EFFECTS OF A SUPPLEMENTAL SCIENCE PROGRAM ON ACHIEVEMENT OF STUDENTS WITH DIFFERENT SOCIO-ECONOMIC AND ETHNIC BACKGROUNDS

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> In every child who is born, under no matter what circumstances, and of no matter what parents, the potentiality of the human race is born again.
>
> James Agee
> Let Us Now Praise Famous Men

This paper is about children. It is an attempt to get to know and work with a group of beautiful people--some Indian, some not.

Persistence and the will to carry on were needed in my life during the difficult time of this dissertation. In so many ways, never really to be known, or ever possibly to be acknowledged, I am deeply obligated.

Professor Kenneth Wiggins, chairman of my committee and friend, has seen me through. I thank him. And I thank Drs. Johnsten, Selakovich and Bruneau for serving on my committee. Also, may I add, I enjoyed the aid of Mr. Don Ely.

There is one more acknowledgment to be made. This is not my paper. It belongs to the kids and to my father.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION AND RELATED LITERATURE

Nature of the Problem

The problem of minority group education in America is one of the fundamental issues to be faced by educators in the 1970's. In terms of elementary education, the amount and kind of science education which pupils in kindergarten through grade six receive is woefully inadequate, and markedly inferior to what it can be, ought to be and must be.[15] The situation deteriorates in reference to culturally distinct groups, specifically the American Indian. Padfield, Hemingway and Greenfeld[25] stress that the recognition of urgent problems in Indian education is almost a cliche. Records of achievement and performance reveal low achievement, serious age-grade lag and high dropout rates. From the point of view of the Indian, the educational experience in Anglo-dominated schools, centered around white, middle-class institutions, is one of chronic frustration. "The game is not his, the referees are not his, but the laws of the dominant society force him to play." The resulting frustration leads to poor performance achievements by Indian students which educators view with increasing alarm.

In relation to the problem of American Indian students dropping out of school, Kutsche[34] presents four speculations as an aid in understanding this phenomenon:

(1) White concept of competition

(2) White awareness of upward mobility

(3) White willingness to defer satisfaction of wants

(4) Recognition on the part of Indians of the consequences of their cultural separateness from the bulk of the American people

Most of these differences stem from differences in family life, that most intimate area of culture which is least visible and consequently most resistant to acculturation.

Reno,[49] quoting Indian tribal leaders, reports that many important areas of Indian education are being neglected in existing schools. The needs of the Indian school child as identified by tribal leaders, included the following: meaningful school boards; cultural identification programs; community education and development through community schools; training in Indian languages; home and school visits; guidance and counseling programs; and in-service training programs.

Stone[56] and Wax[65] write of the educational crisis facing the American Indian in terms of the Indian being a minority group. The term minority group, as used by Stone, does not mean fewer in number, but lower in the power scale--one of the ethnic groups lacking the physical, cultural, social, and economic characteristics of those who have achieved status, power, or prestige. Wax concurs, believing that children who come from lower class and impoverished ethnic groups are incorrectly regarded as empty and culture-less rather than as having a culture and social life of their own which educators must learn about to be competent in their jobs.

This study will limit itself to the American Indians of Oklahoma.

Statement of the Problem

Flowing from and related to these large problems is the problem considered in this study which was to investigate the effects of a supplemental science program on achievement of students with different socio-economic and ethnic backgrounds.

Significance of the Study

The 1964 Report of the Oklahoma State Board of Regents for Higher Education states that only 209 American Indian students were among the freshman class entering Oklahoma colleges and universities in the fall of 1962. Yet, the State of Oklahoma contains over one-third of the approximately 550,000 American Indians, or about 184,000 people.

Furthermore, between grades one through twelve, the yearly drop-out rate of Indian students exceeds seventy-five percent. Most of these drop-outs occur between the eighth and ninth grades and between the ninth and tenth grades.(60) Obviously an attempt must be made to prepare students for high school so that they may have the option of higher education. The elementary school is the logical place to begin.

Websters New Twentieth Century Dictionary of the English Language(66) defines underprivileged as: "...deprived of fundamental social rights, or privileges, and security through poverty, discrimination, etc." Good(23) lists underprivileged as pertaining to one who is considered to have a lack of adequate material benefits. Bayne,(3) Nash,(38) Welch,(67) Beavan,(4) Nader,(37) and Gearing(20) are only a few of the many writers who have commented on the disadvantaged, poorly educated American Indian.

> Poverty and educational deprivation are found together. Where one exists, the other is usually present. But there is also a causal relationship. Ignorance breeds and maintains poverty and poverty cripples educational attainment and breeds more ignorance.(2)

Havighurst(27) expresses this point clearly in terms of educational psychology.

> Examination of known facts about school achievement of definable social groups in the United States (elsewhere he specifically mentions the American Indian) shows that poor school achievement is not primarily a problem of ethnic sub-cultures, but rather is primarily a problem of the lowest socio-economic group interacting to a limited degree with minority sub-cultures.

Giddings(21)(22) points out that many studies have documented the generalization that disadvantaged children do not benefit from current school curricula, at least as it is now taught in the schools. Furthermore, many of the efforts to enrich and improve the education of the disadvantaged have not been founded on facts and insights derived from carefully controlled and evaluated research studies. Much of this work has been based on hunches, and some of the plans and programs have been formulated on the "myth of the lower class."

Then the learning process itself must be considered. Thorndike(58) suggests that learning is dependent on a stimulus-response principle. Skinner,(55) however, broke with the tradition that every response can be traced back to a stimulus by differentiating between two classes of response. Piaget(42) states that learning is stimulated by situations provoked by a psychological experimenter, by a teacher, or by an external situation. Further, he maintains that learning is not spontaneous; it is provoked. In addition, it is a limited process, which is to say limited to a single problem, or to a single structure.

Elsewhere, Piaget[43] adds that thinking takes place in stages which are generally determined by the age of the child. For example, the period from seven to eleven years is characterized by logical processes which are really not dissociated from concrete referents.

Piaget's concept of developmental stages in children is not entirely consistent with Bruner,[8] who claims that any idea or subject can be taught to any child at any stage of development. Furthermore, Bruner states that the intellectual development of young children can be facilitated and accelerated by introducing appropriate materials, instructional methods and curricula.

Cronbach[12] states quite simply that learning is shown by a change in behavior as a result of experience.

In reference to the learning process of the disadvantaged, Clark[9] hypothesizes that disadvantaged youngsters fail to live up to school expectations and do not learn because of the inadequate teaching of some teachers who consider the disadvantaged youngster a poor learner the moment he enters school. While these teacher attitudes are probably inadvertant, "...these youngsters internalize these expectations and become poor achievers." The entire syndrome is reinforced when low aptitude and achievement scores are recorded by disadvantaged students. Society and the school, therefore, expect very little and in turn receive very little.

Reissman,[48] however, suggests that disadvantaged pupils tend to learn at a slower rate and learn more readily through physical, motor involvement, rather than through exclusively conceptual, verbal activities. Successful programs have been developed utilizing this concept.[2][47][59]

The intelligence of American Indian students has been investigated in numerous studies. Fitzgerald and Ludeman[14] note that many investigations have been made concerning the intelligence of Indian children. Most of these investigations point to the fact that the mental capacity of the Indian is inferior to that of the white. However, in no case has there been a serious attempt to offer any possible explanation for the difference in mental rating. Rather, it was taken for granted that such a variation was inherent in the low ethnic groups. Fitzgerald and Luderman suggest that the Indian, tested with the white man's tools and in the white man's language, is handicapped to an appreciable extent. Furthermore, environmental causes and training or nature may affect performance on intelligence tests.

In reference to the relation of degree of Indian blood to possible score on the Otis Intelligence Test, Hunter and Sommermier[30] indicate that the degree of ability involved in the Otis test decreases with a decrease in the amount of white blood.

> There is a positive correlation between increasing degree of white blood in the American Indian and score on the Otis Intelligence Test which would seem to indicate a racial difference, probably of intelligence although possibly of temperament.

Garth[17][19] maintains that differences exist in comparison of mental abilities of mixed and full blooded Indians on a basis of education:

> And the school of the mother's breast and of the mother's knee are not the same for all individuals. They differ from group to group and from one individual to another but more so in the former case than in the latter. Especially would this be true if the groups were racial. The school of the mother's knee cannot be the same for a Navajo papoose living in its mothers hogan, reacting to its mother's bronze features and harsh guttural

> sounds as is that of the white infant, or the Negro baby, in its early nest of qualitatively different stimuli. The patterns are different though they may be on the same elements being richer in quality and more abundant in quantity in some situations than in others.... So when comparisons of mental performances of two races or even of social groups are made one must consider the environmental influence as a very important factor to be controlled.

In another study, Garth[18] compared the intelligence of Mexican and mixed and full blooded Indian children. Again, it was stated that because social status and education had not been controlled, it was not possible to positively state that these data indicate innate racial differences in intelligence. Moreover, it was suggested that differences in opportunity and in mental attitude toward the white man's way of thinking and living were made apparent.

The results indicate that differences in test performance between Indian and white children are not necessarily due to differences in innate capacity. Language ability and reading ability were better determiners of intelligence than ethnic differentiation.

Rupiper[52] showed that Indian children differed from white children as measured by achievement test results, but that the smaller the proportion of fullbloodedness and non-English-speaking ability in a specific group of Indian children, the higher that group achieved.

This is a problem of quality of elementary education among the American Indians of Oklahoma and a concommitant problem concerning the learning process itself. Inadequate science education does not correspond to meaningful accomplishment in terms of the learning process.

Referring to the relationship between socio-economic background and achievement in science, McGlathery[36] reported that where evidence

of science achievement required the student to verbalize, such as naming an object, the lower-class child did not do as well as the middle-class child. On the other hand, where evidence of science achievement required the student to perform essentially non-verbal behaviors, such as identifying an object, socio-economic background was not a predictor of success.

Ruark[51] found significant differences in the understanding of concepts derived from basic textbook content among children in the first grade who are members of culturally discrete groups (Indian and non-Indian).

In a study of the associative learning rates of second, fourth, and sixth grade Indian and white children, Purdy[45] maintained that intelligence is usually measured by what a child knows or what kinds of problems he can solve. The degree to which a child has had an opportunity to interact with his environment and the degree to which his mind assimilates and understands experiences in this environment, determine what kind of score he will obtain on a mental test. Attempts have been made to measure the intelligence of North American Indians. It was found that Indian subjects do as well or better than white subjects on performance tests of mental ability, but they do not do as well as white subjects on verbal tests of mental ability. It was assumed that the reason for the lower verbal scores was insufficient acculturation into white society and inadequacy of test standardizations rather than deficiencies in innate intelligence.

The conclusion reached by Purdy as to why Indian students achieved better scores than did the white students in the sixth grade was that the Indians were probably innately more intelligent than were the

whites, even though they had the same Otis IQ scores. Furthermore, white students probably had developed better attitudes towards themselves and their ability to learn and do well on tests of all kinds.

Vaughn[63] concluded that culturally disadvantaged students who possess reading and verbal skills comparable to non-culturally disadvantaged students might well be intellectually superior to their non-culturally disadvantaged counterparts.

Hypotheses

The effect of the supplemental science program was measured (in terms of science achievement) against the following variables:

1. effectiveness of the supplemental science program on treatment (experimental) group versus non-treatment (control) group
2. effectiveness of the supplemental science program on Indian versus non-Indian groups
3. effectiveness of the supplemental science program on high socio-economic group versus low socio-economic group
4. effectiveness of the supplemental science program on students with favorable science attitudes versus students with unfavorable science attitudes

The hypotheses to be tested in the null are:

1. there will be no significant difference in science achievement between classes using their existing curricula and the addition of a supplemental program
2. there will be no significant difference in science

achievement between Indians and non-Indians

3. there will be no significant difference in science achievement between those students with high socio-economic backgrounds and those students with low socio-economic backgrounds
4. there will be no significant difference in science achievement between students having favorable versus unfavorable attitudes toward the discipline of science

Definition of Terms

1. Achievement is defined in terms of The Stanford Achievement Test.
2. Socio-economic status is defined in terms of The Home Index Scale, an index developed by Harrison G. Gough, Institute of Personality Assessment and Research, Department of Psychology, University of California, Berkeley, California, for use in determining socio-economic status in grades four through twelve. High socio-economic level (background) identifies those students who were above the mean on The Home Index Scale. Low socio-economic level (background) identifies those students who were below the mean on The Home Index Scale.
3. Science attitude is defined in terms of The Reed Science Activity Inventory. Those students who scored above the mean on The Reed Science Activity Inventory had favorable science attitudes. Those students who scored below the mean on The Reed Science Activity Inventory were defined as having an unfavorable science attitude.

4. Indian is defined as a person who is enrolled in a North American Indian tribe or who is a descendent of such an enrolled member and recognized by the tribe regardless of degree of Indian blood.
5. Supplemental science program (treatment) is The Elementary Science Study (ESS), units Attribute Games and Problems, Mirror Cards, Structures, Pattern Blocks.
6. Effectiveness is described by achievement on The Stanford Achievement Test.
7. Underprivileged, in terms of this study, is synonymous with the term low socio-economic background.

Limitations of the Study

There were several limiting factors involved in the study which may have influenced the results.

1. The use of the placebo technique with the control groups, while strengthening the internal validity of the study, seriously limited external validity.
2. The study can be generalized only to those classes involved.
3. The effectiveness of the supplemental approach can be viewed only in light of the specific treatment used, The Elementary Science Study.
4. The possible pervasive effect of the classroom teachers may have contaminated the results.

Assumptions of the Study

The following assumptions were made:

1. The instruments used in the study are valid in measuring achievement in order to interpret correctly the experimental data.
2. The random assignment of treatment will control such possible influencing variables as sex, motivation, anxiety, etc.
3. The random assignment of treatment will control such possible influence of different classroom teachers.
4. Use of the placebo technique will minimize the Hawthorne Effect[32] and possible student contamination.

CHAPTER II

METHOD AND DESIGN

The purpose of this study is to investigate the effects of a supplemental science program on achievement of students with different socio-economic and ethnic backgrounds. A description of this investigation will necessarily involve details of procedure. These considerations will be described in terms of: A) general methodology and design; and B) more specifically, according to the four stated hypotheses.

General Methodology and Design

1. Population and Sample: Four elementary schools in Central Oklahoma were employed in the study. While these four schools were not randomly selected from all the elementary schools in the State of Oklahoma, they were chosen according to the following criteria: a) a school's acquaintance and familiarity with the Education Department at Oklahoma State University; b) reasonable proximity to the OSU campus; c) awareness of Indian students being present in some classes.

Due to the evaluative instruments required to collect data (namely The Stanford Achievement Test, The Home Index Scale and The Reed Science Activities Inventory), and upon the recommendations of the various school principals, sixth grade classes were employed in the study. The principals unanimously suggested that utilization of sixth grade

classes would cause the least disruption in the daily school schedule.

The four schools provided a total of eight sixth grade classes with a student population of 189. (See Table I.)

From the pool of eight classes, four were randomly assigned the treatment. The remaining four classes acted as the control group. (See Table I.) Use of a control group obviated the effects of maturation,[62] contemporary history,[62] and regression effects.[26][44]

2. Design: All of the control and treatment classes have different classroom teachers. Their training, background, experience, sex, age, ability, etc., range across the entire spectrum of teacher capability. This factor is a serious threat to contaminate the results of the study because it is possibly an uncontrolled extraneous variable.

However, the classes given the experimental treatment and those classes acting as the control group were randomly selected. The influences of individual classroom teachers, therefore, was randomized as a function of the random selection of the experimental and control classes. It is recognized that the effect of this randomization technique would be greatly increased if, for example, there was a pool of one hundred classes from which to select. This, however, was impractical. Furthermore, the experimenter wished to avoid disappointing large numbers of schools who might be eliminated from the study due to the capriciousness of random selection.

To insure uniformity of instruction in the supplementary science program, the experimenter conducted all The Elementary Science Study classes. Also, the experimenter administered all evaluative instruments to avoid the possibility of experimenter bias.

To counteract the possibility of the Hawthorne Effect,[32] the

TABLE I

POPULATION

School	No. of Classes		Treatment	Control	Indian Student Population	Non-Indian Student Population	Total Class Population
A	1			X	5	7	**12**
B	3	Class 1	X		8	17	**25**
		Class 2	X		1	25	**26**
		Class 3		X	7	18	**25**
C	1			X	4	29	**33**
D	3	Class 1		X	5	14	**19**
		Class 2	X		5	20	**25**
		Class 3	X		7	17	**24**
Totals	8				42	147	**189**

experimenter presented a placebo treatment to the control group. These classes consisted of films, informal space-science lessons, current events, and discussions.

The possibility of student contamination was avoided through use of placebo treatment. Student contamination assumes that the treatment group will interact with the control group, thereby weakening the experimental treatment. Paying special attention to all classes helps curtail this unwanted interaction. Another possible problem occurs when there is concern that the untreated group (control) is being discriminated against. Again, the placebo treatment applied to control groups alleviates this situation.

Problems of sensitizing students[32] and carry-over of regression effects[44] were eliminated by not utilizing a pre-test, post-test procedure. For one hour a week, during twelve weeks, from September through December, 1970, the four treatment classes were exposed to The Elementary Science Study and the four control classes were given the placebo treatment.

3. Instrumentation: Four instruments were used to conduct this study. The instruments were: a) selected units from The Elementary Science Study; b) The Stanford Achievement Test; c) The Home Index Scale; and d) The Reed Science Activity Inventory.

a) The Elementary Science Study: The program of instruction, the supplemental science program, consisted of four units from the ESS: Attribute Games and Problems; Mirror Cards; Structures; and Pattern Blocks.

Wailes[64] writes that The Elementary Science Study should not pinpoint the development of scientific content to a set of concise and

specific objectives. Moreover, he maintains that The Elementary Science Study is primarily designed not merely to bring to elementary school children the soundest account of the science which increasingly molds their lives, but, even more, to bring to the schoolroom the spirit of science, the chance of discovery, the rewards of investigation. These objectives are as important for the pupils who will never see the last year of high school as for those who will find a career in the research laboratory.

Continuing, Wailes[64] makes clear that The Elementary Science Study has approached its task with the desire to develop meaningful activities for children in the elementary grades, using the following guidelines: 1) the development of blocks of scientific content which supply a flow of related ideas from the questions and observations of elementary children; 2) the development of accompanying inexpensive apparatus which may be effectively used by children themselves; 3) the development of a style of teaching, emphasizing the presentation of scientific content by student experimentation, thus allowing the children to gather and interpret data, draw inferences, and make predictions regarding other related phenomena. The emphasis is thus toward laboratory investigation and discovery by the student.

> The Elementary Science Study of Educational Services, Inc., is composed of self-contained units of work. These separate units do not form a curriculum, but are thought to form threads of a curriculum which has yet to be developed. Five completed representative units are included in the sampler package. The number is to be expanded until 100 to 200 units are available. The approach used in this project is to emphasize the common aspects of the sciences rather than to define the structure of a particular discipline within science. It uses the "predisciplinary" approach, and each unit presumably develops an important thread of science. This treatment of subject

> matter might be considered an attempt to loosely define the broad field of general science in the currently popular way of defining the structure of particular disciplines.(13)

b) The Stanford Achievement Test: To evaluate the effectiveness of the supplemental science program, The Stanford Achievement Test, Intermediate I Battery, Science, was administered to all students in the study, both experimental and control. A review of the test (Miriam M. Bryan, "Stanford Achievement Test," The Sixth Mental Measurements Yearbook, ed. Oscar K. Buros, New Jersey, 1961, p. 121) states:

> The test is recommended for use in the analysis of group differences among school subjects and also of the differences in the abilities of individual pupils in the various subjects for purposes of planning individualized instruction, grouping pupils for instructional purposes, determining and evaluating achievement. It is further recommended for use in the study of strengths and weaknesses for a grade or a school or a system as a whole, in evaluating instructional methods and materials, and as a source of information on which to base curriculum changes. The average estimates of reliability, ranging from .88 to .90, indicate that the test may appropriately serve these purposes....

c) The Home Index Scale: This scale was administered to determine socio-economic background. The Home Index Scale uses twenty-one yes or no questions to determine socio-economic status. The score on The Home Index Scale is obtained by counting the number of yes responses on the first twenty items and then adding extra points according to the following scheme for item twenty-one, which asks the following question: "How many books does your family have?" Responses of zero through ninety-nine books receive no points; one hundred through 499 books receive one point; and five hundred or more books receive two points. The reliability of The Home Index Scale, utilizing a test-retest technique on a sample of fifty-five college students, was .989.

The reliability coefficient, using the Kuder-Richardson method, was .74 for a sample of 252 high school students.[24]

d) The Reed Science Activity Inventory: The last evaluative instrument was The Reed Science Activity Inventory. This instrument measures science interest by determining the voluntary science activities in which students may engage. The inventory is composed of seventy science activity items, with an accompanying sixpoint scale for each item. "The vocabulary and selection of activities is designed for respondents in grades 7-10, although it can be adapted to other levels."[10] Only voluntary science activities are to be reported. Both control and experimental groups will receive this inventory. Attitudes toward the discipline of science will be evaluated by measuring degree of participation in The Reed Science Activity Inventory. A reliability coefficient of .97 for the whole scale was obtained. Administering and completing the inventory requires about fifteen minutes.[10]

4. Statistical Design: Analysis of the data was accomplished by using factorial 2 x 2 analysis of variance on each of the variables:

1. treatment (experimental; control)
2. cultural groups (Indian; Non-Indian)
3. socio-economic background (high; low)
4. science attitude (favorable; unfavorable)

Analysis of variance was selected as the appropriate statistical technique for this study because it is the statistical method that analyzes the independent and interactive effects of two or more independent variables on a dependent variable.[32][44][62] Furthermore, analysis of variance tests the significance of the differences between

the means of final experimental data by taking into account and adjusting initial differences in the data.[32]

Specific Methodology and Design

Hypothesis 1: There will be no significant difference in science achievement between classes using their existing curricula and the addition of a supplementary program.

Four randomly selected classes were introduced to a supplemental science program, consisting of units from The Elementary Science Study, for one hour a week, during four months, beginning in September, 1970. Four control classes were presented a placebo lesson during this same period of time. The eight classroom teachers involved in the project continued to teach their existing science courses by their normal method(s) of presentation.

All four treatment classes were considered as one group and all four control classes were considered as another group in determining this main effect through use of a factorial 2 x 2 analysis of variance, reporting only the main effects. Data collected refers to scores on The Stanford Achievement Test.

Hypothesis 2: There will be no significant difference in science achievement between Indians and non-Indians.

The application of the supplemental science program, as analyzed by its effectiveness on students from two different cultural groupings (Indian and non-Indian populations), was measured. A factorial 2 x 2 analysis of variance was used, reporting only the main effects. The Stanford Achievement Test was the measure of effectiveness. The population utilized in testing this hypothesis was different from the populations used to test the other three hypotheses.

Hypothesis 3: There will be no significant difference in science achievement between those students with high socio-economic backgrounds and those students with low socio-economic backgrounds.

This hypothesis investigated the relationship between the socio-economic backgrounds of the student subjects and their achievement in the supplemental science program, The Elementary Science Study. Socio-economic background was determined by administration of The Home Index Scale. High socio-economic background was designated by a score above the mean on The Home Index Scale; low socio-economic background by a score below the mean on The Home Index Scale. Statistically, a factorial 2 x 2 analysis of variance, reporting only the main effects, was utilized. The overall science achievement of students with high or low socio-economic backgrounds, with or without exposure to the supplemental science program, was evaluated by administering The Stanford Achievement Test at the end of the study. The population used to test this hypothesis was unique and different in reference to the populations used to test the other hypotheses in this study.

Hypothesis 4: There will be no significant difference in science achievement between students having favorable versus unfavorable attitudes toward the discipline of science.

The attitude of the participating students toward science, in relation to the addition of The Elementary Science Study to their normal science curriculum, was investigated. An attitudinal scale, The Reed Science Activities Inventory, was administered to all students at the conclusion of the study. Scores above the mean on The Reed Science Activities Inventory designated a favorable attitude; scores below the mean on The Reed Science Activities Inventory indicated an unfavorable attitude. Favorable or unfavorable attitudes toward science by students

with or without exposure to the supplemental science program, The Elementary Science Study, was measured in relation to the independent variable in the study, The Stanford Achievement Test.

CHAPTER III

PRESENTATION OF DATA

The use of measurement in the development of knowledge forces the experimenter to introduce precision into his thinking.[60] This study will therefore bring research techniques and statistical analysis to an investigation of the four hypotheses proposed. The .05 level of confidence was used to determine significance for each hypothesis. Data were analyzed by the Oklahoma State University Computer Center, using the IBM 360 Model 65 computer. An analysis of variance for factorial design, revised September 12, 1969, from the Health Science Computing Facility, UCLA, was used to determine mean squares.

Hypothesis 1: There will be no significant difference in science achievement between classes using their existing curricula and the addition of a supplementary program.

The computed F ratio for treatment was 12.8631 ($p<.001$). Therefore, the null hypothesis is rejected and it is concluded that there is a significant difference between the experimental and control groups. The experimental group, with a mean of 126.87178, as compared with the control group mean of 106.89743, had superior science achievement. (See Table II.)

Hypothesis 2: There will be no significant difference in science achievement between Indians and non-Indians.

For cultural group, an F ratio of 5.6573 was obtained ($p<.05$). The null hypothesis is therefore rejected. There is a significant difference in science achievement between Indians and non-Indians.

TABLE II

ANALYSIS OF VARIANCE

TREATMENT AND SOCIO-ECONOMIC BACKGROUND

Source	SS	df	MS	F	P
Total	52220.19141	155			
Treatment	3890.00244	1	3890.00244	12.8631	<.001
Socio-Economic Background	2060.82829	1	2060.82829	6.8145	<.01
Error	46269.3632	153	302.4141		

The non-Indians, with a mean of 131.56250, showed a significant difference in science achievement. The Indian mean was 108.68750. (See Table III.)

> Hypothesis 3: There will be no significant difference in science achievement between those students with high socio-economic backgrounds and those students with low socio-economic backgrounds.

Because of an F ratio of 6.8145 ($p<.01$), this null hypothesis must be rejected. Those students with high socio-economic backgrounds had superior science achievement. The computed means were: high socio-economic background--124.15384; low socio-economic background--109.61537. (See Table II.)

> Hypothesis 4: There will be no significant difference in science achievement between students having favorable versus unfavorable attitudes toward the discipline of science.

The computed F ratio for science attitude was 0.0713, a non-significant statistic. The null hypothesis is accepted and it is concluded in this study that the factor of science attitude did not significantly affect science achievement. (See Table IV.)

TABLE III

ANALYSIS OF VARIANCE

CULTURAL GROUP

Source	SS	df	MS	F	P
Total	26067.7500	63			
Socio-Economic Background	1406.2500	1	1406.2500	3.8009	<.10
Cultural Group	2093.06250	1	2093.06250	5.6573	<.05
Error	22568.4375	61	369.9743		

TABLE IV

ANALYSIS OF VARIANCE

SCIENCE ATTITUDE

Source	SS	df	MS	F	P
Total	54736.57031	143			
Treatment	3630.06024	1	3630.0624	10.0202	<.005
Science Attitude	25.84023	1	25.84023	0.0713	NS
Error	51080.6700	141	362.2742		

CHAPTER IV

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The intent of this study was to investigate the effects of a supplemental science program (ESS) on the achievement of students with different socio-economic and ethnic backgrounds.

It was found that students who received the supplemental program achieved higher scores on The Stanford Achievement Test. Also, those students who were Indian and those students having a low socio-economic background (according to the results of the instruments administered in this study) did not achieve the level of those students who were classified as non-Indian and with a high socio-economic background. Finally, the factor of attitude toward science did not significantly effect achievement.

Conclusions

Improved science achievement, through use of a supplemental science program as an adjunct to existing curricula, would have import in terms of striving for quality education. Furthermore, this desired improvement could be introduced into a curriculum in an orderly and non-disruptive manner, due to the very nature and philosophy of The Elementary Science Study. There would be relevance to "Educational Diffusion," as described by Rogers.(50)

The ESS supplemental program requires no special training for teachers. Students, in fact, teach themselves and each other - stimulating group interactions occurred at every session. The materials used are inexpensive. Some can be improvised. Sophisticated equipment, therefore, is not necessary. This condition augments easy continuity and follow-up.

With a class virtually self-conducted, the teacher is available to render individualized attention. Moreover, an ESS consultant could manage the program for a large number of classes, thus further freeing the classroom teacher.

Successful use of a supplemental science program would have possible meaning in such areas as curriculum planning, teacher education programs and school budgeting.

Although the treatment variable was highly significant, Indian students did not achieve at a level equal to or better than non-Indian students, according to this study. Such intervening variables as reading disabilities, cultural bias of instruments and validity of instruments may have contributed to this result. Furthermore, culturally different children frequently achieve at a lower level in white middle-class schools.

It would appear students with low socio-economic backgrounds, as measured in this study, failed to reach a high level of achievement because of a general paucity of experience. It is suggested that socio-economic background, rather than intelligence, correlates with achievement.

Lack of a statistically significant difference between student attitude toward science and achievement may have been due to lack of

validity between The Reed Science Activities Inventory and The Stanford Achievement Test. Also, reading problems may have influenced the results.

Recommendations

The following are recommendations for future studies to augment, challenge or verify the conclusions made here:

1. investigate the interactive effects of the dependent variables
2. replicate the study, using a different placebo treatment
3. replicate the study, using no placebo treatment
4. develop better instruments to measure such factors as process, attitude and socio-economic background
5. develop and use a pre-test post-test scale to arrive at changes in attitude due to treatment

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