains Region.

2. Participants in the program normally teach more than one science subject and at more than one grade level. Many of the participants have at least some teaching responsibility at the Junior High School level.

3. The participants enjoy teaching science and they like the students they teach.

4. The participants entered the program in generally good agreement with science educators as to the types of classroom and laboratory activities which should be used for secondary school science instruction. The program components, in general, contributed positively toward strengthening this agreement.

5. The science laboratory does not appear to be a major part of participants' science instruction in grades 7-9. This statement is based on the amount of time participants report that their students spend in the laboratory.

6. The participants have fairly positive attitudes toward their science facilities, equipment, and materials. One would assume there is a relationship between this finding and number five above, but at this time that relationship is sheer speculation.

7. Participants in all programs, where data was available, showed significant progress in subject matter competencies by the completion of the program.

8. Little change could be noted on the participant attitude measures used as pre- and posttests. It should be noted, however, that pretest attitude scores were quite high.

9. In general, participants were pleased with their respective program components, the University of South Dakota, and the City of Vermillion. Where problems were uncovered, avenues for improvement are being pursued.

10. Data collected on participants' students is being processed. No comparative information will be available until follow-up data is collected in Spring, 1972.