DIMENSIONS OF SCIENCE INTEREST ACTIVITY FROM RACIALLY DIFFERENT JUNIOR HIGH SCHOOL POPULATIONS

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This is to certify that the

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ABSTRACT

DIMENSIONS OF SCIENCE INTEREST ACTIVITY
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By

Joseph Ulahannan Matchanickal

The out-of-school science interest activities of children, if accurately identified and measured, may form one basis for an effective, purposeful school science program, relevant to the needs of the children. An examination of several important studies related to this investigation indicated that boys and girls in the public school setting are still two distinct groups with specific sex-associated interests. Also, there is a dearth of published science interest studies related to minority groups, specifically blacks. The Reed study in 1959 and several related subsequent studies by the Harvard Project Physics team not only established the variations in the science interest activity patterns of boys and girls, but also demonstrated the existence of dimensions of such interests. A study updating the previous findings and relating the science interest activities of boys and girls from differential racial composition is long overdue.

The major objectives of this study were: (1) to identify the dimensions of voluntary, undirected science activities of the off-school setting among boys and girls in grades 7 and 8 from schools with differential racial composition, based on their reported participation in a list of general science activities normally expected of them; and (2) to determine if the degree of participation in activities around a particular dimension of interest varied among samples of students from predominantly white, mixed, and predominantly black schools, or more specifically between blacks and whites.

An instrument was developed for the study, similar to that of the Reed Inventory, taking into consideration the evaluation of a panel of judges and their suggestions, together with information obtained by pilot testing. The instrument was administered to children from five predominantly white schools (0-33.33% blacks), six mixed schools (33.34-66.66% blacks), and six predominantly black schools (66.67-100% blacks). A total of 2711 students satisfactorily completed the instrument.

A comparative study of the above 17 volunteer schools from seven school districts in Michigan on 12 chosen variables demonstrated that these schools were, in general, homogenous except for geographical location, racial composition, and socioeconomic status.

Determination of the reliability coefficient for the pupils' responses according to Hoyt's technique indicated internal consistency of the items and consistency of each pupil's responses. Principal component analysis of the responses followed by varimax rotation using standard procedures yielded nine distinct factors: Academic, Nature Study, Mechanical Hobby, Biology Experiment, Drug, Cosmology, High Verbal, General Collection, and Environmental. Intercorrelations of the factors gave very low values, establishing the independence of the factors. The reliability coefficients of all the factors were sufficiently high. Factor scores were generated for each subject and used as the dependent variable in testing school, race, and sex main effects and interaction effects using the Finn MANOVA technique. To study visually the variation in the expressed participation in activities, several histograms were drawn, taking the factors as independent variables and the mean factor scores as dependent variables.

White children and children from the predominantly white schools expressed significantly higher participation in Nature Study, Mechanical Hobby, Drugs, Cosmology, and Environmental factors than black children and children from the predominantly black schools. The latter, however, were significantly higher on Academic and Biology Experiment factors. It may be said, in general, that the white children tend to excel in their expressed participation in those kinds of activities that are inspired by inquiry and experimentation, while black pupils tend to excel most in academic types of activities.

The histogram for the mixed schools is intermediate in nature, as it generally occupies a middle position with respect to those for the other two types of schools. On further exploration of this phenomenon, it was found that the intermediateness was due to a combination of shift and averaging of factors. There is, however, a definite tendency for the activity interests of children in the mixed school setting to change toward a more common pattern.

Girls were thought to have a lower level of overall interest in science activities than boys. In the sample studied, however, girls expressed a high degree of participation in activities around several factors and excelled in a few compared to the boys. A few traditionally sex-associated interests were even reversed in this study.

Several questions arose from the study, and may be of interest in further research: Are the interest patterns of the white inner city child similar to or different from those of his black counterpart? As with the out-of-school activities, do the classroom interests in science vary with respect to race and sex? Do the types of items included in the inventory developed for this study and other similar studies really measure the science interests of children? How can the out-of-school activities be effectively included in a school science program?

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This thesis is dedicated to my parents,

Ulahannan and Annamma Matchanickal

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CHAPTER I

STATEMENT OF THE PROBLEM

Introduction

The early recognition of the role of interest in education, the number of investigations on its varied aspects, and its inclusion as a principal factor in several curriculum models is suggestive of its unique role in the historical evolutionary process of American education. The benefit of the skillful application of interest to educational planning is no less important today, as Young aptly expressed:

> The subject of children's interest may seem to be old, but the challenge to create new techniques of ascertaining them, to find more effective means of utilizing them and to develop methods which will stimulate new interests is as new as tomorrow.[1]

The Problem

Just as there are individuals with similar interests, there are, in an individual, patterns of interests that are highly interrelated and that form dimensions of his interests. This is evidenced by the intercorrelated patterns of activities in individuals and groups in their everyday life. In other words, we tend to perform certain groups of related activities and avoid certain other groups of such activities.

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[1]D. Young, "Identifying and Utilizing Children's Interests," Educational Leadership, XV (December, 1955), 165.

In a population of students, there are identifiable clusters of common learnings they wish to acquire and activities they wish to perform. This expression of interest may be very different among distinct groups within the population. The major problem in this study is the identification of the clusters of voluntary science activities spontaneous to middle school children in the off-school environment, based on their reported participation in several of these activities. Also, it is necessary to determine if this expression of interest varies between boys and girls in schools with differential racial distributions.

Objectives

The general objectives of this study, then, are:

1. To determine the major dimensions or factors of voluntary science interest activities (mostly confined to the off-school environment) among a sample of seventh and eighth grade children drawn from predominantly white, mixed, and predominantly black schools.

2. To compare and contrast the factorial interest level among children in the above three types of schools and between boys and girls based on factor scores of individuals.

3. To update science interest studies at the middle school level, with special emphasis on the dimensions of voluntary science interest activities.

The study tasks are expressed more explicitly in the following questions:

1. What are the major dimensions of voluntary science interest activities of a sample population of children in grades 7 and 8, drawn from predominantly white, mixed, and predominantly black schools (factor analysis of responses)?

2. Are the factorial interests determined by factor scores significantly different among the three types of schools (MANOVA)?

3. Are the factorial interests determined by factor scores significantly different between boys and girls (MANOVA)?

4. Are the factorial interests determined by factor scores significantly different between blacks and whites in the sample population (MANOVA)?

5. Are the factorial interests based on factor scores different between black boys and white boys, black girls and white girls, black boys and black girls, white boys and white girls, seventh graders and eighth graders in the sample population, and between blacks and whites in the mixed school sample (visual comparison with histograms)?

The answers to some of the above questions can be obtained by testing the following hypotheses:

Hypothesis 1: There will be a significant difference in the interest level of certain factors among the three categories of schools.

Hypothesis 2: There will be a significant difference in the interest level of certain factors between black and white pupils.

Hypothesis 3: There will be a significant difference in the interest level of certain factors between boys and girls.

Hypothesis 4: There will be no significant interaction effect among sex and the three levels of schools and between sex and the two levels of race.

The hypotheses are to be tested using MANOVA and F tests based on factor scores of individuals. In the case of school as well as race main effects being significant for a given factor, the Scheffé post hoc analysis will be used to contrast between the levels.

The Need for the Study

One of the common beliefs in education is that pupils will enjoy and accomplish more by doing those things in which they are interested. Several studies have been conducted to demonstrate this idea.[1] All of the studies seem to confirm the idea that students do relatively better in the subjects in which they are more interested than in those subjects in which they are less interested. Specifically, Edwards and Wilson concluded, in their study, that intrinsic interest in science and achievement in high school chemistry are significantly correlated when other variables related to achievement

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[1]T. B. Edwards and A. B. Wilson, "The Specialization of Interests and Academic Achievement," Harvard Educational Review, XXVII (1958), 183-196; A. N. Frandsen and A. D. Sessions, "Interests and School Achievement," Educational and Psychological Measurement, XII (1953), 94-101; E. L. Thorndike, "Interests and Abilities," Journal of Applied Psychology, XXVIII (1944), 43-52; E. L. Thorndike, "Early Interests: Their Permanence and Relation to Abilities," School and Society, V (1917), 78-179.

are held constant.[1] If it is true that building an instructional framework around the interests of pupils will result in higher achievements with less effort, then educators should attempt to discover the interests of their charges and plan teaching programs accordingly. Burnett wrote, in support of this position:

> I simply believe that this elusive, effervescent, powerfully motivated interest of the child which we call spontaneity is the only possible basis for real coherence of learning activities.
>
> . . . .
>
> Consistency and development of learning activities are impossible unless based upon the inherent impulses, promptings and desires of the child.[2]

Children do become interested in various activities, and many of them are in the area of science. Nearly 70 per cent of a student's time is spent outside the class environment. He is motivated and influenced by his parents, friends, books, and television, as well as by his teachers. It is important that the school incorporate these outside activities into the children's curriculum. As Burnett further stated:

> It is the job of the school to relate its work so intimately to children's lives that those lives become richer, fuller, healthier and more stable and satisfying. Coherence in a school program is meaningless except as it refers to the need of coherence in a child's life outside of school.[3]

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[1]T. B. Edwards and A. B. Wilson, "Association Between Interest and Achievement in High School Chemistry," Educational and Psychological Measurement, XIX (1959), 601-610.

[2]R. W. Burnett, "Spontaneity and Coherence in Elementary Science Experiences," Science Education, XL (April, 1956), 195.

[3]Ibid., p. 199.

In order to plan the curriculum for children's interests, it is important that reliable instruments be available to identify and measure these interests. Although some studies have proved the contrary, it is accepted by some science interest investigators that interests change with time, place, and persons. This fact calls not only for repeated measures on individuals, but for the constant updating of interest instruments. Several studies have demonstrated that science interests vary with specific groups. Therefore, the specific science interest areas and activity dimensions of any subgroups within a larger group need to be identified and considered in the plan of a common curriculum. Painter wrote:

> The use of children's interests as the basis of a curriculum adapted to a specific group is a valid approach in any school situation. It is an effective means of keeping children so vitally interested in their learning activities that time experiencing results.[1]

Science interest activity studies, in particular, are not of recent origin, but determination of the multidimensionality of science activities has occurred only within the last 12 years. To date, no such studies have been done with a population that included as subgroups racial minorities, specifically blacks. If there is a significant variation in the factorial interests among children in predominantly white, mixed, and predominantly black schools, or more specifically between blacks and whites, then such information

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[1]F. M. Painter, "Interests and the New Curriculum," Instructor, L (Spring, 1941), 23.

should be available to curriculum planners and teachers in the schools. This study is designed to utilize modern instruments and analytical techniques to provide an opening for developments in this area.

Background of the Problem

In the past, the most commonly used method of measuring interests from activities was to obtain a quantitative score based on a respondent's subjective statements of likes and dislikes of items in an inventory. Such inventories as the Strong Vocational Interest Blank,[1] the Kuder Preference Record,[2] the Minnesota Vocational Interest Inventory, and the California Occupational Interest Inventory have been used extensively in the identification and measurement of science and vocational interests. However, Ewens demonstrated that the correlation between a respondent's actual participation in science activities and his verbal statements of preferences is rather low (r=.42).[3] Reed and Cooley believed that reports of voluntary participation in activities might be a better indicator of interest, since such participation requires an actual expenditure of time and

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[1]Edward K. Strong, Jr., Vocational Interests of Men and Women (Stanford: Stanford University Press, 1943).

[2]G. F. Kuder, Manual to the Kuder Preference Record (Chicago: Science Research Associates, 1946).

[3]W. P. Ewens, "Experience Patterns as Related to Vocational Preference," Educational and Psychological Measurement, XLI (1956), 223-231.

effort.[1] Tyler suggested that,

> The allotment of time to some activities and not others and the relative amount of time spent in these activities would reveal the ways in which individuals organize their experience, the decisions they make, the strategies they follow, and the interests they develop.[2]

Verbal expressions of interest, on the other hand, seem to be more subjective and have idiosyncratic and comparative frames of reference for different students. The pragmatic maxim that one should judge a man more by what he does than by what he says partially supports the argument favoring voluntary activities as the more valid measure of present interest.

A study using voluntary science activities as the criterion variable was performed by Reed at Harvard in 1959.[3] In this study, he developed a Scientific Interest Activity Inventory taking several ideas from the Strong Vocational Interest Blank, the Kuder Preference Record, and the Ewens Interest Scales.[4] The respondents to the Reed inventory were

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[1]W. W. Cooley and H. B. Reed, Jr., "The Measurement of Science Interests: An Operational and Multidimensional Approach," Science Education, XLV (October, 1961), 320-326.

[2]Leona E. Tyler, "The Development of Vocational Interests: 1. The Organization of Likes and Dislikes in Ten-Year-Old Children," Journal of Genetic Psychology, LXXXVI (1955), 33-44.

[3]H. B. Reed, Jr., "Pupils' Interest in Science as a Function of the Teacher Behaviour Variables of Warmth, Demand, and Utilization of Intrinsic Motivation" (unpublished Ed.D. thesis, Harvard University, 1959).

[4]W. P. Ewens, "The Development and Standardization of a Preliminary Form of an Activity Experience Inventory: A Measure of Manifest Interest," Journal of Applied Psychology, LX (1956), 169-174.

asked to check the frequency of voluntary participation in 70 activities. Following the successful application of factor analysis in social science research by Kaiser in 1958,[1] the responses from the Reed study were factor analyzed by Cooley in 1961. This analysis generated, for the first time, evidence that the science interest of children was probably multidimensional. Several subscales definitely appeared within the interest scales. The Reed inventory has been used in several studies made in connection with the evaluation of Harvard Project Physics. In all of these studies, the multidimensionality of children's science activities was consistently apparent. These studies also demonstrated that the factorial interest score of one subgroup of children could be significantly different from that of another subgroup within a given population.

The above studies led the present researcher to inquire if the science activity dimensions have undergone any substantial change in number and characteristics within the last 12 years, and if the factorial interest scores vary significantly when the ethnic distribution in a population differs.

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[1]H. F. Kaiser, "The Varimax Criterion for Analytic Rotation in Factor Analysis," Psychometrika, XXIII (1958), 187-200.

Limitations and Assumptions

1. Although the middle school may include grades 6, 7, 8, and 9 in some school systems, only the seventh and eighth grades are included in this study.

2. Certain science activities can be closely identified with certain specific areas in the teaching situation; however, in this study the principal focus is the report of the activities themselves and not the subject matter as such.

3. It is assumed that all the science activities included in the inventory developed for this study are within the normally expected sphere of activities of the children considered in the study.

4. It is assumed that the items in the inventory represent voluntary activities.

5. Interests and attitudes are closely related concepts. However, this study does not presume to make an in-depth study of the attitudes and values of the racial groups in the population.

6. The results of the study are applicable only to school districts that contained 20 per cent or more black students, since the individual school buildings were drawn only from such districts.

Treatment Approach to the Problem

An attempt was made to cite major research studies in the areas of science interests at the middle school level to determine their development and use in curriculum development. Following the advice of Professor Reed himself, the activity inventory that he developed in 1959 was updated, modified, and adapted, taking into consideration the welcome advice and criticism from a panel of judges. The tentative items in the inventory thus developed were pilot tested using one class each of seventh or eighth graders from the three types of schools included in the study. The final form of the inventory was administered to as many children in the seventh and eighth grades as possible in as many of the three types of schools as volunteered to participate in the study. The responses of the students were factor analyzed, and the subgroups within the sample were contrasted factor by factor by MANOVA, based on individual factor scores. The findings of the study may be related to certain common as well as individual characteristics among schools of similar racial distributions.

Definitions and Explanations

Predominantly White Schools--In this study, those schools that contain between 0 and 33.3 per cent distribution of black children are included in this category of schools (W-schools).

Mixed Schools--These are schools that contain between 33.4 and 66.6 per cent distribution of black children (M-schools).

Predominantly Black Schools--These are schools that have between 66.7 and 100 per cent distribution of black children (B-schools).

Voluntary Science Interest Activities--In this study they include all activities within the domain of science not directly required by the school curriculum, but proceeding from one's own choice inspired by scientific curiosity and interests, performed mostly in the off-school environment. It should be understood that in an inventory designed for a study only a few representative activities of the many available ones can possibly be included.

Organization of the Thesis

Presented in Chapter I were the statement of the problem, the need for the study, a short account of the background of the problem, the hypotheses, the limitations and assumptions of the study, and an overview of the treatment of the problem.

Included in Chapter II is a review of related research studies on science interest in general and science interest activities in particular.

In Chapter III the overall research design of the investigation is described, along with an account of the analysis of the data.

In Chapter IV the findings from the study are presented. Finally, Chapter V contains the conclusions of the study, implications for educational practice, and recommendations for future research.

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

Various definitions of "interest" and interest factors may be found in the psychological and educational literature. The use of interest as a springboard to selection of content, related activities, and teaching method has been accepted by many educators from the days of the John Dewey Society for the Study of Education[1] to the more recent publications of the American Educational Research Association in its Review of Educational Research.[2]

While the use of student interest as a basis for the selection of content, activities, and teaching methodology is accepted by many educators, the notion still leaves many unanswered questions. Among them is the key idea, "What, exactly, is student interest?" Getzels defined interest as follows:

> An interest is a characteristic disposition, organized through experience, which impels an

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[1] John Dewey, Interest and Effort in Education (Boston: Houghton Mifflin Company, 1913).

[2] The following yearbooks of the National Society for the Study of Education deal, in whole or in part, with interest and the curriculum: 33rd, 35th, 37th, 38th, 39th, 43rd, 45th, 46th, 54th, 57th yearbooks (Chicago: University of Chicago Press).

> individual to seek out particular objects, activities, understandings, skills or goals for attention or acquisition.[1]

If interest is a motivating factor in education, as the above definition suggests, one still cannot distinguish between needs and values. Hurlock defined interest as a "preoccupation with an activity when the individual is free to choose. When the child finds an activity satisfying, it continues to be an interest."[2] Other definitions of interest vary widely, but most have in common certain elements such as striving for particular goals or a persistence in attaining an end or a readiness to respond toward something.

The interest factor in education has been related to a variety of other variables such as aptitudes, abilities, personality characteristics, socioeconomic status, etc. Since most of the correlations between interest and other variables are low, it is generally thought that interest is relatively independent of these variables.[3]

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[1]Jacob W. Getzels, "The Nature of Reading Interest," Supplementary Educational Monographs, No. 83 (Chicago: University of Chicago Press, 1961), p. 7.

[2]Elizabeth B. Hurlock, Child Development (New York: McGraw-Hill Book Company, 1956), p. 440.

[3]John G. Darley and Theda Hagenah, Vocational Interest Measurement: Theory and Practice (Minneapolis: University of Minnesota Press, 1955), p. 279; Donald E. Super and John O. Crites, Appraising Vocational Fitness (Rev. ed.; New York: Harper, 1962), p. 688; John W. Gustad, "Vocational Interest and Socio-Economic Status," Journal of Applied Psychology, XXXVIII (1954), 336-338; David R. Saunders, "Moderator Variables in Prediction," Educational and Psychological Measurement, XVI (1956), 209-222.

The major objective of this chapter is to present a literature survey of science interest studies related to subject areas and activities in order to demonstrate certain progressive trends in objectives, instrumentation, and techniques. After a brief defense of the treatment of science interest as a dependent measure, the chapter surveys some of the major cross-sectional as well as longitudinal studies in which the major concern is interest in the subject matter. Next, studies are examined which are transitional between purely subject matter and activity-oriented studies. These studies focus on the science activities of children, yet draw conclusions related to the subject matter interests of the population. The chapter further presents a number of science activity-oriented studies, beginning with the Reed-Cooley and Walberg efforts to establish the dimensions of the voluntary science activities of children. This section is followed by other studies related to the Reed Science Interest Inventory, performed by one or more members of the Harvard Project Physics team. The chapter then concludes with a review of the limited number of available studies concerned with the science interests of black children.

Science Interest as a Dependent Measure

A number of factors have contributed to the selection of interest in science in general and science interest activities in particular as a dependent variable in this study. The measurement of interest under school conditions has reached a fairly high level of sophistication.[1] As previously pointed out, it is thought that interest is relatively independent of ability differences, especially up to mid-adolescence. An analysis of some of the origins of interest suggests that it is displayed early in life,[2] and is amenable to influences from teachers, parents, friends, and environment. Yet interest is sufficiently permanent to be an important predictor of many future activities of pupils.[3] Besides, interest would appear to be a worthy school objective in its own right, for as Strong stated:

> Interests supply something that is not disclosed by ability and achievement. They point to what the individual wants to do; they are reflections of what he considers satisfying. If our objective is happiness and success, we must consider both interests and abilities, for surely enjoyment is just as important as efficiency in everyday life. . . .[4]

Science teaching in the schools has made revolutionary progress in the United States since the beginning of the 1960's. The traditional "lecture-demonstration-read report"

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[1] R. L. Thorndike and E. Hagen, Measurement and Evaluation in Psychology and Education (New York: John Wiley and Sons, 1955).

[2] R. D. MacCurdy, "Science Interest Grows," Science Education, XLIV (December, 1960), 401-407.

[3] J. L. Norton, "General Motives and Influences in Vocational Development," Journal of Genetic Psychology, LXXXII (1953), 263-278; Thorndike and Hagen, op. cit.

[4] E. K. Strong, Vocational Interests of Men and Women (Stanford, California: Stanford University Press, 1943), p. 19.

system has been largely replaced by an "experimentation-investigation-discussion-problem solving" methodology in American school systems. In spite of such far-reaching changes in science teaching, the science activities of children are largely limited to certain controlled and guided inquiries inside or outside the classrooms in formal school operations. The individual voluntary home or free time science activities that are spontaneously natural to some, if not all, students are often a neglected element in the present educational system, and have little bearing on the curriculum-making process. These undirected activities of children deserve much better consideration on the part of curriculum writers. Their potential for student development is implied from a consideration of their unique characteristics:

- They often occupy a large portion of the student's leisure time.
- They are more personally attended to than some of the school science activities.
- They can supplement certain school science programs.
- They may represent the most original and creative types of science activity.
- They closely represent the youthful activities and laboratory procedures of great scientists.
- There is a high intercorrelation among the activities of a given individual.

- They are frequently predictive of the occupational goals of many students.

Talking about out-of-school leisure science activities, Howland said:

> I believe that science can be great fun to children and youth and its pursuit in the spirit of the wondering child (which may also be that of our investigators) can be a highly successful educational experience. . . . Let the child or the youth pursue them for the joy he may find and education will come as the almost inevitable by-product--an unsought gift of the gods. And while he's having fun, a scientist, possibly a creative scientist, is being developed. It would not seem strange to me if history should sometime record what the solutions of the grave problems facing the world today had come from a prolongation into later life of the intellectual spare-time pleasures of childhood, the work of boys who had refused to grow up.[1]

From such considerations, it is implied that a knowledge of the pupils' interest in the subject and his activities would be very advantageous to the educational process; thus the treatment of science interest as a dependent measure seems to be justified.

The factor of pupil's interest has been a determinant in the construction of curriculum in some science subject areas, and has been shown to have a particular bearing on professional aspirations in this field. Most of the interest studies in the educational literature are found in the field of educational psychology, or more specifically, in the areas of occupational and vocational interests. In the preceding chapter, reference was made to the important

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[1] W. E. Howland, "Interest in Education," School and Society, LVI (1942), 175.

instruments used to measure vocational and occupational interests. Some of these have been adapted to school populations and used to measure the science interests of students. However, there is a feeling among science interest investigators that these inventories do not adequately identify and measure interest factors in the specific subject areas, particularly in science. Comprehensive reviews of literature on these and other instruments, as well as on interests in general, have been included in the works of Fryer, Strong, Berdic, Carter, Super, Darley and Hagenah, Layton, and Super and Crites cited in the bibliography.

The interest factor has also been used in curriculum development in other subject areas, particularly in reading, social studies, and mathematics. The form of these studies has been the same, and consists usually of opinion, attitude, or preference surveys; responses to interest inventories; or assessment scales.

Science Interest Studies--Subject Oriented

Several studies have been conducted to identify the specific areas of science interest among children. All of them seem to fall into one of the following five general categories: (1) analysis of interest as revealed by pupils' questions about or reactions to certain scientific objects formally presented for their inspection, (2) analysis of scientific questions submitted for publication in children's magazines, (3) analysis of questions which pupils ask their teachers about science, (4) questionnaire surveys of pupils' likes and dislikes, and (5) analysis of the choice of reading materials in science.

More research studies have been undertaken with young children in the elementary grades than with older children. However, since all of these investigations have a general bearing on the problem, a number of more important studies and findings at all grade levels will be described.

Early studies on the nature interests of fourth to seventh grade children by Trafton[1] and Downing[2] demonstrated that children were very much interested in the causes which operate to produce the actions of animals and plants.

Mau, in 1912, studied the interests of kindergarten and primary grade children using scientific specimens.[3] She concluded that the order to interests for boys seemed to be animal life, physical objects, and plant life; and for girls the order was animal life, plant life, and physical objects. Mau also found that there was an increasing interest in animal life among older children and the awakening of interest was very marked in grade three.

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[1] G. H. Trafton, "Children's Interest in Nature Materials," Nature Study Review, IX (September, 1913), 150-160.

[2] E. R. Downing, "Children's Interests in Nature Materials," Nature Study Review, VIII (December, 1912), 334-338.

[3] L. E. Mau, "Some Experiments With Regard to the Relative Interests of Children in Physical and Biological Nature Materials in Kindergarten and Primary Grades," Nature Study Review, VIII (November, 1912), 285-291.

In 1923, Pollock analyzed 3,500 questions asked by eighth grade children from 13 schools.[1] He found that while there was considerable overlapping, many interests of girls were not expressed by boys, and vice versa. Also, girls were interested in more science topics than were boys.

The study by Curtis in 1924 on science interests of children and adults showed that boys were more interested in technical processes and theories than girls, and girls were more interested in biological topics.[2] Girls were interested in 12.4 per cent more science topics than boys. A close correlation was found between the interests of boys and men, and between the interests of girls and women.

One of the pioneering works in this field was carried out by Craig in 1927, and remained the basis for elementary school science curriculum for many years.[3] He established a series of 82 objectives for elementary school science curriculum based on predetermined criteria. He then secured 700 questions pertaining to science from about 2,000 boys and girls. These questions were evaluated and classified

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[1]C. A. Pollock, "Children's Interests as a Basis for What to Teach in General Science," Ohio State University Education and Research Bulletin, III, 1 (1924).

[2]F. D. Curtis, "Some Values Derived From Extensive Reading of General Science," Teachers College Contribution to Education, no. 163 (New York: Teachers College, Columbia University, 1924).

[3]G. S. Craig, "Certain Techniques Used in Developing a Course of Study in Science for the Horace Mann Elementary School," Teachers College Contribution to Education, no. 276 (New York: Teachers College, Columbia University, 1927).

as an indication of the needs of these children. By correlating these two sources of evidence, Craig was able to synthesize a course of study in Horace Mann Elementary School.

The Thompson study in 1927 on 1,454 eighth and ninth grade students demonstrated that science interests differed according to sex.[1] Boys' interests centered around modern inventions, wonders of nature, and sports and hobbies. Girls' interests were directed toward astronomy, nature study, and aesthetic topics. Neither boys nor girls were found to be interested in commonplace topics or in strictly vocational areas.

In 1931, Nettles made a study of the science interests of 1,067 pupils in the seventh, eighth, and ninth grades.[2] His summary showed that science interest is independent of intelligence. The dominant interests of boys were chemistry, astronomy, animals, aviation, and electricity. The chief interests of girls were astronomy, animals, plants, chemistry, and the human body.

The study by Mahoney in 1952 analyzed 6,561 questions collected from 2,534 children in the fourth, fifth, and sixth

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[1] R. H. Thompson, "A Study of the Interest of Junior High School Students in Science" (unpublished Master's thesis, The University of Southern California, Los Angeles, 1927).

[2] C. H. Nettles, "Science Interests of Junior High Pupils," Science Education, XV (May, 1931), 219-225.

grades in Flint, Michigan.[1] She was able to conclude that, as a whole, these children were more interested in biological than in physical science, that live animals were more interesting to them than mounted specimens, and that the chief phases of biology in which the children were interested were physiology and morphology.

The Fitzpatrick study, published in 1936, attempted to establish the strongest and most persistant interests of pupils.[2] The results indicated interests in human anatomy, disease, and astronomy. This study also showed that there was a permanence of interest and specific preferences only in the stronger interests of the pupils.

In 1938, Wolford made a study of the science interests of eighth grade pupils of the Appalachian region.[3] He found that the greatest interests were in the topics dealing with securing a living in the region, and many questions were asked concerning the theoretical side of things rather than the practical.

Drill, in 1945, concluded that boys showed a greater interest in science than girls, and that children were

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[1]H. M. Mahoney, "A Study of the Scientific Interests of the 4th, 5th and 6th Grade Children of the Public Schools of Flint, Michigan" (unpublished Master's thesis, University of Michigan, 1933).

[2]F. L. Fitzpatrick, Science Interests (New York: Teachers College, Columbia University, 1936).

[3]Feaster Wolford, "Methods of Determining Types of Content for a Course of Study for 8th Grade Science in the High Schools of the Southern Appalachian Region," Science Education, XXII (April, 1938), 197-199.

interested in specific science items rather than in scientific generalizations.[1]

The Von Qualen and Kambly study, in 1945, showed that their sample of students in the fourth through sixth grades was most interested in ancient animals, science in industry, transportation, and living animals.[2]

Baker, in 1945, asked children in grades 3 to 6 to record the science questions they most wanted answered. The compilation of questions about animal life, energy, the human body, and astronomy gave Baker curriculum direction for science programs.[3]

The Paterson study, in 1947, demonstrated that boys showed the greatest interest in conservation, chemical and physical changes, and forms of energy, while girls showed the greatest interest in life, health and safety, and conservation.[4]

The conclusions of the classic study by Jersild and Tasch are significant: (1) Children show much interest in

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[1]Edna Drill, A Study of Science Interests in Certain Elementary School Children of New York State as Revealed in Their Free Discussion Periods (Ithaca, New York: Cornell University, 1945).

[2]Vivian D. Von Qualen and P. E. Kambley, "Children's Interests in Science as Indicated by Choices of Reading Materials," School Science and Mathematics, XLV (December, 1945), 798-806.

[3]Emily V. Baker, Children's Questions and Their Implications for Planning the Curriculum (New York: Bureau of Publications, Teachers College, Columbia University, 1945).

[4]Henry F. Paterson, "A Technique for Determining the Science Interests of Children of the Intermediate Grades of Quincy, Massachusetts" (unpublished Master's thesis, Boston University, 1949).

knowing about life and the world in which they live. (2) The objects of their interest and the degree of interest shown vary from school to school and from class to class. (3) There is evidence that children's interests are for the most part learned, and greatly influenced by adults.[1]

Blanc's study, in 1951, on 500 seventh, eighth, and ninth grade pupils concluded that, in general, there was more agreement than disagreement on what boys and girls would like to study in science.[2] The field of interest which was of greatest interest to pupils at all levels was physical science. The social implications of science rated poorly in their interests.

The Young study found fourth graders showing greatest interest in the universe and strong interest in animals, earth, human growth, and weather.[3] The investigator also reasoned that parents' estimates of their children's interests were generally accurage, except in the area of human development, where they failed to see the children's high concern.

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[1]Arthur T. Jersild and Ruth J. Tasch, Children's Interests and What They Suggest for Education (New York: Bureau of Publications, Teachers College, Columbia University, 1949).

[2]Sam S. Blanc, "Science Interests of Junior High School Pupils," School Science and Mathematics, LI (December, 1951), 745-752.

[3]Doris Arlene Young, "Factors Associated With the Expressed Science Interests of a Select Group of Intermediate Grade Children," Dissertation Abstracts, XVII (February, 1957), 318-319.

Thompson and MacCurdy conducted two studies in 1956 and 1959 with students who took part in science fairs.[1] Their conclusions were that science interest is closely related to later occupational choice, originates and develops early in life, and is centered around free-play activities associated with pets and scientific toys. They counseled the teaching profession that science should become more a self-experience for the student than a teacher-directed vicarious experience.

Based on projects in science fairs, Bowen, in 1964, concluded that boys are more interested in physical science than girls.[2] He believed that science interest differences among girls and boys affect the quality and quantity of science taught in the schools. He also suggested that the sex, science interests, and attitude of teachers play an important part in the interests and values of their pupils.

Perroden worked with 554 children in the fourth, sixth, and eighth grades to determine whether their interests corresponded to the course of study.[3] The favorite areas of study were health, safety, and the human body. The

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[1] R. M. Thompson and R. D. MacCurdy, "The Birth of Science Interest," School and Society, LXXXV (February, 1957), 56-57; R. D. MacCurdy, op. cit.

[2] John J. Bowen, "Topic Preference of Boys and Girls in School Science Exhibitions," School Science and Mathematics, LXIV (January, 1964), 47-52.

[3] Alex F. Perroden, "Children's Attitudes Towards Elementary School Science," Science Education, L (April, 1966), 214-218.

study of living things was popular, with girls excelling in it. Fewer pupils listed favorite units in the physical sciences than in the biological sciences, with boys showing higher preference in this area than girls. Also, pupils in general indicated that they liked to do "experiments" but they disliked tests and written work. The responses of the students were indicative that both boys and girls want an opportunity to do things in science, to discuss what they are learning, to explore their curiosities, and to be able to ask questions. Lecturing, listening, copying notes, and writing answers to teachers' questions are not popular learning activities.

Most of the studies presented so far have been cross-sectional studies of interests, including, in most cases, the variation of interest with sex. However, several science educators feel that a knowledge of expressed science interests of a group of pupils is not sufficient to construct adequately a course based on these interests, because different experiences may cause new interests to arise. Longitudinal studies are said to be more valuable in this respect,[1] and a few have been conducted.

Ruffner, in 1939, attempted to measure the pupils' interests in general science, and to measure interest changes within a definite period of time, using two parallel ninth

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[1]R. P. Tisher, "Necessity for a New Type of Science Interest Study," Science Education, XLVIII (December, 1964), 478-485.

grade groups and a questionnaire containing 108 items.[1] She found that interests in most areas of science were stable and permanent.

Zim made a comprehensive series of investigations into science interests of adolescents from 1934 to 1940.[2] This investigation attempted to discover the typical science interests and activities of his subjects. The method used included a science interest questionnaire, a composition analysis, a science exhibit study, a film choice questionnaire, a wondering-questions checklist, and an analysis of science-fair application forms. The general conclusions were as follows: (1) Although there is evidence that interests change gradually with age during the adolescent period, these interests are permanent enough to warrant their use in curriculum construction. (2) School science does not seem to be an important source of adolescent science interests; many of these develop through outside activities which are thus potential sources of education. (3) Both sexes exhibit a strong interest in topics related to health, growth, and reproduction, but, in general, boys are more interested in electricity and mechanics, while girls show a preference for biological aspects of science. (4) Adolescents' science interests are specific rather than

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[1]Frances E. Ruffner, "Interests of 9th Grade Students in General Science" (unpublished Master's thesis, The University of Buffalo, 1939).

[2]H. S. Zim, Science Interests and Activities of Adolescents (New York: Ethical Culture Schools, 1940).

general. (5) Adolescent boys are about five times as active in science as girls.

A few interest studies done at the high school level have also been reported. Mark, in 1953, attempted to develop a course in physical science for high school students based on their expressed interests in science topics.[1] Several secondary school texts were analyzed; topics for each area were compiled and ranked by a panel of judges. Using 75 per cent of the highest ranked topics from each area, a questionnaire was developed and administered to 400 students in 20 schools. A master sheet was prepared ranking the topics, and later the topics were developed and organized into broad units to form the outline for the course.

Weaver and Derico attempted to identify the science interests of a selected group of eleventh grade pupils in a Georgia school.[2] They used a series of four questionnaires, each containing the same items, but presented in alternate ways in order to check the consistency of testimony in general. They concluded that there was consistency in the response testimony and that categories of interest were identifiable, with a preference of interest in knowledge areas,

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[1]S. J. Mark, "Development of a Course in Physical Science for High School Students Based on Their Expressed Interest in Science Topics," Science Education, XXXVIII (May, 1954), 169-171.

[2]E. K. Weaver and R. L. Derico, "Science Interests of 11th Grade Students," Science Education, XLIX (October, 1965), 380-384.

somewhat less interest in comprehensive areas, and lowest interest in analysis areas.

Barrilleaux tried to relate IQ, science interest, and science achievement of secondary school students.[1] His conclusion was that within the IQ range 86-139, there is a high and very significant positive relationship between the relative intensity of science interest and probability of success in high school science.

Some interest studies on high school electives also have been reported. Blanc, in 1957, attempted to determine whether there was a correlation between topics of emphasis in current biology texts and the expressed interests of biology students in one high school.[2] His conclusion was that there was no consistent correlation between emphasis given to topics by textbook writers and the expressed interests of pupils. He also found the higher the grade received in first semester biology, the greater the number of expressed interests in topics appeared on the questionnaires.

The Murphy study, which was done in 1968, concluded that neither the content nor the process method of instruction yielded significant gain in biology interest.[3]

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[1]L. E. Barrilleaux, "High School Science Achievement as Related to Interest and IQ," Educational and Psychological Measurement, XXI, 4 (Winter, 1961), 929-936.

[2]Sam S. Blanc, "A Comparison of the Biology Interests of 10th and 11th Grade Pupils With a Topical Analysis of High School Biology Textbooks," Science Education, XL (1957), 127-132.

[3]G. W. Murphy, "Content vs. Process Centered Biology Laboratories," Science Education, LII (March, 1968), 142-162.

In an attempt to relate interest and achievement in high school chemistry, Edwards and Wilson reported that intrinsic interest in science and achievement in high school chemistry are significantly correlated when other variables related to achievement are held constant.[1]

Science Interest Studies--Activity Oriented

It is evident from the findings of some of the studies mentioned, that activities in science are of special interest to children. Several studies of science activity preferences of children have been reported in the literature. However, until 15 years ago, studies of the science activities of children were not carried out to study the activities themselves for their own educational value; rather, investigations were performed with the primary objective of determining the areas of interest. For example, if a boy liked to work with batteries and bulbs, the researcher concluded that he liked electricity. Only since the 1960's have educators incorporated experimental and investigative activities into the teaching and learning of science, and here it seems that the voluntary activities of children in science, largely untapped by the schools, have potential to form the pivot of a more meaningful curriculum. A short review of a few early studies and more detailed

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[1] T. B. Edwards and A. B. Wilson, "Association Between Interest and Achievement in High School Chemistry," Educational and Psychological Measurement, XIX, 4 (Winter, 1959), 601-610.

accounts of recent studies are attempted in the following pages, with the objective of determining their present contribution to curriculum making.

Meister, in a series of experiments lasting for more than five years, studied the value of certain after-school types of activities, both organized (i.e., Science Club) and unorganized (i.e., playing with a scientific toy or equipment).[1] His conclusions and recommendations resulted in the establishment in subsequent years of several types of extracurricular science activities in schools, like science clubs and fairs.

In 1924, Herriott studied the reactions of men, women, boys, and girls on 576 physics activities.[2] Her conclusions reflect the attitude of the people toward learning science, and her recommendations are typical of the science teaching practices in the first quarter of this century.

Anderson, in 1954, administered a new type of science interest questionnaire to 55 pupils in seventh and eighth grade classes.[3] This questionnaire was designed to reveal what students are interested in doing in science (not necessarily optional activities), as well as their

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[1]Morris Meister, "The Educational Value of Scientific Toys," School Science and Mathematics, XXII (December, 1922), 801-813).

[2]M. E. Herriott, "Life Activities and the Physics Curriculum," School Science and Mathematics, XXIV (June, 1924), 631-634.

[3]Harold S. Anderson, "A Key to the Science Interests of Junior High Students," The Science Teacher, XXI (1954), 227-230.

subject-matter interests. Students were asked to indicate which of 18 different types of activities they had done or would like to do in five major science subject-matter areas. Examples of the activities are: own, hear, see, work with, study, and solve problems. The five subject-matter areas were: 1. Living Things, 2. The Human Body, 3. The Earth, 4. The Universe, and 5. Matter-Energy. Anderson's findings were that boys and girls were very interested in activities pertaining to the area of living things. However, boys preferred more activities involved with matter-energy than with the human body, and girls were just the opposite. The ranking of the activity categories was: 1. hear, 2. solve problems, 3. study, 4. work with, 5. own, and 6. see. It was found that activities like giving reports, reading, explaining, and answering questions were not much liked.

The Anderson experiment would appear to be a turning point in science interest activity studies. The researcher seems to have emphasized more the activities themselves than the subject-matter area. However, the activities in his questionnaire were of the type usually performed in the classroom or lab, and not very many of them were voluntary.

Craig, in 1962, began a two-year program of experimentation by administering the Anderson questionnaire to a total of 120 students and estimating the activities in which individual students were most and least interested. He then provided supplementary activities and demonstrated that such a process increased the overall activity interest; in particular, there was a significant increase in the interest level of the previously disinterested students.[1] Later, Craig compared the activity interests of junior high school students and preservice teachers and found that the interests of the two groups were quite similar.[2] The summary table from that study is given on the following page, as it contains much interesting information.

It is apparent from some of the studies cited that the teacher is an important influencing factor in the development of the student's science interest. Talking about the preferences of children, Miller said:

> The teacher unconsciously influences the children in their choice; if she is known to have a large rock collection, some of the children list rock collecting; if her previous classes have given many plays, there will be requests for dramatics; or if, in the past, she has been willing to stay after school to hold club meetings, the children will ask for after school activities.[3]

Several dimensions of the teacher's influence on pupil science interest have been studied. Taylor found the growth in science interests to be significantly greater for high school students who worked with full-time science teachers than for students who worked with part-time

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[1] R. C. Craig and H. C. Holshbach, "Utilising Existing Interests to Develop Others in General Science Classes; An Experimental Study of the Relationship Between Learning Experience and Science Interests," School Science and Mathematics, LXIV (February, 1964), 120-128.

[2] R. C. Craig, "The Science Interest of Future Teachers," Science Education, L (October, 1966), 373-378.

[3] E. F. Miller, "Utilizing Children's Interests," Instructor, LVII (October, 1948), 24.

Table 1.--Rank and per cent of affirmative responses to activity items.

	Have Done				Would Like to Do			
	Junior High Students[a]		Preservice Teachers[b]		Junior High Students[a]		Preservice Teachers[b]	
	Rank	%	Rank	%	Rank	%	Rank	%
Solve Problems	1	64.6	6	62.1	2	63.6	1	65.5
Play With	2	62.5	2	71.4	14	53.4	15	43.3
See	3	54.9	4	64.3	9	58.2	7.5	56.9
Study	4	52.4	3	68.1	3	62.6	3	63.6
Hear	5	52.0	8	61.4	1	70.2	6	58.6
Work With	6	50.9	11	57.4	6	59.6	13	47.4
Work on Class Projects	7	49.8	10	58.3	16	48.7	9	55.5
Take Apart	8	48.7	14	51.0	13	54.9	16	41.7
Own	9	48.4	17	43.6	7	59.3	14	45.7
Ask Questions	10	46.9	5	62.6	12	55.6	7.5	56.9
Wonder About	11	45.8	9	60.0	17	45.8	12	48.1
Find Out	12	44.0	12	53.3	5	60.0	10	53.1
Discover	13	44.0	7	61.7	8	58.5	4	60.0
Read	14	43.3	1	81.7	11	56.0	5	58.8
Go	15	42.2	16	45.7	10	57.5	2	64.5
Use	16	35.6	13	51.4	4	61.4	11	50.0
Explain	17	32.4	15	50.2	15	50.2	17	38.3
Give Reports	18	30.2	18	42.4	18	35.6	18	32.9

[a]Data for junior high students from Anderson, op. cit., Table 11.

[b]Differences among the several groups of preservice teachers--elementary, secondary science, and secondary non-science--were negligible.

Source: R. C. Craig, "The Science Interest of Future Teachers," Science Education, L (October, 1966), 373-378.

teachers.[1] In the same study, a variety of factors in teacher preparation, experience, and attitudes were found to be unrelated to growth in science interests as measured by the California Occupational Interest Inventory.

Studies Establishing the Dimensions of Science Interest

Reference was made in Chapter I to the Reed Inventory. This inventory was developed to measure pupil change in science interest as a result of three teacher attributes--warmth, demand, and creation of intrinsic motivation.[2] Significant positive within-class correlations were found between teacher warmth and pupil interest. No significant relation could be found between teacher demand and pupil interest. The highest correlation of any of the three teacher variables was that between teacher's perceived intrinsic motivation and pupil interest. Also in this study, boys reported significantly more scientific activities than did girls. The most important finding in this study was that the pupils reported they had performed more self-initiated or "not required" activities when they perceived the teacher as more deliberately encouraging of such activities.

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[1]Thomas W. Taylor, "A Study to Determine the Relationships Between Growth in Interest and Achievement of High School Science Students and Science Teacher Attitudes, Preparation, and Experience," Dissertation Abstracts, XVII, 12 (1957), 2943-2944.

[2]H. B. Reed, "Pupil's Interest in Science as a Function of the Teacher Behavior Variables of Warmth, Demand, and Utilization of Intrinsic Motivation" (unpublished Ed.D. thesis, Harvard University, 1959).

As mentioned earlier, a factor analysis by Cooley and Reed of the male inventories in the above study revealed that the Inventory included a total of six factors.[1] They were: (1) a general science interest factor, including such activities as "doing extra science homework, asking questions and discussing in science class, talking about science with peers and adults, and listening to talks on science"; (2) a "woodsy-birdsy" factor, including activities like "studying animal and bird life, collecting biological specimens, and visiting parks and zoos"; (3) a science tinkerer factor, including activities like "investigating electric appliances, working with home chemistry sets, and devising new inventions"; (4) a wonderer, "thinking about science," dimension, including activities such as "finding out about space travel, exploring the meaning of concepts like time, gravity, space and energy"; (5) a high verbal activity factor, including activities like asking questions and discussing in class; and (6) a few items related to behavioral sciences and the human body. The last two are not major factors in this study.

The Reed Science Interest Inventory has been used in its original form, with minor changes, or in adapted versions in several evaluation studies of the Project Physics.

The original version of the Inventory, with five degrees of participation instead of the standard six, was

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[1]W. W. Cooley and H. B. Reed, "The Measurement of Science Interests: An Operational and Multidimensional Approach," Science Education, XLV (1961), 320-326.

administered by Walberg to 725 boys and 332 girls, mostly in grade 12, participating in the experimental evaluation of Project Physics.[1] The sample included students from all parts of the United States and two classes from Canada. Using the same criteria for solution as in the Cooley-Reed study, a factor analysis was performed using the total responses. Contrary to the results of Cooley and Reed, this study revealed only five factors. It appears that two of the Cooley-Reed factors, I and V, which they called "General Science Interest" and "High Verbal Activity," were merged into one factor, Factor I, labeled "Academic" in the Walberg investigation. Aside from this exception, the factor structure was the same. Thus there seems to be some stability of the factors across time, grade level, and sex.

In the Walberg study, factor scores were generated for individuals, and the factors were contrasted between boys and girls. The 332 girls scored significantly higher than boys on three of the five dimensions of science interests: Academic, Nature Study, and Applied Life. The 725 boys scored significantly higher on the other two dimensions: Tinkering and Cosmology. The above findings are neatly presented in Figure 1.

Table 2 summarizes the distinct factors that have been identified by the Reed-Cooley and Walberg studies.

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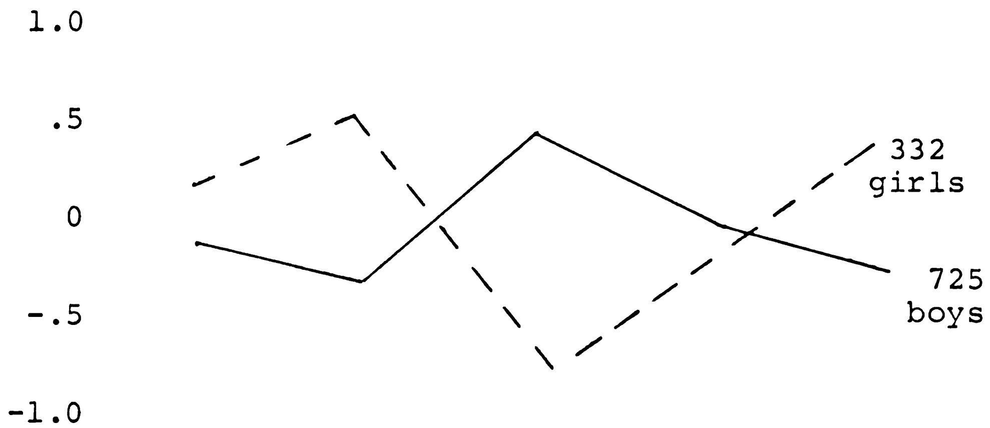
[1]H. J. Walberg, "Dimensions of Scientific Interests in Boys and Girls Studying Physics," Science Education, LI (March, 1967), 111-116.



	Academic	Nature Study	Tinkering	Cos-mology	Applied Life
Probability of no difference between groups	.01	.001	.001	.05	.001
Percent variance accounted for by sex	.7	9.3	35.6	.4	7.1

Figure 1.--Comparison of the scientific interests of boys and girls.

Source: H. J. Walberg, "Dimensions of Scientific Interests in Boys and Girls Studying Physics," <u>Science Education</u>, LI (March, 1967), 111-116.

Table 2.--Factors identified by the Reed-Cooley and Walberg studies.

No. of Factor	Name in Reed-Cooley Study	Walberg Study
Factor I	General Science	Academic
Factor II	Woodsy-Birdsy	Nature Study
Factor III	Tinkering	Tinkering
Factor IV	Thinking About	Cosmology
Factor V	High Verbal	Applied Life
Factor VI	Unnamed	--

Studies Related to the Reed Inventory

Using only items pertaining to Academic and Tinkering subscales in the Pupil Activity Interest scales, Welch and Rothman found that the control group not using Project Physics obtained significantly higher gain scores in Tinkering activities, while the experimental group using Project Physics had significantly higher gain scores on Academic types of science activities.[1]

In another study attempting to explore the factors that contribute to students' satisfaction with a course in physics, Welch used a sample of students who had not taken a course in physics before.[2] Subjects were given the Pupil Activity Inventory, which consisted of 39 items with a five-point response scale. Welch found that initial interest in science activities is slightly related to expressed satisfaction. But after the particular course was over (in this case Project Physics), expressed course satisfaction was significantly related to greater participation and science activities. However, it has not been established whether satisfaction resulted from participation in the activities or whether students participated in the activities because they found physics more satisfying.

[1] W. W. Welch and A. I. Rothman, "The Success of Recruited Students in a New Physics Course," Science Education, LII (1968), 270-273.

[2] W. W. Welch, "Correlates of Course Satisfaction in High School Physics," Journal of Research in Science Teaching, VI (1969), 54-58.

In another study, Welch used the same inventory along with other instruments to determine if there was a correlation between teacher heterosexuality and measures of student learning.[1] One of the findings was that male sexuality was not significantly related to the science activities of girls, while it was for boys. The same finding was confirmed in another study by Rothman, Welch and Walberg, in which the Tinkering activity factor was negatively correlated with male sexuality for girls and positively correlated for boys.[2] However, with a more random selection of teachers, Rothman demonstrated that male sexuality is not significantly related to science activities for girls.[3] There is evidence, however, that science interest activities are more actively pursued when boys are taught physics by male teachers.

In the study by Rothman, Welch, and Walberg, strong evidence was obtained for the fact that teachers' personalities and value systems are more strongly related to students' changes in science interest than the extent of teacher preparation in physics, mathematics, history, or philosophy of science or their knowledge of physics and years of physics

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[1]Walberg, Welch, and Rothman, "Teacher Heterosexuality and Student Learning," Psychology in Schools, VI (1969), 258-265.

[2]Rothman, Welch, and Walberg, "Physics Teacher Characteristics and Student Learning," Journal of Research in Science Teaching, VI (1969), 59-63.

[3]A. I. Rothman, "Teacher Characteristics and Student Learning," Journal of Research in Science Teaching, VI (1969), 340-348.

teaching experience.[1] The same conclusion was reached by Rothman with a different sample of teachers and students.[2]

To understand more fully the problems of women studying science, particularly physics, Walberg administered a series of tests to 705 girls and 1,369 boys studying physics.[3] One of the instruments was the Pupil Activity Inventory, the 70 items on a five-point response scale. After factor analysis and contrasting of the five factors between boys and girls, the researcher concluded that girls participated more in activities involving nature study and applications of science to everyday life. Boys participated more in cosmological and tinkering activities. In other words, girls' activities predominated in life sciences and their application, and boys engaged more often in abstract ideation and physical manipulation of objects.

An attempt has been made to relate the classroom climate to teacher personality, student ability, and interest in the subject. There is evidence that teacher personality, student ability, and interest in the subject are variables

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[1]Rothman, Welch, and Walberg, op. cit.

[2]Rothman, op. cit.

[3]H. J. Walberg, "Physics, Femininity and Creativity," Developmental Psychology, I (1969), 47-54.

that are predictive of the socioemotional climate of the classroom.[1]

In addition, it was found in another study that students who reported engaging in more physics activities, because they were interested, felt more personally intimate with their fellow class members, less alienated, and less strictly controlled.[2]

Jones attempted to relate expressed, manifest, and tested interests to the ability factor of his subjects.[3] He estimated the subjects' "expressed interest" by administering to them the Kuder Preference Record (includes outdoor, mechanical, computational, science, literary, and clerical scales), a Word Preference Inventory (contains biology and physics scales), and an Activities Preference Inventory (has three scales: biology, physics, and mathematics). He then assessed the manifest interest of his subjects by administering the adaptation of the Reed Science Activity Inventory, which included three factors: reading activities, mechanical interest hobbies, and nature interest hobbies. The

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[1]H. J. Walberg, "Teacher Personality and Classroom Climate," Psychology in the Schools, V (1968), 63-67a; Walberg and Anderson, "The Achievement-Creativity Dimension and Classroom Climate," Journal of Creative Behaviour, II (1968), 281-291.

[2]H. J. Walberg and G. J. Anderson, "Classroom Climate and Individual Learning," Journal of Educational Psychology, LIX (1968), 414-419.

[3]K. J. Jones, "Interest, Motivation and Achievement in Science," Journal of Experimental Education, XXX (Fall, 1964), 41-53.

investigator then went on to determine the "tested interest" of the subjects by administering a Science Vocabulary Test that included biology, physics, mathematics, and earth science scales. Relating the scores on the above three dimensions of interest to ability, anxiety, and drive by appropriate statistical analysis, the researcher was able to conclude that expressed interest, when combined with an ability-type measure, could predict tested interest. The combination of manifest interest and ability measure, however, is a better predictor of tested interest.

Science Interests of Black Children

Very few science interest studies involving black children have been conducted. No studies of the types described in the foregoing pages have been conducted for predominately black children. However, there are some studies in which race has been one of the independent variables.

In the study of Koelsche and Newberry, a comparison of the science interest categories of Negro and Caucasian fourth and sixth grade children was made and the conclusion was that the factor of race does not cause a significant difference in the science interest categories of children.[1] The researchers in 1967 conducted a two-phase study of the science interests of fourth and sixth grade children from two

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[1]Charles L. Koelsche and Lloyd S. Newberry, "A Study of the Relationship Between Certain Variables and the Science Interests of Children," Journal of Research on Science Teaching, VII, pp. 237-241.

schools in the South. The major purpose of the study was to construct a valid and reliable instrument for determining children's interests and to use this instrument to compare the interest categories of these children. In the first phase they developed a 36-item "What I Like to Do Science Interest Inventory," based on the curriculum guide, "Science for Georgia Schools" (1964), in which the subject matter was divided into nine categories. In the second phase of the study, they used the inventory to compare the science interest categories of children on certain variables. It was found that methods of teaching science, grade, and sex were discriminating factors in the science interest categories of these children.

In a study conducted by Dziuban and Elliot in 1967 to determine if a group of fourth through seventh grade students in schools in disadvantaged areas responded similarly to the published norms on the eight scales of "What I Like to Do Inventory,"[1] it was found that the subjects obtained consistently higher scale scores than did the norm group of 3,803 urban and rural pupils from nine geographic regions of the United States.[2] "Science" was one of the factors in the interest scales. None of the differences, however, was

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[1]L. P. Thorpe, C. E. Meyers, and M. R. Bonsall, "What I Like to Do" (Chicago: Science Research Associates, 1954).

[2]C. D. Dziuban and J. P. Elliot, "Factor Analysis of Urban Disadvantaged Children's Interests; What I Like to Do (Inventory)," Educational Leadership, XXVI (November, 1968), 161-163.

significant. The investigators suggested lack of knowledge concerning the items as one of the possible reasons for higher means than the national norm for the group.

Conclusion

In this chapter, a review of the literature was made to seek a definition of interest and examine its relationship to personal as well as other social variables. From the studies cited, there is evidence that children's interest in science develops early and that although interest in the details of topics changes with time and the volume of science facts available to the society, interest in certain fundamental areas and concepts is sufficiently permanent to warrant its use in curriculum making. Early studies indicated that boys had higher relative interest in science than girls, and that the interest of girls developed mainly in biological science, while boys showed a progressive increase in interest in the physical sciences. Later studies seem to indicate that the gap between boys and girls, both in level of interest and differences in areas of interest, is being closed. Since the early 1950's, the number of interest studies based on science activities has increased, and this may be attributed to the realization by science educators that science activities form the bulwark of effective science teaching and learning. Reed and his colleagues at Harvard argued that undirected and voluntary activities in the off-school environment have great potential as supplements or complements to the school science program. This group then determined the general dimensions of such activities. Further studies by one or more members of the project team related the factors to certain student variables such as achievement or course satisfaction and to certain teacher antecedent variables such as heterosexuality, personality, value systems, knowledge, and experience.

An examination of the literature on interest related to minority groups, specifically blacks, showed a dearth of published studies. Hence, in Chapter III we will proceed to select and identify science interest factors of a sample of black and white students from schools with varying racial distributions.

CHAPTER III

DESIGN AND ANALYSIS

Introduction

In this chapter, the development of an instrument to identify and measure interest in science activities is described. The items were based on the suggestions of a panel of judges and represented a modification of the Reed Inventory. Information obtained from pilot testing is described, followed by the selection procedures for the sample of school buildings. A short comparative description is given of the three categories of schools included in the study. The chapter next outlines the methods used to administer the inventory and the types of analysis performed. The last section concludes with a description of the graphic display of findings to be discussed in Chapter IV.

Development of the Interest Inventory

Development of the Interest Inventory was divided into several steps. The first step involved the construction of an item-list suggestive of the voluntary science activities that can normally be expected of seventh and eighth graders. The review of the literature provided considerable input; the one most helpful source was the Reed Science Interest Activity Inventory, referred to in Chapter I and included in its entirety in Appendix A. This inventory was developed using ideas from Ewen's interest scale, which itself was an adaptation of portions of the Kuder Preference Record. In the present study, a further modification of the inventory was undertaken; items were retained, reworded, adapted, or replaced. Additional ideas for items were gleaned from the research of Rothney (1934) on interest measurement, from published lists of pupils' reports on their science activities, and from examination of junior high and elementary texts. Of particular help was the writer's experience as a science instructor at the college and secondary level and as science consultant to the campus elementary school at the University of Wisconsin, Milwaukee. The initial list consisted of 98 items related to various science subject areas and pertaining to the interests of boys and girls.

The second step in the development of the Pupil Inventory involved the submission of the tentative list of items for evaluation and criticism to a racially mixed panel of judges consisting of science educators; professors of education, physical science, and biological science; teachers; and parents. The judges were asked to evaluate the items on a four-point scale. A copy of the list of items, along with the instructions mailed to the members of the jury, is found in Appendix B.

These 30 members of the jury included six nationally famous science educators, four faculty from departments of physical and biological science, two professors of elementary curriculum, 15 junior high school science teachers from various parts of Michigan, and three parents. The judges were more or less equally divided between the two races and sexes (eight black men and six black women, seven white men and nine white women).

The responses of the first 30 members of the jury who responded out of the 45 to whom materials were mailed were considered. The responses of the 30 members of the jury were tabulated, and the means and standard deviations calculated for each item. An item analysis of the judges' responses was performed, and the 70 items with the highest means that were within a standard deviation of 1.0 (range of scores 0-3) were retained and the others were eliminated. Some of the items were rephrased according to the suggestions of the judges.

In the next step, using Fry's readability technique, word, syllable, and sentence counts were made to certify that the instrument as a whole was at the seventh grade reading level. The average number of syllables per 100 words was about 130, and the average number of sentences per 100 words was about five.

The fourth step consisted of pilot testing the instrument. In spring, 1972, the instrument (Appendix C), composed of 70 items along with the necessary instructions, was administered by the writer to one eighth grade science class in a school which belonged to the "predominantly white" category, located in a suburban community, and to two seventh grade classes, one from the "mixed" category in an urban area and the other from a "predominantly black" category in the inner city. The purposes of the pilot study were to check on the administrative procedures and instructions to the pupils, to determine the time necessary for completion of the Inventory, to detect any confusion pupils might have had over the wording of the items, and to determine from the responses of the students if the variance of response was zero for any of the items from the results of an item analysis.

The results of the pilot study showed that for none of the item responses was the variance zero for the three pilot classes together or separately. As a result of discussion with the pilot students by the writer, changes were made in the instructions to the students, rough spots in the procedure were eliminated, and shortcomings in the wording of a few items were corrected.

The completed Pupil Inventory (Appendix D) is made up of 70 science interest activity items. Administration of the Pupil Inventory requires less than 30 minutes per class.

Population in the Study

The population in this study consisted of boys and girls in grades seven and eight in school districts in the state of Michigan that contained 20 per cent or more black students. Within these districts, individual buildings contained from .5 to 100 per cent black students. The basic unit for the study was the building. This criterion for inclusion of school districts in the design of the investigation was due to the fact that the study may have special bearing on the process of racial integration in schools.

The Levels of the Population

The population of buildings was divided into three levels. The first level, known in this study as "predominantly white schools," consisted of individual school buildings whose attendance rolls had between 0 and 33.3 per cent distribution of black children during the 1971-72 school year. The second level, "mixed schools," contained between 33.4 and 66.6 per cent distribution of black children in the individual school buildings. The third level, "predominantly black schools," included the individual school buildings that contained 66.7 to 100 per cent distribution of black children.

Selection of the Sample

This phase of the study consisted of three steps.

1. The researcher selected from the State Assessment (1971-72) for the state of Michigan all the school districts that contained 20 per cent or more black students. There were 24 such school districts in Michigan for the school year 1971-72.

2. All the school buildings in the above-mentioned school districts that contained either seventh grade or eighth grade or both were identified. There were 180 such

individual school buildings for the school year 1971-72. Information on the racial composition of each of these school buildings was obtained from the State Superintendent's office. Each building was assigned to one of the three levels on the basis of its percentage of black population. Of the total of 180 schools, 92 buildings fell into the category of predominantly white schools, 25 in the mixed schools category, and 63 in the predominantly black schools category.

3. Toward the beginning of spring, 1972, a letter requesting the cooperation and participation of the school in the study was sent to the principal of each of these schools. Simultaneously, permission to conduct the study in the schools was requested from the district authorities who required such a procedure. Toward the middle of spring, the researcher was assured of the cooperation and participation of the science teachers and their students from 18 schools drawn from eight school districts scattered around various regions of the state of Michigan, along with the necessary authorization from school officials. The 18 schools that volunteered to participate were equally distributed among the three categories of schools in the study.

Further Description of Sample Schools

Data on several variables for the district as well as for individual school buildings were available from several sources. The writer, however, has chosen only 12 variables to use to give a defined description of the sample, because they appeared the most pertinent with respect to the objectives of the study. Two of these variables are given qualitative treatment, and the rest are quantitative. The 12 variables and data on them for individual school buildings are listed in Table 3. Explanations of some of the variables are given in Appendix E. The sources of information on these variables are presented in Table 4.

Table 4.--Sources of information for the 12 variables.

Source of Information	Variable
The opinions of the school principal or the science teacher(s)	1 & 2
The files of the State Research Director	3,4,5,6,7,9,10,11,&12
The Michigan State Assessment: Fourth Report	8

The five school buildings included in the W-school category are located in four major cities in the state. Their principals and/or science teachers rate them as city schools. They draw their students from predominantly white middle class families. The percentage of black populations ranges from 0.5 to 24.3 per cent. School 2 is an elementary school and includes 100 seventh grade students. Looking at the averages on measures 6 through 12, one can see that there is no substantial difference among schools on these measures, except that the data for School 4 for variables 7, 8, and 9 are much below the mean.

Table 3.--Comparison of the three types of schools on selected variables.

Category of Schools	Schools	Geographic Location: Inner City School (1)	Geographic Location: City School (2)	% Black (3)	No. in 7th Grade (4)	No. in 8th Grade (5)	Pupil-Teacher Ratio (6)	% Teachers With 5 or More Years Exper. (7)	K-12 Inst. Exp. /Pupil (8)	Student's Estimate of SES (9)	Attitude Measures: Imp. of School Achieve. (10)	Attitude Measures: Self-Percep. (11)	Attitude Measures: Attitude Toward School (12)
Predom. White	School 1		x	.5%	383	388	24.4	78%	572	52.4	51.5	49.4	48.9
	School 2		x	1.0%	100	0	28.9	69%	792	47.3	52.6	48.5	49.6
	School 3		x	3.1%	246	282	24.8	76%	572	50.0	52.1	49.7	51.6
	School 4		x	11.3%	481	459	22.0	33%	454	43.5	51.4	48.7	49.8
	School 5		x	24.3%	261	249	22.2	58%	585	49.3	53.0	50.6	49.5
	Average			...	...	...	24.46	62.8%	595	48.5	52.1	49.4	49.9
Mixed	School 1		x	39.7%	300	287	20.6	52%	454	47.1	52.1	50.9	49.5
	School 2		x	40.3%	0	836	n.a.	21%	576	n.a.	n.a.	n.a.	n.a.
	School 3		x	41.2%	751	0	n.a.	48%	576	n.a.	n.a.	n.a.	n.a.
	School 4		x	51.8%	0	290	n.a.	n.a.	792	n.a.	n.a.	n.a.	n.a.
	School 5		x	55.2%	438	462	24.4	60%	591	45.6	51.2	50.7	50.7
	School 6	x		65.9%	467	423	23.5	65%	591	48.0	53.1	48.6	48.3
	Average			...	...	...	22.8	49.2%	596.6	46.9	52.1	50.06	49.5
Predom. Black	School 1	x		95.5%	531	427	28.6	71%	481	50.3	50.7	50.6	48.0
	School 2	x		95.8%	240	213	13.7	38%	454	40.6	53.0	46.9	48.5
	School 3	x		97.5%	225	207	20.9	74%	572	39.5	54.1	46.8	52.7
	School 4	x		99.6%	121	0	21.0	85%	792	44.2	55.0	49.1	55.6
	School 5	x		99.6%	570	548	23.6	37%	481	44.2	50.3	49.6	49.3
	School 6	x		100.0%	72	0	25.9	62%	481	n.a.	n.a.	n.a.	n.a.
	Average			...	...	...	22.2	61.1%	543.5	43.8	52.6	48.6	50.8

n.a. = data not available

Among the six Mixed schools, one is considered an inner city school and the others are considered city schools. These six schools are also located in four major cities in Michigan. The percentage of blacks in these schools ranges from 39.7 to 65.9 per cent. Schools 3 and 4 in this level were racially integrated by busing since the beginning of the school year. These two schools contain either seventh or eighth grades, but not both. School 4 is a high school beginning at the eighth grade. Data on several variables are not available for three schools at present from any of the three sources mentioned above. Except for the data on variable 7, values for other measures are not too discrepant among these schools.

The six schools included in the predominantly black category of schools are also located in four major cities in the state. All are considered inner city schools. The racial composition among them is almost 100 per cent black. Two of the schools are elementary schools ending with the seventh grade. Except for the data for School 2 on variables 6 and 7, values on other variables among schools are rather constant, indicating that these schools are not very different from each other.

Comparison Among the Three Categories of Schools

It is easily seen that as the location of the school shifts toward the inner city, the percentage of blacks definitely increases. There is a gradual decrease in the average on socioeconomic status (not of individual pupils, but a composite of the entire district) from W-schools to the B-schools. The averages on other measures like 6, 7, 8, 10, 11, and 12 are rather uniform among levels; at least no recognizable trend exists. Therefore, it is possible to say that except for geographical location, percentage of blacks, and socioeconomic status, the schools are homogeneous in terms of other variables. In this study, the percentage of blacks is the major concern; however, the results may be related to the other two variables.

Administration of the Pupil Inventory

Copies of the Pupil Inventory were taken by the researcher to each of the participating schools. Each cooperating science teacher was given careful instructions on procedures for gathering the data, and each was familiar with the major details and purposes of the research project. The science teachers then administered the Inventory at their own convenience. Each teacher read the printed instructions aloud to the pupils, with emphasis on the importance of honest and careful responses and on the serious nature of the research. The teachers were asked to explain the wording of an item if individual students did not understand it. The researcher was told by the individual teachers that explanation was seldom required. All responses were marked on the IBM answer sheets. Personal information regarding the race, sex, and grade level of the student was requested in the Inventory, and the responses to these items were marked on the IBM sheet itself by the student.

All data were collected late in the school year (between May 15 and June 6, 1972) to ensure that the children had had enough time during the school year to perform the activities included in the Inventory.

A total of 3,002 students, taught by 53 teachers from 17 schools in seven school districts, participated in the study. In one school from the predominantly white category, the Inventory could not be administered due to unforeseen circumstances. A coding for the category of the school was included by the writer on each IBM answer sheet before it was scored.

Analysis of the Data

Scoring procedures revealed 292 cases of pupils' apparent carelessness or failure to complete the Inventory adequately. Of the 3,003 Inventories administered, these 292 were rejected, leaving 2,711 in the final tabulation. The distribution of rejected responses among schools, race, and sex was as follows:

		Boys	Girls
Predominantly white schools	Whites	48	40
	Blacks	5	3
Mixed schools	Whites	20	28
	Blacks	27	31
Predominantly black schools	Whites	7	6
	Blacks	38	39

The responses on each Pupil Inventory were then punched onto IBM cards. To verify the copying operation involved in card punching, a print-out from the cards was proofread against the responses on the original scoring sheets. New cards were punched for any on which errors were found. The scale code for each activity item on the IBM card ranged from 0 to 3; i.e., the four possible responses for each item were scale coded as follows: "never" = 0, "once or twice" = 1, "often" = 2, "very often" = 3. Thus the possible score range for the 70 activity items was 0-210. For analysis, a deck of 2,711 basic data cards contained the following information: grade code, race code, sex code, school category code, and the item response code.

The careful proofreading of the punched cards gave confidence that the basic data used in the analysis were free from copying errors.

Reliability of the Pupil Inventory Scales

An inventory intended to discriminate within-the-person has its own special requirements, which are not necessarily the same as those for a measure intended to discriminate among people. A single test which differentiates well among persons is useless in itself for differentiating within-the-person, and scores which are comparable within-the-person are not necessarily comparable from person to person. Thus an internal reliability measure concerned with the consistency of the items in the science activity scale was necessary. Using the analysis of variance theory developed by Hoyt,[1] the reliability coefficient was calculated for the whole interest inventory. The value was between .9550 and .9553. This high value indicated internal consistency of the science interest items, and consistency of each pupils' responses. Reliability of the subscales of interest or the factors was also calculated and is reported in Chapter IV.

Factor Analysis of the Activities

As has been established by the investigations of Reed, Cooley, and Walberg, and discussed in Chapter II, the total score on a science interest inventory can be thought of as a composite of several independent dimensions of science interest. Therefore, the 70 items for the whole sample of 2,711 students were factor analyzed. The procedure used was a principal component factor analysis of the intercorrelation matrix, followed by a varimax rotation of the extracted factors. The analysis was programmed to stop factoring when the minimum latent root was less than one or, in other words, the threshold Eigen value was set equal to 1.0. Previous studies indicate that this approach results in a solution of the dimensionality of science interests, which is least dependent upon the particular items utilized in the Inventory. The necessary computations and the

[1]Cyril Hoyt, "Test Reliability Estimated by Analysis of Variance," Psychometrika, VI (1941), 153-160.

rationale for this particular solution of the factor analysis problem were summarized in papers by Kaiser in 1958 and 1959. Reliability coefficients of the factors were determined using Hoyt's analysis of variance technique and factor scores were generated for each individual. Following a 3x2 analysis of variance design, the factors were contrasted among the three categories of schools and between boys and girls using factor scores as dependent measures. Cell distribution of the sample in the MANOVA design was as follows:

	Boys	Girls
Predominantly white	401	447
Mixed	603	660
Predominantly black	262	338

Subsequently, 2x2 analysis of variance was performed after removing the 26 cards for responses that came from race groups other than black or white to contrast the factors between blacks and whites, and between boys and girls. Cell distribution of the sample in MANOVA design was as follows:

	Boys	Girls
Black	510	640
White	751	784

Twelve histograms were constructed using the factors as independent variables and the cell means of the factor scores generated in the analysis as dependent variables in order to represent visually the variation in the interest level of activities among specific groups within the sample population.

The order of histograms is as follows:

1. Predominantly black schools vs. mixed schools vs. predominantly white schools.
2. Predominantly black schools vs. predominantly white schools.
3. Blacks from mixed schools vs. whites from mixed schools.
4. Whites in mixed schools vs. white schools.
5. Blacks in mixed schools vs. black schools.
6. Total blacks in the sample vs. total whites in the sample.
7. Boys vs. girls.
8. White boys vs. white girls.
9. Black boys vs. black girls.
10. Black boys vs. white boys.
11. Black girls vs. white girls.
12. Seventh grade vs. eighth grade students.

The results of the analyses and histograms are presented in Chapter IV.

Summary

In this chapter, the construction of an initial list of 98 items and the development of the 70-item Inventory was described, taking into consideration suggestions from a panel of 30 judges and the information obtained from pilot testing with one class each of seventh or eighth graders from the three categories of schools considered in the study. The chapter also contained a description of the procedures involved in the selection of the sample and the administration of the Inventory to the pupils. The types of analyses performed were outlined, and the basis for the several histograms to be constructed was indicated.

CHAPTER IV

THE RESULTS

The following is the order in which the results of the analysis are presented:

1. The means and standard deviations of the activity items.
2. The results of the "principal factor--varimax rotation" analysis and discussion of the factors.
3. The reliability coefficient of the factors.
4. The intercorrelations of the factors.
5. A factor by factor discussion of the results of
   a. the two-way MANOVA with factors as dependent variables and three categories of schools and two levels of sex as independent variables.
   b. the two-way MANOVA with factors as dependent variables and two levels each of race and sex as independent variables.

The Means and Standard Deviations of the Items

With the scale value ranging from 0 to 3 for the four possible responses, the means and standard deviations were calculated for each item. The items in the order of decreasing means are arranged as shown on the table in Appendix F.

The Results of the "Principal Axis--Varimax Rotation" Analysis and Discussion of the Factors

Several solutions are possible in a "principal axis--varimax rotation" analysis. The number of factors to be rotated is left to the researcher. It is generally accepted by statisticians that keeping a threshold eigenvalue of 1.00 to determine the number of factors to rotate generally yields a standard solution. According to this criterion, the analysis resulted in a nine factor solution. The writer also obtained five, six, seven, eight, ten, and eleven factor solutions with the given data matrix. However, an attempt to interpret the clusters of items in the above solutions convinced the investigator that the nine factor solution yielded the most meaningful factors. Therefore, the nine factor solution was accepted. In Table 5 are the first nine eigenvalues, the variance associated with them resulting from the principal component analysis of the intercorrelation matrix, and the percentage of common factor variance accounted for by the nine factors resulting from the varimax rotation.

Tables 6 through 14 present information on factors I through IX, respectively, and they include the clustered items, the corresponding rotated factorial loadings, and the Hoyt reliability coefficient of the factor.

Interpretation of Factor I

Factor I, labeled "Academic," appears to be generally the same as the Cooley-Reed Factor I, which they called

Table 5.--Results of principal axis--varimax rotation analysis; factors, eigenvalues, per cent of variance, per cent of common factor variance.

Factor	Eigenvalues	Per Cent of Variance	Common Factor Variance After Rotation
1	17.6176	25.17	6.93
2	2.6837	3.83	6.42
3	2.3927	3.42	6.18
4	1.9151	2.74	4.30
5	1.6560	2.37	3.67
6	1.3158	1.88	3.90
7	1.1878	1.70	4.44
8	1.0964	1.57	4.33
9	1.0606	1.52	4.01

"General Science Interest," and contains several items included in Walberg's Factor I, also labeled "Academic." Contrasted with the remaining factors, it seems to include items that are strongly class oriented: doing extra problems, discussing science in class, writing reports, etc. The items included in this factor perhaps do not represent highly voluntary activities and may be done for extra grades or might generally be required by some teachers as part of the science program. One suspects that scores on this factor might be influenced by general school scholastic interests rather than scientific curiosity. The factor has a reliability coefficient of .8555, indicating strong correlation among the items to cluster together.

Table 6.--Factor I (academic) clustered items, rotated factorial loadings, and reliability coefficient.

	Rotated Factorial Loading
18. During this year I did extra problems; i.e., more than I was required to in my school science work.	.4810
28. Browsed through science books in the library or book store.	.3502
31. Brought to class current news of space events and suggested discussions on them.	.6155
34. Brought to class some materials or books of scientific interest so that the whole class could benefit from them.	.6152
35. Took time out to study the lab manual or sheets in order to be better prepared for the lab.	.4549
37. Engaged in individual projects in science which required extra reading or writing or interviewing, etc.	.4916
38. Entered into science contest to compete for awards.	.5017
44. Spent time with a friend outside the class because we are both interested in science.	.4704
51. During this school year, I tried to find out how science can make housekeeping chores easier and give me more time to play.	.3085
52. Spent time preparing for a science project not required for class or a science fair.	.4992
53. Performed more labs than were required of me.	.4848
Reliability Coefficient	.8555

Interpretation of Factor II

Factor II, here labeled "Nature Study," is about the same as the "Woodsy-Birdsy" dimension of the Cooley-Reed study and is identically labeled in Walberg's study. It includes activities like visiting gardens, parks, greenhouses, zoos, and aviaries; collecting biological specimens; and going on nature exploring trips. The reliability coefficient of this factor is fairly high, .8254. This is a fairly stable factor, identified in several previous studies involving science interest activities. The general nature of activities constituting this factor is fairly stable across time. The items have quite high factorial loadings (Table 7).

Interpretation of Factor III

Factor III is the science tinkerer factor, here labeled "Mechanical Hobbies," and is similar to the "Tinkering" factor in the previous studies. Most of the items involved working with mechanical things and a curiosity about how "gadgets" work. Examples are: repairing electric lamps and cords; investigating mechanical, electrical, and electronic appliance equipment; working with magnets, batteries, and wires; and devising new inventions. In many studies in which this factor has been identified, the items forming this factor have high factorial loadings when compared to items forming other factors. The reliability coefficient of the factor is .8354, indicating strong clustering tendency of the items (Table 8).

Table 7.--Factor II (nature study) clustered items, rotated factorial loadings, and reliability coefficient.

	Rotated Factorial Loading
14. Watched some of the science programs on TV like "Mr. Wizard," "Star Trek," "Under Water World," "Jacques Cousteau," etc.	.3150
25. During this year, visited greenhouses, gardens, parks, woods, creekbanks, vacant lots, back yards, etc. to watch, observe, and learn more about different varieties of plants & animals.	.5744
26. Collected frog eggs, tadpoles, or cocoons to study the changes that take place in them.	.4943
27. Walked into the woods or collected pictures to study the change of color in leaves during the Fall.	.5395
46. Cultivated and cared for vegetables and flowers.	.5471
47. Worked on a collection of insects, bird nests, or animal specimens.	.5663
48. Collected and pressed leaves and flowers.	.5401
50. Went on nature exploring trips.	.5222
55. Tried to find out about national parks and wild life areas in the state.	.4439
56. Visited places where animals and birds are kept.	.5348
62. Kept caterpillars and watched them develop into moths and butterflies.	.4082
Reliability Coefficient	.8254

Table 8.--Factor III (mechanical hobby interest) clustered items, rotated factorial loadings, and reliability coefficient.

	Rotated Factorial Loading
6. Tried to assemble electronic equipment like transistor radio or tried to repair such broken equipment by myself.	.6870
7. Disassembled old appliances like clocks, etc. to find out how they are made.	.6816
12. Read magazines like Popular Science, Popular Mechanics, Natural Geographic or any other such magazines at home, school or any other place.	.3068
13. Attempted to work out my own inventions or perform new types of experiments, maybe taking ideas from books, magazines or any other sources.	.4588
16. Got interested in one or more of the scientific occupations like aviation, engineering, medicine, farming, etc. and learned more about them myself.	.3456
23. Tried to repair a broken bike or a lawnmower or vacuum cleaner or any such household articles because I like doing such things.	.7037
36. Visited places like factories, bakeries, gas stations, etc. (where several machines are used for various purposes) to observe and study the use of these machines.	.4378
49. Repaired electric lamps and cords or any appliance that works on electricity.	.7058
54. Had fun making rockets, guns, color sprays, etc. out of simple materials found at home.	.4893
66. Worked with magnets, batteries, wire, electric motor, etc. at home to determine how electricity and magnetism are related.	.5914
Reliability Coefficient	.8354

Interpretation of Factor IV

Factor IV, here labeled "Biology Experiments," is perhaps like tinkering in the biology area and includes only six items. Most of the items are well within the biological sciences. This factor was formed by the clustering of some of the new items included in the inventory and a few items drawn from the general interest, nature study, and tinkering factors in the previous studies where they had low factorial loadings. Examples are: using home chemistry set and microscope, experimenting with plants and growing bacterial and plant cultures. The reliability coefficient is .7073, which, although lower than that of the previous three factors, is still high enough to be considered a distinct factor.

Table 9.--Factor IV (biology experiments) clustered items, rotated factorial loadings, and reliability coefficient.

	Rotated Factorial Loading
9. Made use of common household materials like vinegar, salt, soda, etc. or a home chemistry set to perform some simple experiments.	.4762
17. Used a microscope at home.	.3261
61. Experimented with mouthwash and antiseptics to find out whether they really prevent infections.	.4716
63. Experimented on plants with different chemical fertilizers.	.4918
64. Tried to find out how dangerous bacteria may be kept out of water, milk, and other foods.	.3422
65. Grew my own sample of bacterial and plant culture.	.4625
Reliability Coefficient	.7073

Interpretation of Factor V

Factor V is a factor not found in previous studies, and clusters entirely with new items in the inventory. The factor, here labeled "Drugs," consists of items that pertain to drug-associated activities and contains only five items. The lower reliability coefficient of .6638 indicates less tendency for the items to form one single factor. In fact, a 12 factor analysis of the original responses clearly demonstrated that this factor included two subscales: an ethnic interest factor with the items dealing with sickle cell anemia and skin color, and a "stimulant factor" with items related to drugs.

Table 10.--Factor V (drugs) clustered items, rotated factorial loadings, and reliability coefficient.

	Rotated Factorial Loading
30. Tried to learn about the misuse of drugs and cautioned my friends on the dangers of smoking cigarettes and marijuana.	.4033
45. Got interested to know more about heart surgery and tried to learn more about it.	.4830
67. Tried to learn what is being done to control and cure sickle cell anemia.	.6380
70. Tried to find out more about the effect of excessive use of drugs and alcohol on the proper functions of the brain.	.4769
72. Tried to find out the scientific reason for the difference in skin color among people.	.5575
Reliability Coefficient	.6638

Interpretation of Factor VI

Factor VI, in this study called "Cosmology," has an identical name in the Walberg study and is similar to the "Thinking About" factor in the Cooley-Reed study. This dimension includes activities related to space exploration and atomic energy. Examples are: finding out about space travel; exploring the meaning of concepts like time, gravity, and energy; and the use of atomic energy for constructive ends. The reliability coefficient is .7402, indicating stability. It has remained a stable identifiable factor in science interest activity studies during the last 12 years.

Table 11.--Factor VI (cosmology) clustered items, rotated factorial loadings, and reliability coefficient.

	Rotated Factorial Loading
20. Tried to learn as much as possible about the moon rocks or went to see them on display.	.4628
21. Tried to follow the latest developments in U.S. and Russian space explorations.	.7085
24. Tried to find out how atomic energy is used for power production.	.3842
29. Discussed with teachers and adults current news items on man's exploration of space.	.5660
39. Spent away time dreaming about questions like "What is energy," "What is space," etc. without meaning to do so.	.4198
71. Tried to take sides on modern issues like nuclear testing, space exploration, SST, etc.	.5284
Reliability Coefficient	.7402

Interpretation of Factor VII

This dimension seems to indicate some kind of collection interest among the pupils, and is formed by the clustering of some new items included in the inventory and some items from the "General Interest" and "Academic" factors of the previous two studies. The factor here is named "General Collection." Examples are: bought scientific materials; collected shells, rocks, leaves, etc.; collected pictures and drawings of animals; and identified fossils. The reliability coefficient is rather low, .7060, and the factorial loadings of the items are not too high, indicating that the items are rather loosely clustered. It is also interesting to note in advance that the interest level on this factor is rather constant for the different groups forming the sample population in this study (Table 12).

Interpretation of Factor VIII

Factor VIII, labeled "High Verbal," is quite similar to Factor V in the Reed-Cooley study, also identically labeled. It refers mostly to high verbal activities like asking questions, discussing, and explaining. Again, this dimension may not represent activities that are necessarily voluntary and highly related to science interest. The reliability coefficient is .7663. The factor is significantly contrasted between boys and girls, but not among other groups (Table 13).

Table 12.--Factor VII (general collection) clustered items, rotated factorial loadings, and reliability coefficient.

	Rotated Factorial Loading
4. During this school year read newspaper articles on science topics at home, school library, or any other place.	.4963
5. Spent my own money to buy articles that are of scientific use to me.	.5131
8. Made extra drawings of animals, plants, or equipment by consulting sources other than my texts.	.4723
10. During this school year, collected several types of shells, rocks, leaves, or any such materials to study them more closely.	.5339
11. Got interested in identifying and studying fossils.	.4117
22. Cut out and saved articles of scientific interest to me from newspapers or other sources.	.3560
32. Made large pictures or drawings which illustrate some special science interest to me.	.4369
Reliability Coefficient	.7060

Table 13.--Factor VIII (high verbal) clustered items, rotated factorial loadings, and reliability coefficient.

	Rotated Factorial Loading
15. Asked questions on science to grown-up persons because I had always wanted the answers for them.	.4112
19. Talked with fellow students about scientific topics.	.3529
33. Watched very closely when the teacher performed a demonstration experiment in the class.	.5342
41. Hung around with people who work with scientific things.	.3846
42. Participated in classroom discussions and volunteered to answer questions in class.	.5834
43. Helped younger students and classmates with problems and projects in science.	.4258
57. Deliberately brought up science topics during meals at home.	.3134
73. I have tried to verify certain scientific statements of the teacher and other persons in one or several of the ways I could.	.3422
Reliability Coefficient	.7663

Interpretation of Factor IX

Factor IX is clearly the "Environmental" factor, and consists of entirely new items included in the inventory. Examples are: collected litter from the ground, participated in organized cleanup campaigns, collected papers and magazines for recycling, and identified pollutants in the locality. The reliability coefficient is .8110, indicating strong stability of the factor.

Table 14.--Factor IX (environmental) clustered items, rotated factorial loadings, and reliability coefficient.

	Rotated Factorial Loading
40. Was active with groups interested in environmental preservation.	.4695
58. Tried to find out the effect of insecticides and pesticides on wild life.	.3927
59. Collected litter from the ground and participated in organized cleanup campaigns.	.5498
60. Took the lead to collect old newspapers and magazines for recycling so that fewer trees would be cut down to make paper.	.4251
68. Tried to find the agents of air and water pollution in my locality.	.5213
69. I have thought about what I could do to prevent further pollution and clean up the mess.	.6105
Reliability Coefficient	.8110

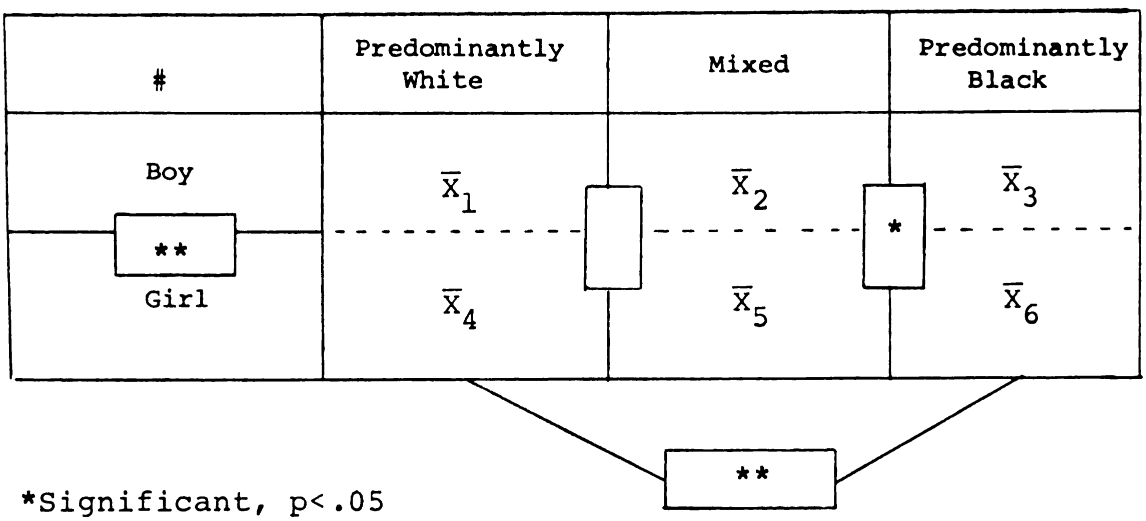
It is to be noted that seven out of the nine factors are either the same as or quite similar to the ones identified in the previous studies. This illustrates the stability of the factors across time, grade level, sex, and race.

The Intercorrelations of the Factors

In Table 15 are presented the intercorrelations among the factors. None of the intercorrelations is significant. This establishes the fact that the factors are independent of each other.

Format of the Presentation of the Results of MANOVA Analyses

It is proposed to present the results of MANOVA analyses factor by factor, followed by a short discussion of the results. The format of the presentation is as follows: (1) Presentation of the cell means for the school x sex MANOVA analysis by the following figure.



*Significant, $p<.05$
**Significant, $p<.01$
#Significant sex-school interaction effect

Table 15.--Intercorrelation matrix of the factors.

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9
Factor 1 Academic	1.000								
Factor 2 Nature Study	0.016	1.000							
Factor 3 Mech. Hobby	0.051	-0.066	1.000						
Factor 4 Biol. Exp.	-0.023	0.021	0.081	1.000					
Factor 5 Drugs	0.022	0.004	0.093	-0.007	1.000				
Factor 6 Cosmology	-0.010	0.015	0.114	-0.025	-0.055	1.000			
Factor 7 Gen. Coll.	0.003	-0.004	-0.004	0.003	-0.005	-0.001	1.000		
Factor 8 High Verbal	0.007	-0.005	-0.020	0.011	0.002	0.007	-0.001	1.000	
Factor 9 Environmental	0.022	-0.016	-0.022	0.016	-0.039	-0.006	-0.004	-0.004	1.000

A short description of the figure is in order to understand better the representation of significance levels of the main, post hoc, and interaction effects reported in the writing. The symbols $\overline{X}_1$ -- $\overline{X}_6$ stand for cell means of factor scores for the given factor. khe asterisks and double asterisks stand for the main or post hoc effect significance levels. The symbol # indicates whether the sex-school interaction effect for the particular factor is significant or not. In the figure presented for illustration, we find that the sex main effect is significant **($p<.01$). This shows that the probability of the mean of $\overline{X}_1$, $\overline{X}_2$, and $\overline{X}_3$ being equal to the mean of $\overline{X}_4$, $\overline{X}_5$, and $\overline{X}_6$ is less than .01. Likewise, the probability of the mean of $\overline{X}_1$ and $\overline{X}_4$ being equal to $\overline{X}_3$ and $\overline{X}_6$ is less than **($p<.01$); i.e., predominantly white and black schools are significantly different on this factor. Similarly, mixed schools and predominantly black schools are also significantly different *($p<.05$). Predominantly white and mixed schools, however, are not significantly different, so the rectangular block between these means does not show an asterisk. In this case, we also note that there is a significant interaction effect between sex and school type.

(2) Short discussion of the results.

(3) Graphical representation of the overall main effects for (a) school and (b) race.

(4) Interaction effect (if any) is graphed and briefly discussed.

Factor I (Academic Interest)

The cell means of factor scores on this dimension of interest for the school by sex analysis of variance are given in Figure 2. Similar data for the race by sex analysis are given in Figure 3.

The school main effect is significant ($p<.01$). The Scheffé method of contrast between the three levels of schools shows that the difference between any two categories of schools is significant at the .01 level. There is a significant increase in the reported interest level on this factor from W-schools through M-schools to B-schools. A comparison of whites and blacks confirms the finding. The trend is well represented on Graph 1a and Graph 1b.

The sex main effect is significant ($p<.01$) in both the analyses, showing higher overall reported academic interest for boys. Pupils in predominantly black schools report significantly greater participation in academic-type science activities (like writing reports; science projects; extra labs; and reading, writing, and working out problems) than children in predominantly white schools. Also, the overall reported participation of boys in these types of activities is significantly higher than that of girls, that of the black boys being highest, at least in the sample studied.

Factor II (Nature Study Interest)

The cell means of factor scores for the school by sex, and race by sex MANOVA analyses are provided in Figures 4 and 5, respectively.

	Predominantly White	Mixed	Predominantly Black
Boy	-.097	.112	.292
**	**	**	**
Girl	-.238	-.057	.116

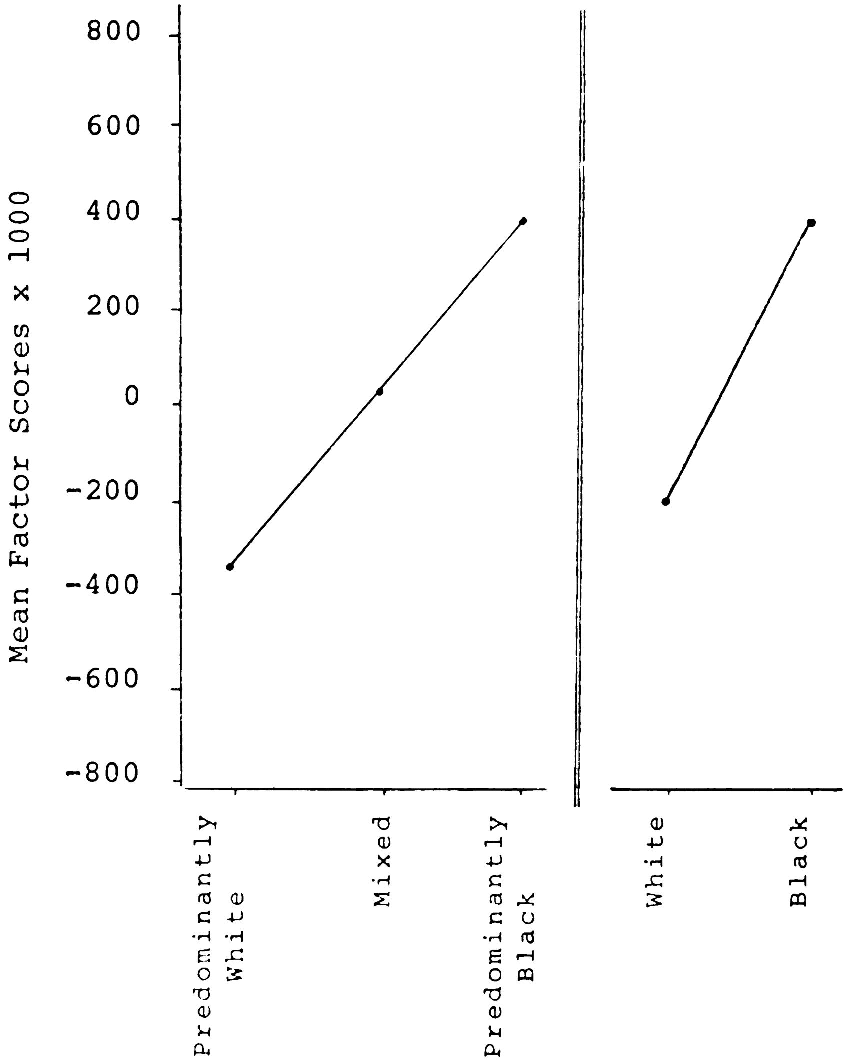
**Significant, p<.01.

Figure 2.--Academic factor, results of school vs. sex MANOVA of factor scores for entire sample.

	White	Black
Boy	-.079	.304
**	**	
Girl	-.219	.120

**Significant, p<.01.

Figure 3.--Academic factor, results of race vs. sex MANOVA of factor scores for entire sample.



Graph la.--Plot of Mean Factor Scores by School Type for Academic Factor.

Graph lb.--Plot of Mean Factor Scores by Race for Academic Factor.

#	Predominantly White		Mixed		Predominantly Black
Boy	-.08		-.174		.007
**		**		**	
Girl	.315		-.005		-.009
	** (Predominantly White vs. Predominantly Black)				

**Significant, p<.01.
#Significant school-sex interaction effect, p<.01.

Figure 4.--Nature study factor, results of school vs. sex MANOVA of factor scores for entire sample.

#	White		Black
Boy	-.073		-.158
**		**	
Girl	.238		-.083

**Significant, p<.01.
#Significant race-sex interaction effect, p<.01.

Figure 5.--Nature study factor, results of race vs. sex MANOVA of factor scores for entire sample.

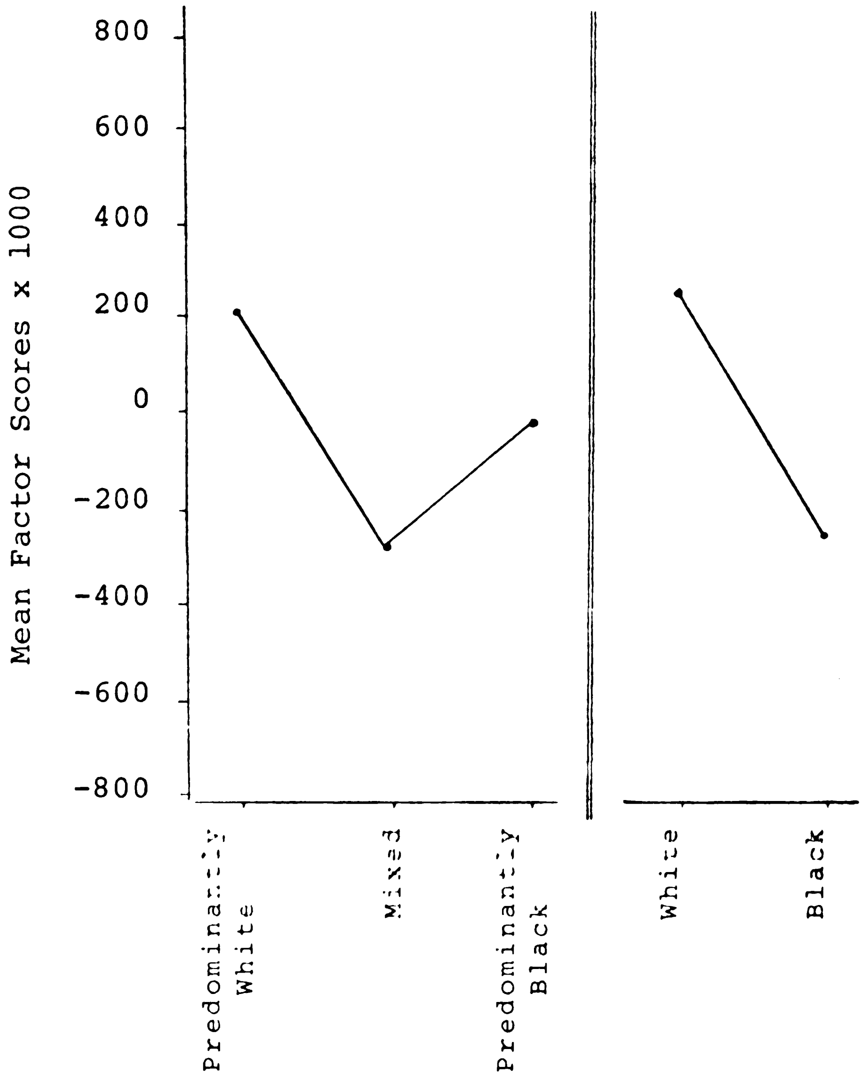
The overall school effect is significant ($p<.01$). On post hoc analysis, it was found that the reported participation of pupils on this dimension of science activities significantly decreases from W-schools to M-schools, and then increases significantly to the B-schools.

The net school effect is a decrease in the expressed participation in the activities of this factor from W-schools to B-schools (Graph 2a). The same results are confirmed by the race by sex analysis (Graph 2b). From the results of both analyses, the scores of girls are significantly higher than those of boys, showing greater expression of nature interest for girls. The white girls are the greatest on this factor.

In both the analyses, there is a significant interaction effect ($p<.01$); in the school versus sex design, while the reported interest of girls continues to decrease from M-schools to B-schools, that of the boys increases, producing the above effect. In the race versus sex design, the reported interest of boys does not decrease as rapidly as that of the girls from the white to the black population. The interaction effects are graphed as shown in Graph 3a and Graph 3b.

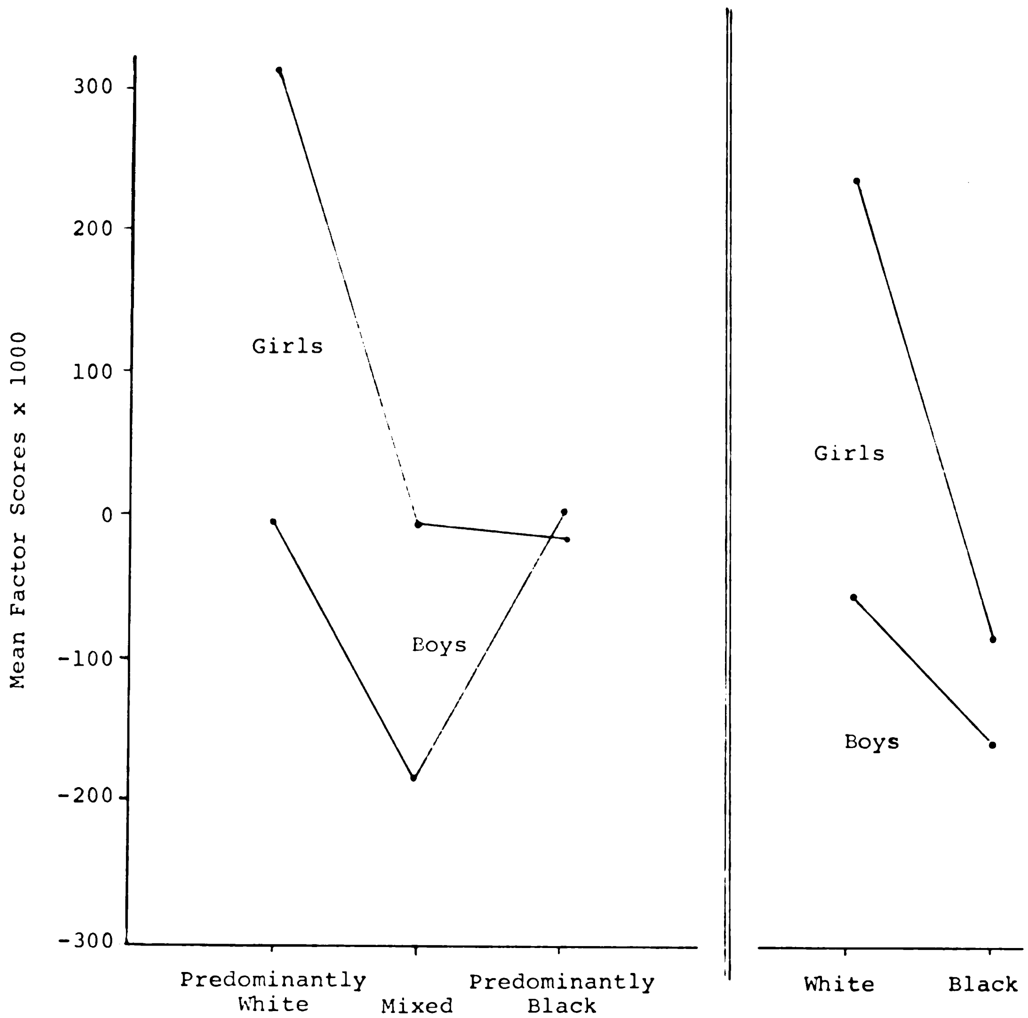
Factor III (Mechanical Hobby Interest)

The cell means of factor scores for school by sex and race by sex MANOVA analyses are presented in Figures 6 and 7, respectively.



Graph 2a.--Plot of Mean Factor Scores by School Type for Nature Study Factor.

Graph 2b.--Plot of Mean Factor Scores by Race for Nature Study Factor.



Graph 3a.--School-Sex Interaction Effect for Nature Study Factor.

Graph 3b.--Race-Sex Interaction Effect for Nature Study Factor.

#	Predominantly White	Mixed	Predominantly Black
Boy	-.620	-.429	-.541
**		**	
Girl	.655	.392	.287

**Significant, p<.01.
#Significant school-sex interaction effect, p<.01.

Figure 6.--Mechanical hobby factor, results of school vs. sex MANOVA of factor scores for entire sample.

#	White	Black
Boy	-.532	-.486
**	**	
Girl	.635	.203

**Significant, p<.01.
#Significant race-sex interaction effect, p<.01.

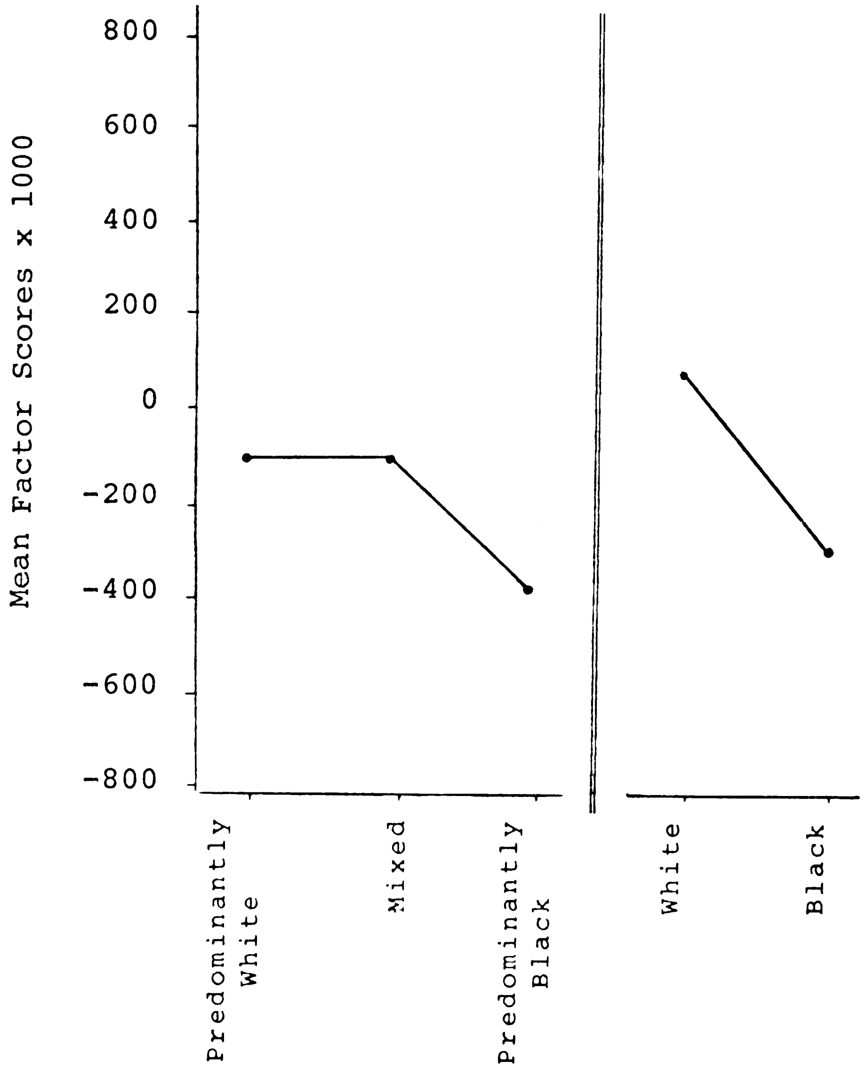
Figure 7.--Mechanical hobby factor, results of race vs. sex MANOVA of factor scores for entire sample.

The high mean factor scores presented in Figures 6 and 7 show that there is high overall interest in mechanical hobbies for certain groups in the sample. The overall school effect is significant ($p<.01$). On post hoc analysis, however, the contrast is not significant between W-schools and M-schools. The overall picture is a significant drop in the reported mechanical hobby interest from the W-schools to B-schools, which is well correlated with the significant lack of reported enthusiasm by black pupils compared to the white children. The net results are presented on Graph 4a and Graph 4b. The sex main effect in both analyses is significant ($p<.01$), with girls scoring much higher on this dimension.

The cause of significant ($p<.01$) interaction effect in both the analyses can be understood by graphing the values. While the stated interest of girls on this factor continues to decrease all the way down the three levels of schools, that of the boys increases to M-schools and then decreases. In the white versus black comparison, the rapid decrease in the stated interest of the girls interacts with the slow increase for the boys from the white population to the black population (see Graph 5).

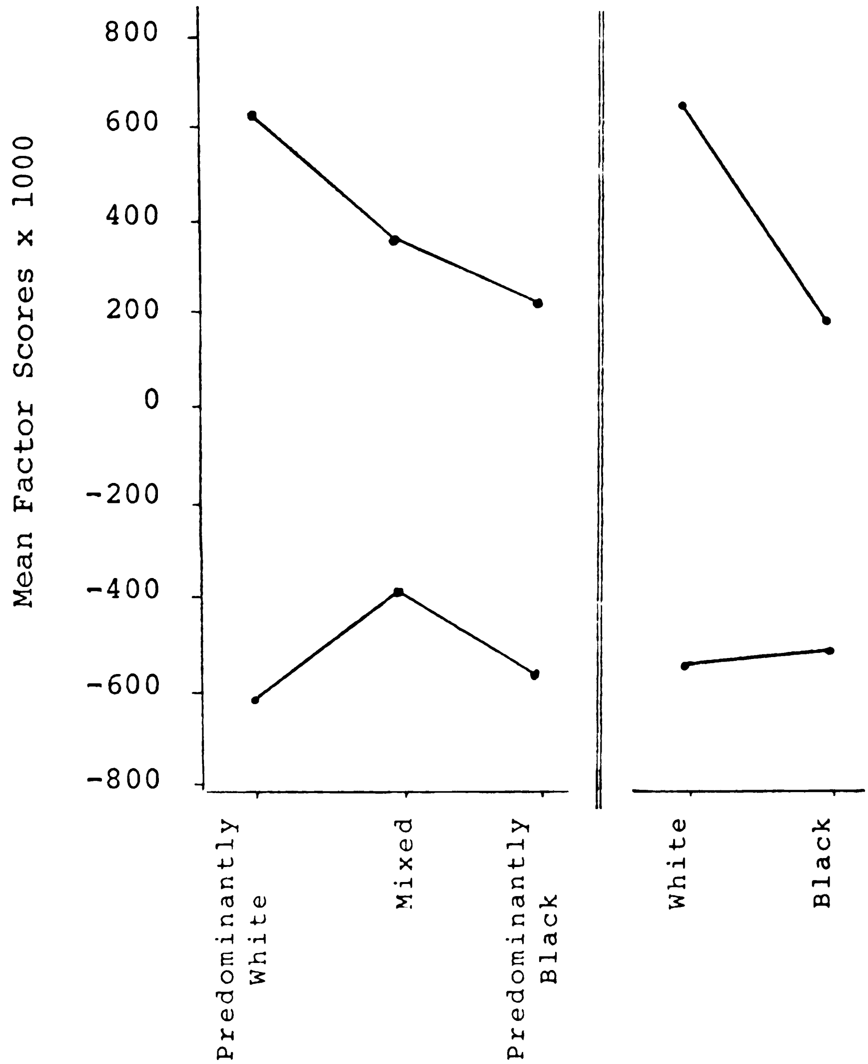
Factor IV (Biology Experiments Interest)

The cell means of factor scores for the school-sex MANOVA analysis are presented in Figure 8. Similar data for race-sex MANOVA analysis are presented in Figure 9.



Graph 4a.--Plot of Mean Factor Scores by School Type for Mechanical Hobby Factor.

Graph 4b.--Plot of Mean Factor Scores by Race for Mechanical Hobby Factor.



Graph 5a.--School-Sex Interaction Effect for Mechanical Hobby Factor.

Graph 5b.--Race-Sex Interaction Effect for Mechanical Hobby Factor.

#	Predominantly White		Mixed		Predominantly Black
Boy	-.036		.265		.189
**		**			
Girl	-.210		-.146		-.013

**Significant, p<.01.
#Significant school-sex interaction effect, p<.01.

**

Figure 8.--Biology experiments factor, results of school vs. sex MANOVA of factor scores for entire sample.

	White		Black
Boy	.090		.278
**		**	
Girl	-.200		-.072

**Significant, p<.01.

Figure 9.--Biology experiments factor, results of race vs. sex MANOVA of factor scores for entire sample.

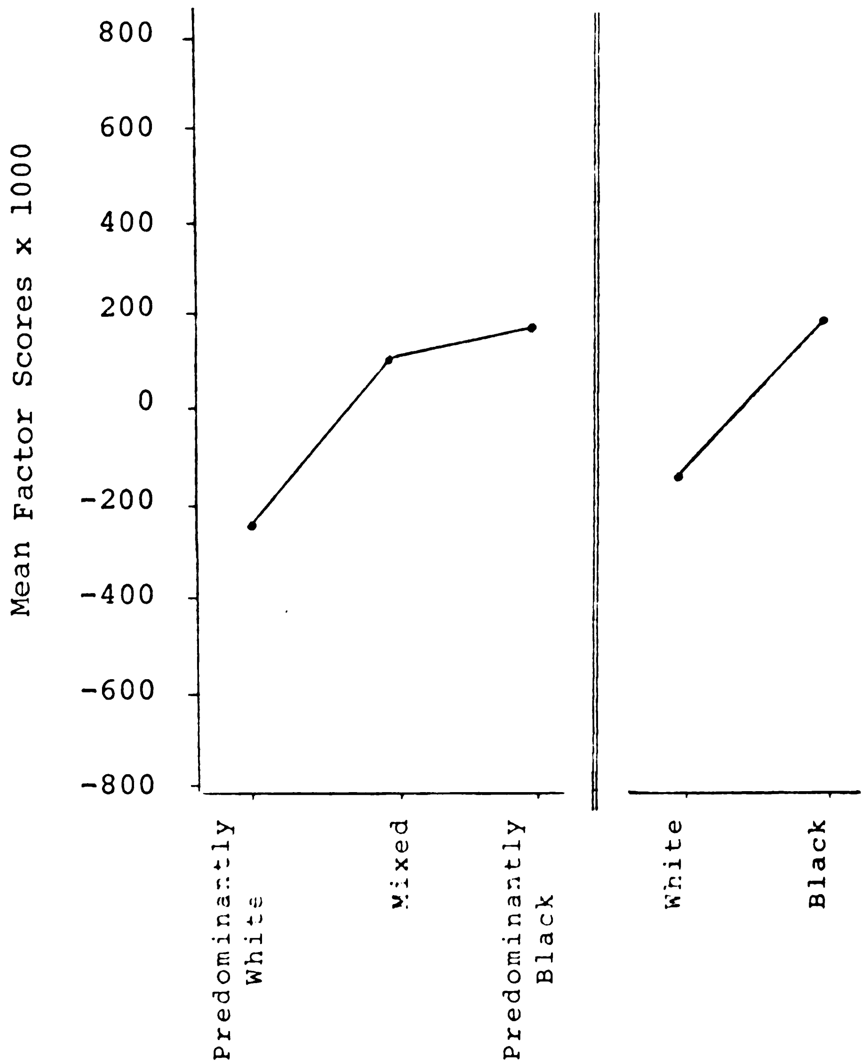
The school main effect is significant ($p<.01$). On post hoc analysis, it was found that the mean of factor scores increases significantly from the W-schools to the M-schools; further increment to the B-schools is not significant. The overall significant rise in the stated biology experiments activities from W-schools to B-schools is confirmed from the white versus black analysis design. The net results of the two analyses are represented in Graph 6a and Graph 6b. The sex main effect is significant ($p<.01$) in both the analyses, with the expressed participation of boys in these activities much higher than that of girls.

The significant ($p<.01$) interaction effect between school and sex in the school-sex analysis of variance is due to the sharp decrease in the mean of factor scores for boys from M-schools to B-schools, while that of the girls gradually increases between the same schools. The effect is graphed and shown in Graph 7.

Factor V (Drug Interest)

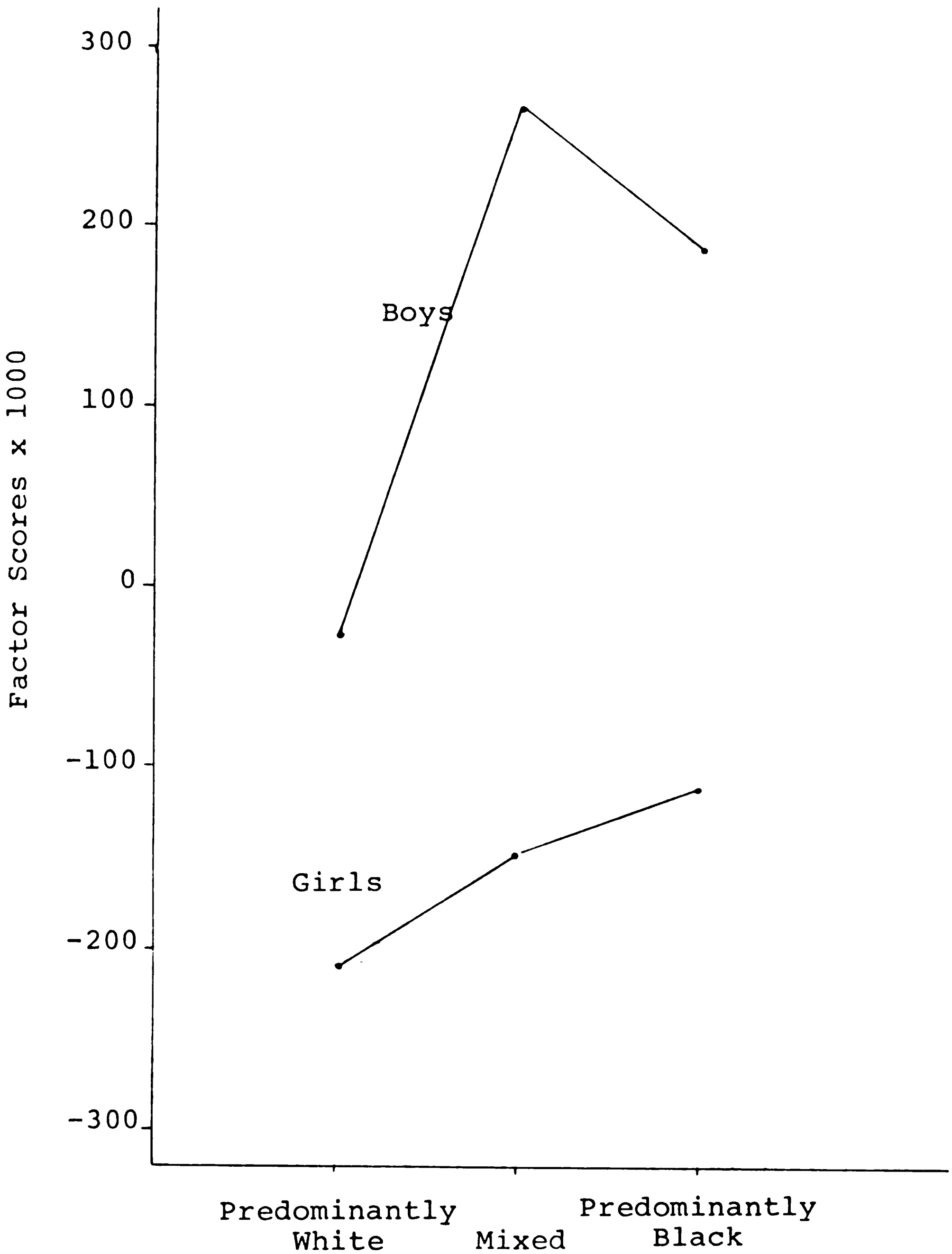
The means of factor scores for the school-sex MANOVA analysis are given on Figure 10. Also, similar data for race by sex MANOVA analysis are given on Figure 11.

The school main effect is significant ($p<.01$). The Scheffé post hoc contrast technique significantly discriminates the schools on this dimension. There is a significant decrease in the expressed interest on drug-related activities from W-schools all the way down to B-schools.



Graph 6a.--Plot of Mean Factor Scores by School Type for Biology Experiment Factor.

Graph 6b.--Plot of Mean Factor Scores by Race for Biology Experiment Factor.



Graph 7.--School-Sex Interaction Effect for Biology Experiment Factor.

	Predominantly White	Mixed	Predominantly Black
Boy	.533	.176	-.241
Girl	.163	-.239	-.509

**Significant, p<.01.

Figure 10.--Drug interest factor, results of school vs. sex MANOVA of factor scores for entire sample.

	White	Black
Boy	.480	-.190
Girl	.133	-.552

**Significant, p<.01.

Figure 11.--Drug interest factor, results of race vs. sex MANOVA of factor scores for entire sample.

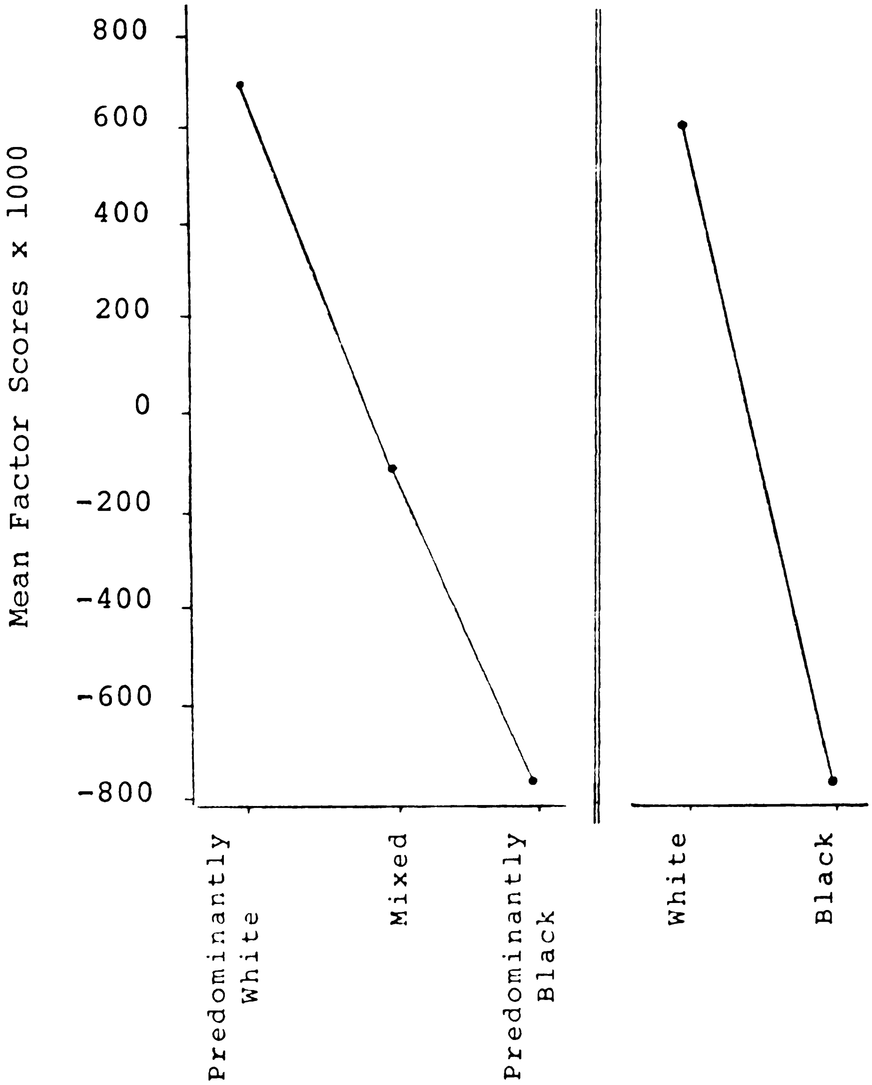
The results are in close agreement with the findings of the white versus black comparison. The net findings are represented on Graph 8a and Graph 8b. The sex main effect is also significant at the .01 level, with scores of boys higher than those of girls.

Factor VI (Cosmology Interest)

The means of factor scores for the cells in the school by sex and race by sex MANOVA analyses are given on Figures 12 and 13, respectively.

The school main effect on this factor is significant ($p<.01$). The Scheffé post hoc contrast technique reveals that the difference in the means of the factor scores on the expressed cosmology interest between W-schools and B-schools is significant at the .01 level, while the difference in the same data between M-schools and B-schools is not significant (Figure 12). The reported participation of white children in cosmology activities is significantly greater than that of the black pupils. The overall results are presented on Graph 9a and Graph 9b.

The sex main effect is significant ($p<.01$) in both the analyses; the scores of boys on this factor are significantly higher than those of girls. It seems, therefore, that the stated interest of boys in atomic and space subjects and activities is significantly higher than that of girls in the sample studied.



Graph 8a.--Plot of Mean Factor Scores by School Type for Drug Interest Factor.

Graph 8b.--Plot of Mean Factor Scores by Race for Drug Interest Factor.

	Predominantly White		Mixed		Predominantly Black
Boy	.297		.165		.228
**		**			
Girl	-.106		-.219		-.257

**Significant, p<.01.

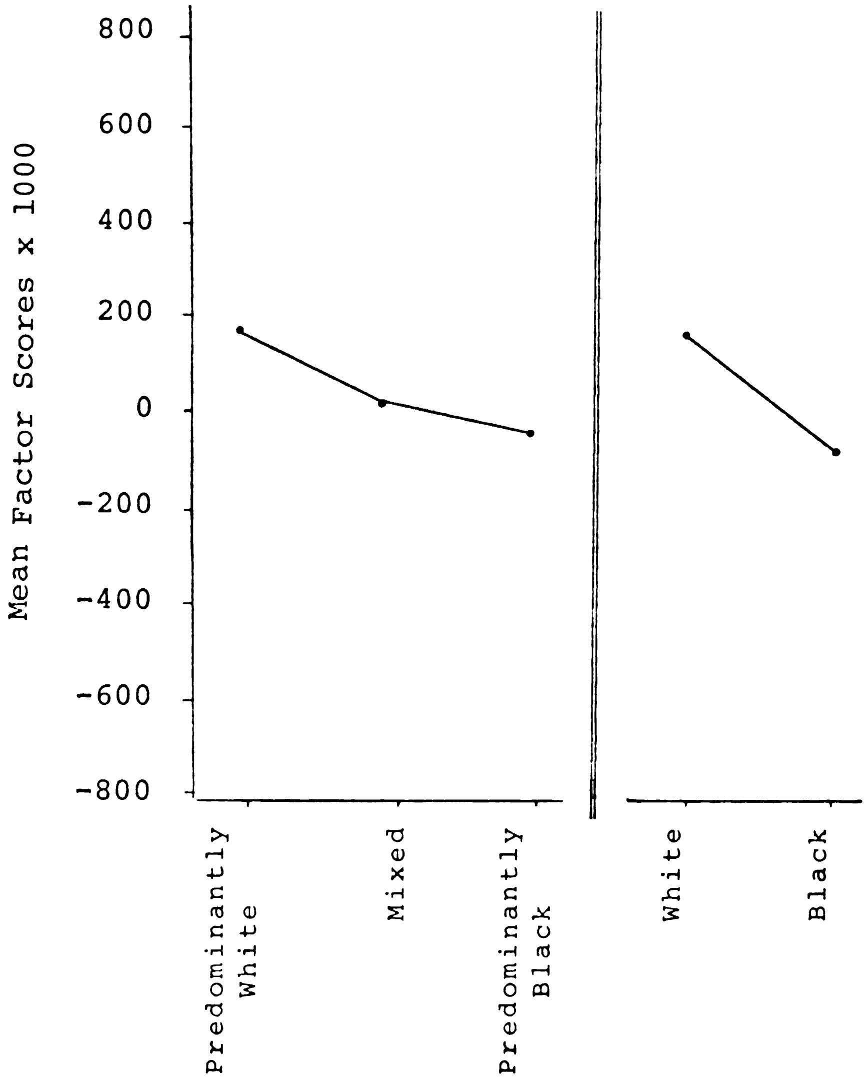
** (Predominantly White vs. Predominantly Black)

Figure 12.--Cosmology interest factor, results of school vs. sex MANOVA of factor scores for entire sample.

	White		Black
Boy	.270		.132
**		**	
Girl	-.095		-.297

**Significant, p<.01.

Figure 13.--Cosmology interest factor, results of race vs. sex MANOVA of factor scores for entire sample.



Graph 9a.--Plot of Mean Factor Scores by School Type for Cosmology Interest Factor.

Graph 9b.--Plot of Mean Factor Scores by Race for Cosmology Interest Factor.

Factor VII (General Collection Interest)

The cell means of factor scores for school vs. sex and race vs. sex MANOVA analyses are given on Figures 14 and 15, respectively.

The school, race, and sex main effects are not significant through the analyses. Also, the low mean scores indicate low interest on these activities in general.

Factor VIII (High Verbal Interest)

The means of factor scores for the cells in the school-sex and race-sex MANOVA analyses are presented on Figures 16 and 17, respectively.

The school as well as the race main effects are not significant in either analysis. The sex main effect is significant at the .05 level in the school by sex analysis and at the .01 level in the race by sex analysis. There is an overall lack of interest in this dimension, as can be seen from the low means. It seems, therefore, that although the overall interest on this dimension is low when compared to other factors, girls participate in activities like asking questions, discussing, explaining, etc. significantly more than do boys.

The interaction effect between race and sex is significant at the .01 level. Upon graphing the data (Graph 10), it is seen that while the reported interest of boys on this factor decreases from white to black samples of pupils, that of the girls increases, producing the interaction effect.

	Predominantly White	Mixed	Predominantly Black
Boy	.031	-.030	-.006
Girl	.056	-.023	-.006

Figure 14.--General collection interest factor, results of school vs. sex MANOVA of factor scores for entire sample.

	White	Black
Boy	.044	-.076
Girl	.013	-.007

Figure 15.--General collection interest factor, results of race vs. sex MANOVA of factor scores for entire sample.

	Predominantly White	Mixed	Predominantly Black
Boy	.062	-.102	-.078
*			
Girl	.040	.030	.057

*Significant, $p < .05$.

Figure 16.--High verbal interest factor, results of school vs. sex MANOVA of factor scores for entire sample.

#	White	Black
Boy	-.003	-.132
**		
Girl	.010	.090

*Significant, $p < .01$.
#Significant race by sex interaction effect, $p < .01$.

Figure 17.--High verbal interest factor, results of race vs. sex MANOVA of factor scores for entire sample.

Graph 10.--Race-Sex Interaction Effect for High Verbal Interest Factor.

Factor IX (Environmental Interest)

The cell means for this factor in the school-sex and race-sex MANOVA analyses are given on Figures 18 and 19, respectively.

The relative interest on this factor is shown by the relatively high means. The school effect is significant ($p<.01$). Post hoc analysis shows a significant difference in means at the .01 level between any two levels of schools, the means of factor scores being highest for W-schools and lowest for B-schools. Comparable results are obtained from the white versus black comparison. The overall picture is better represented on Graph 11a and Graph 11b. The sex main effect is not significant in either analysis, showing that the overall stated interest of boys and girls on environment and pollution control is about the same.

In the race-sex analysis, there is a significant interaction effect ($p<.01$). On graphing the data (Graph 12), it is seen that the expressed interest of girls on environment decreases faster than that of boys from white to black samples of pupils.

The Histogramic Representation of the MANOVA Results

Several sets of histograms have been drawn, taking the factors as independent variables and the MANOVA cell means of the factor scores as dependent variables. These histograms show visually the variation in the expressed participation of the activities in specific groups within the

	Predominantly White		Mixed		Predominantly Black
Boy	.141	**	-.072	**	-.128
Girl	.281		-.040		-.234
			**		

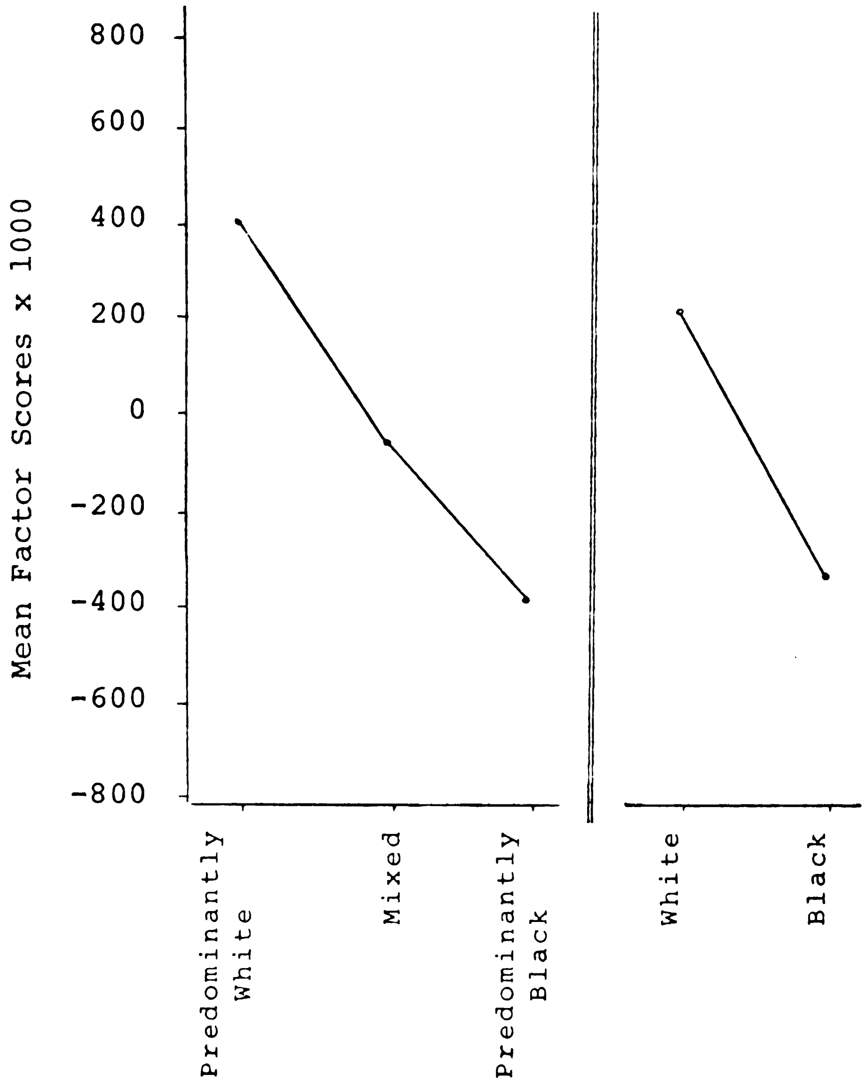
**Significant, p<.01.

Figure 18.--Environmental interest factor, results of school vs. sex MANOVA of factor scores for entire sample.

#	White		Black
Boy	.050	**	-.121
Girl	.186		-.185

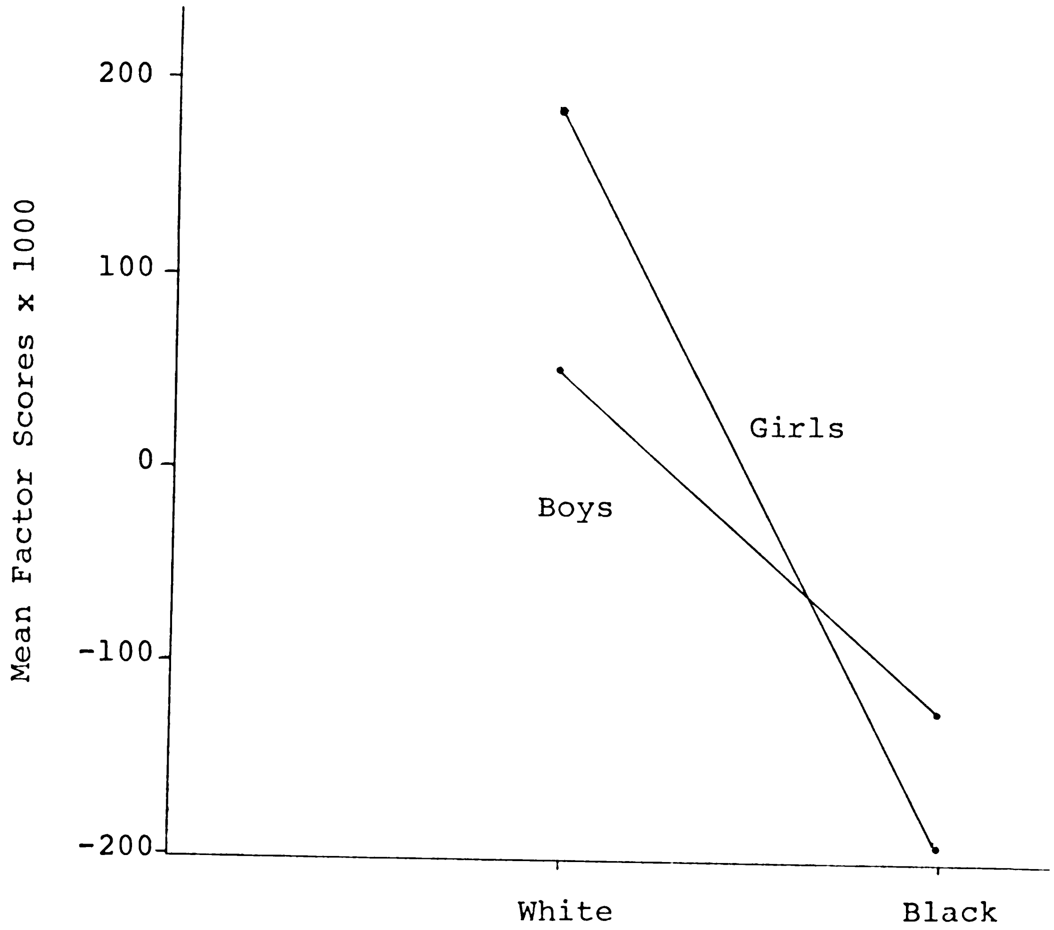
**Significant, p<.01.
#Significant race by sex interaction effect, p<.01.

Figure 19.--Environmental interest factor, results of race vs. sex MANOVA of factor scores for entire sample.



Graph 11a.--Plot of Mean Factor Scores by School Type for Environmental Interest Factor.

Graph 11b.--Plot of Mean Factor Scores by Race for Environmental Interest Factor.



Graph 12.--Race-Sex Interaction Effect for Environmental Interest Factor.

sample populations. The data have been described in the previous sections of this chapter. Significant differences ($p < .05$) between two groups show visually as a difference of 240 units or more on the vertical axis between the histogram points. Salient features of the histogram and an interpretation of relationships between two or more histograms are included in the discussion that follows.

<u>Graphs 13-17</u>

Graph 13: W-school vs. M-school vs. B-school

Graph 14: Whites vs. Blacks

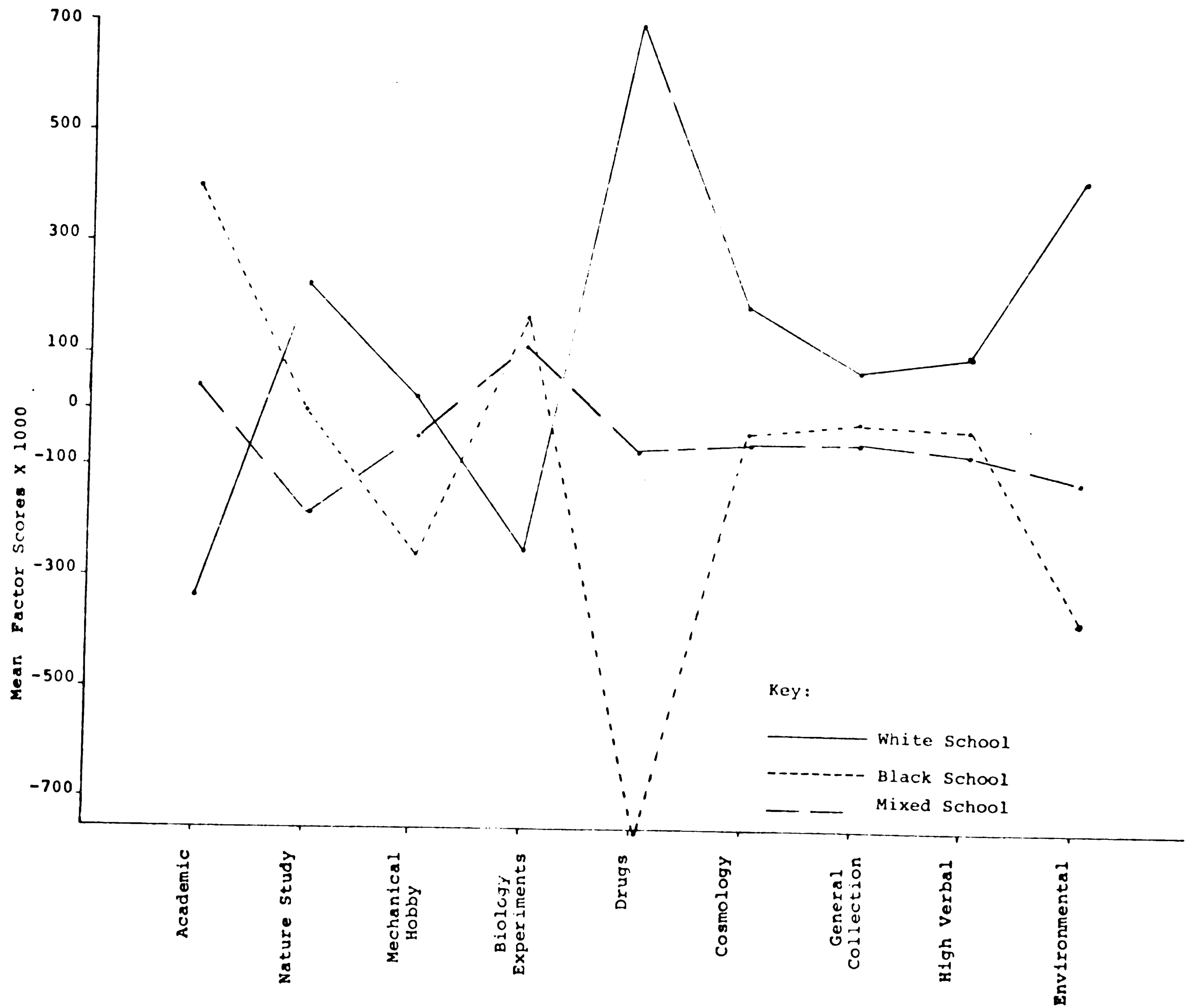
Graph 15: Whites in Mixed schools vs. Blacks in Mixed schools

Graph 16: Whites in Mixed schools vs. W-schools

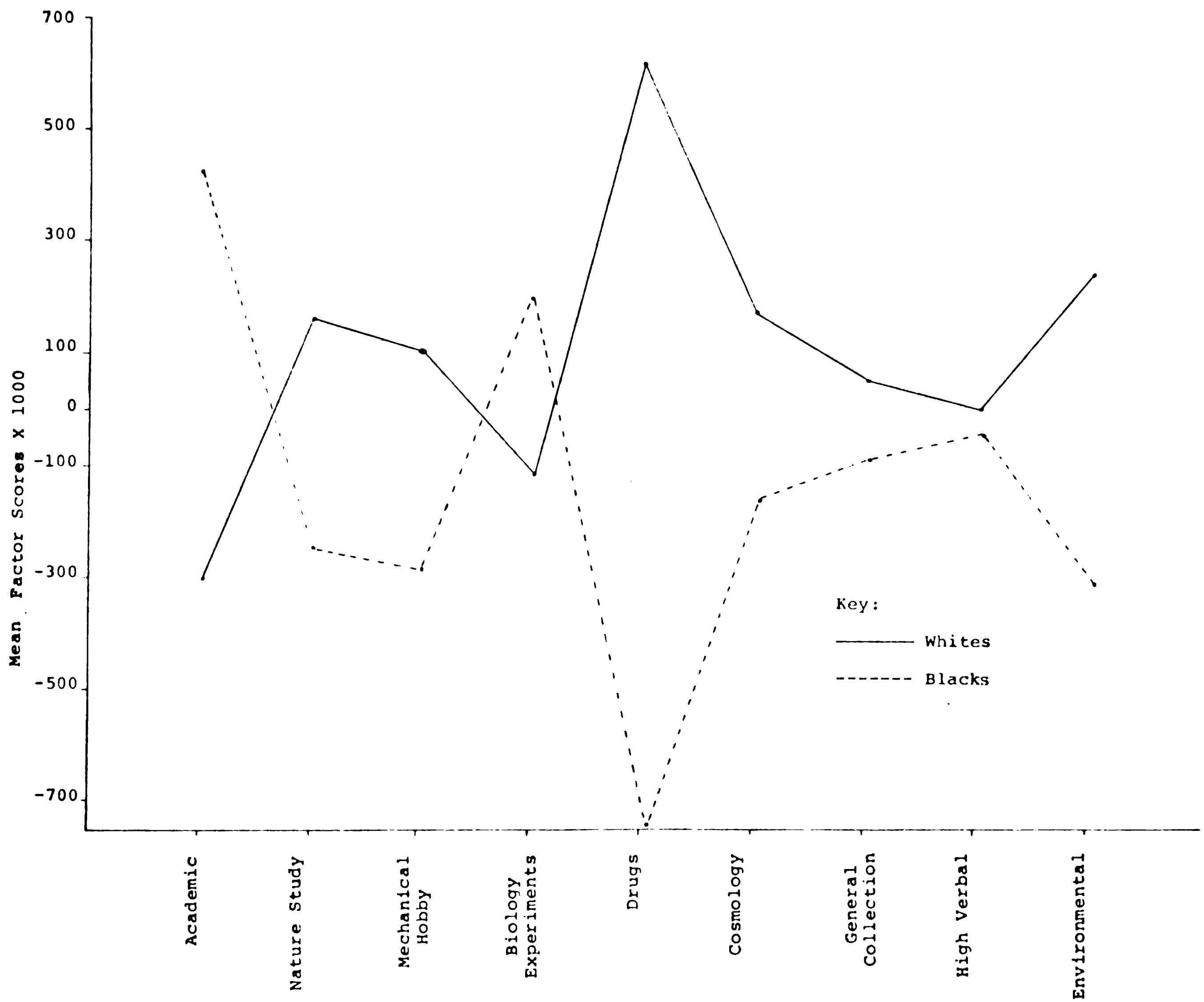
Graph 17: Blacks in Mixed schools vs. B-schools

Graph 13 contains three separate histograms, one for each of the three categories of schools. Graph 14 contains histograms generated for all white and black students in the study taken separately. The histograms for the school compositions and for racial differences appear to be virtually the same. White students in W-schools are significantly higher on Nature Study, Mechanical Hobby, Drugs, Cosmology, and Environmental factors. Black students in B-schools are significantly higher on Academic and Biology Experiments factors. These findings are also shown in Table 16.

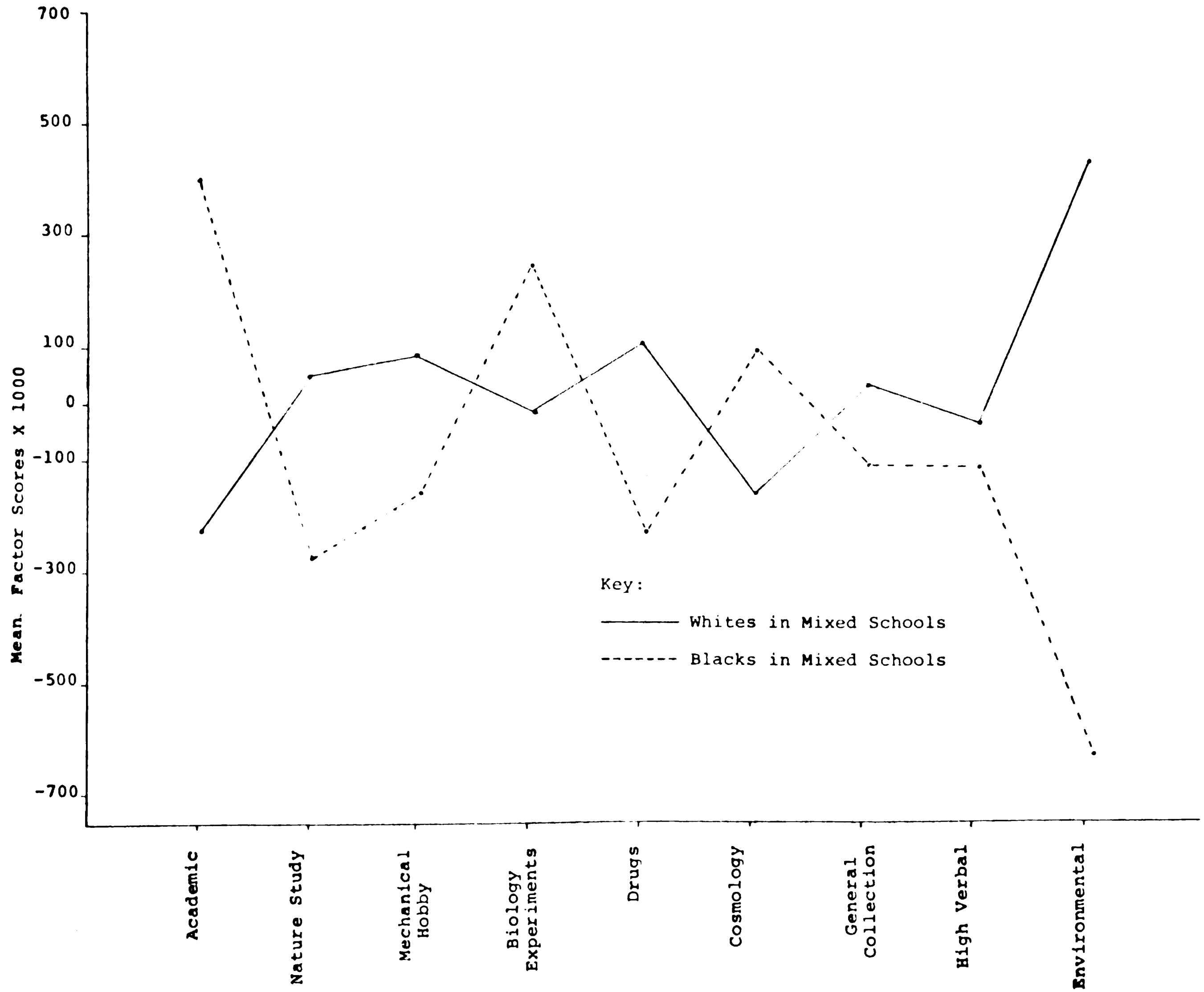
It is interesting to observe from Graph 13 that while the histograms for the W-schools and B-schools are



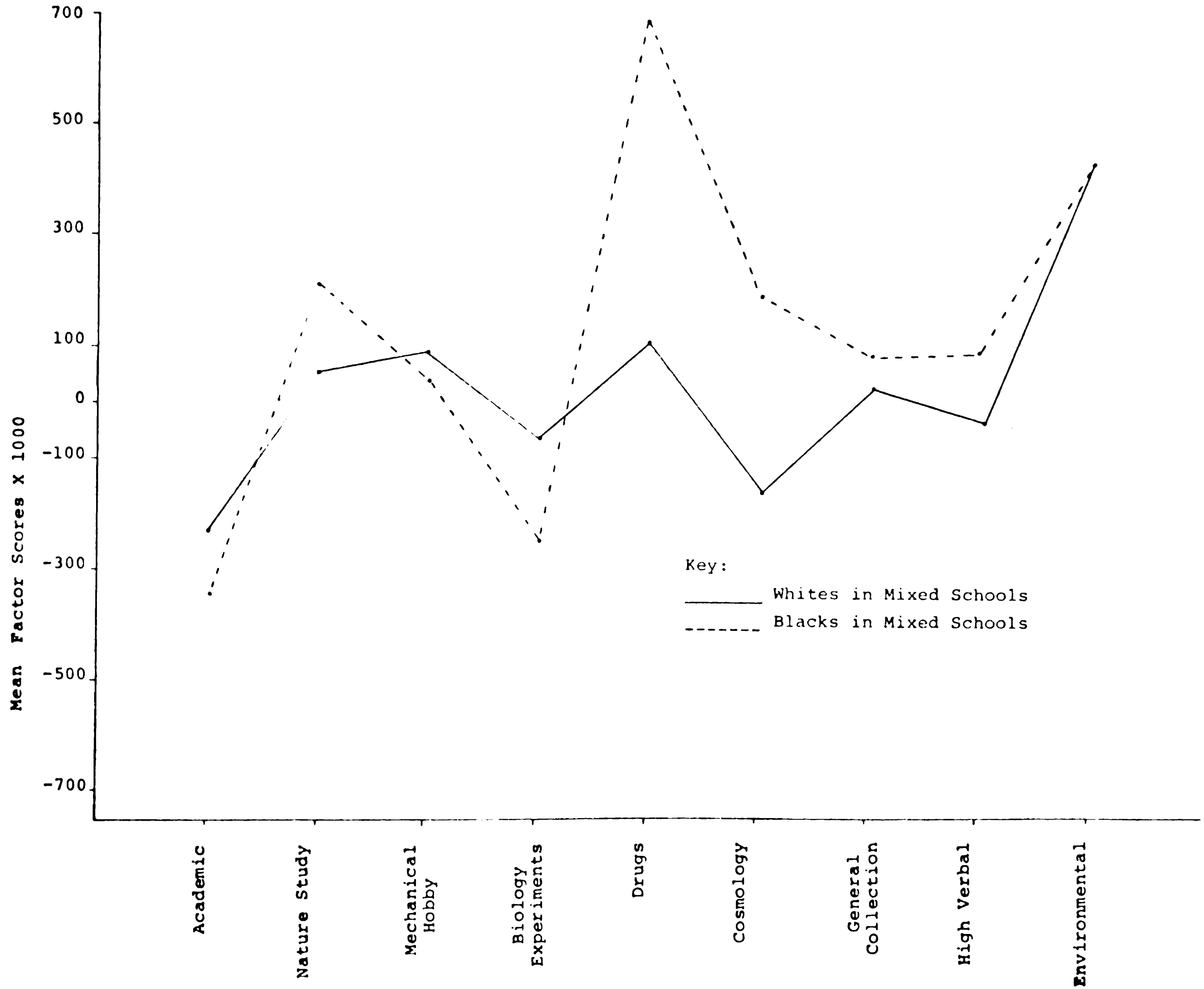
Graph 13.--Comparison of the Science Interests of W-Schools, M-Schools, and B-Schools.



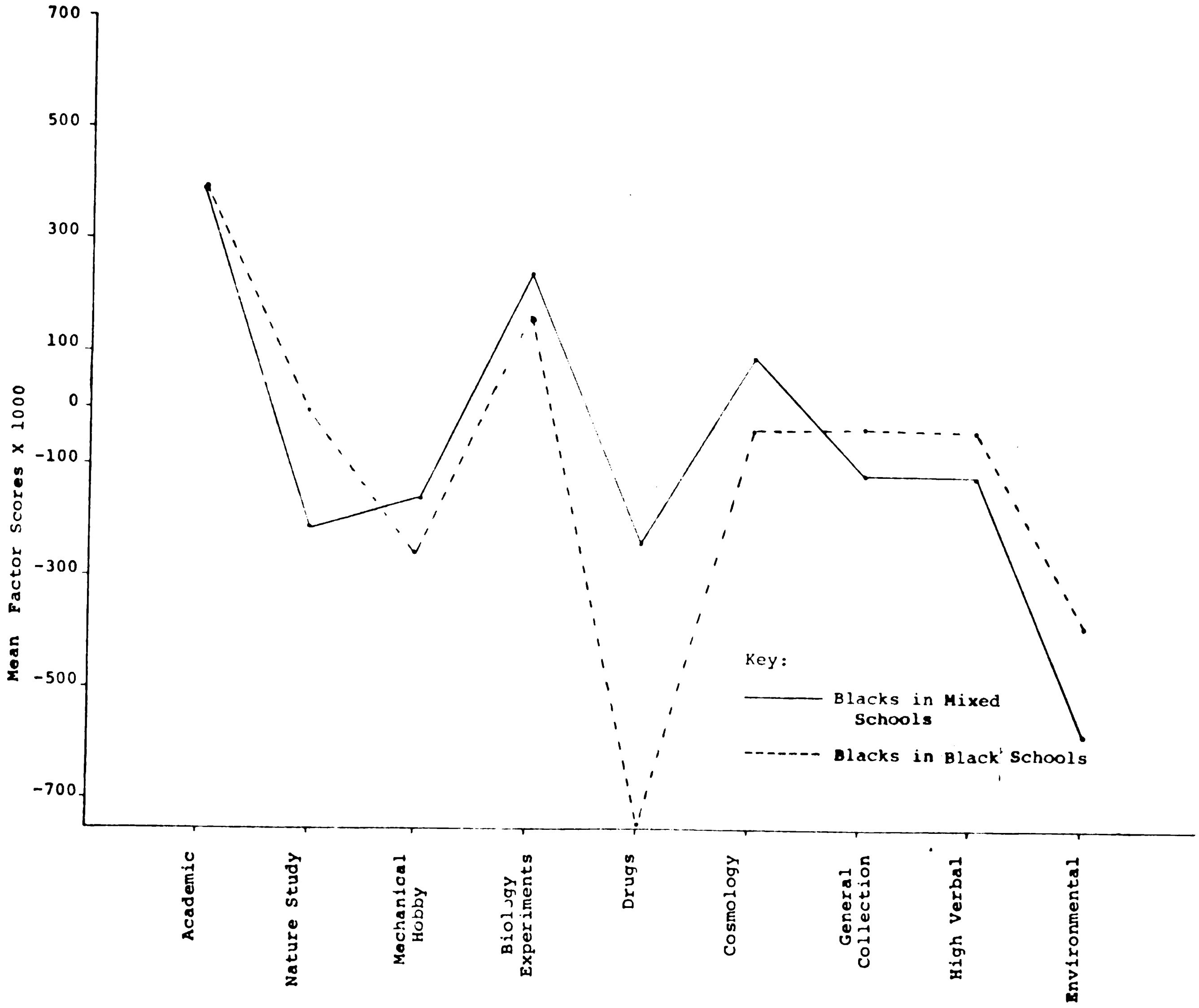
Graph 14.--Comparison of the Science Interests of Whites and Blacks.



Graph 15.--Comparison of the Science Interests of Blacks and Whites from M-Schools.



Graph 16.--Comparison of the Science Interests of Whites in M-Schools and W-Schools.



Graph 17.--Comparison of the Science Interests of Blacks in M-Schools and B-Schools.

Table 16.--Visual representation of significant factors for schools and race.

		Academic	Nature Study	Mech. Hobbies	Biology Exp.	Drugs	Cosmology	Collection	High Verbal	Environment
W-schools and Whites	are significantly higher in:		x	x		x	x			x
B-schools and Blacks	are significantly higher in:	x			x					

confined generally to the upper and lower parts of the graph, that for M-schools lies between them. In five of the seven significant factors for the schools main effect, the histogram point for the M-schools falls between the points for the other two types of schools. The points fall very near one of the other schools in those cases where factors are not significant.

In order to study the factors which might contribute to the nature of this histogram, Graph 15 was drawn, which contains separated histograms for the black and white students from the M-schools. From this graph it is observed that the histograms for the whites and the blacks have the same pattern as of those for predominantly W-schools and

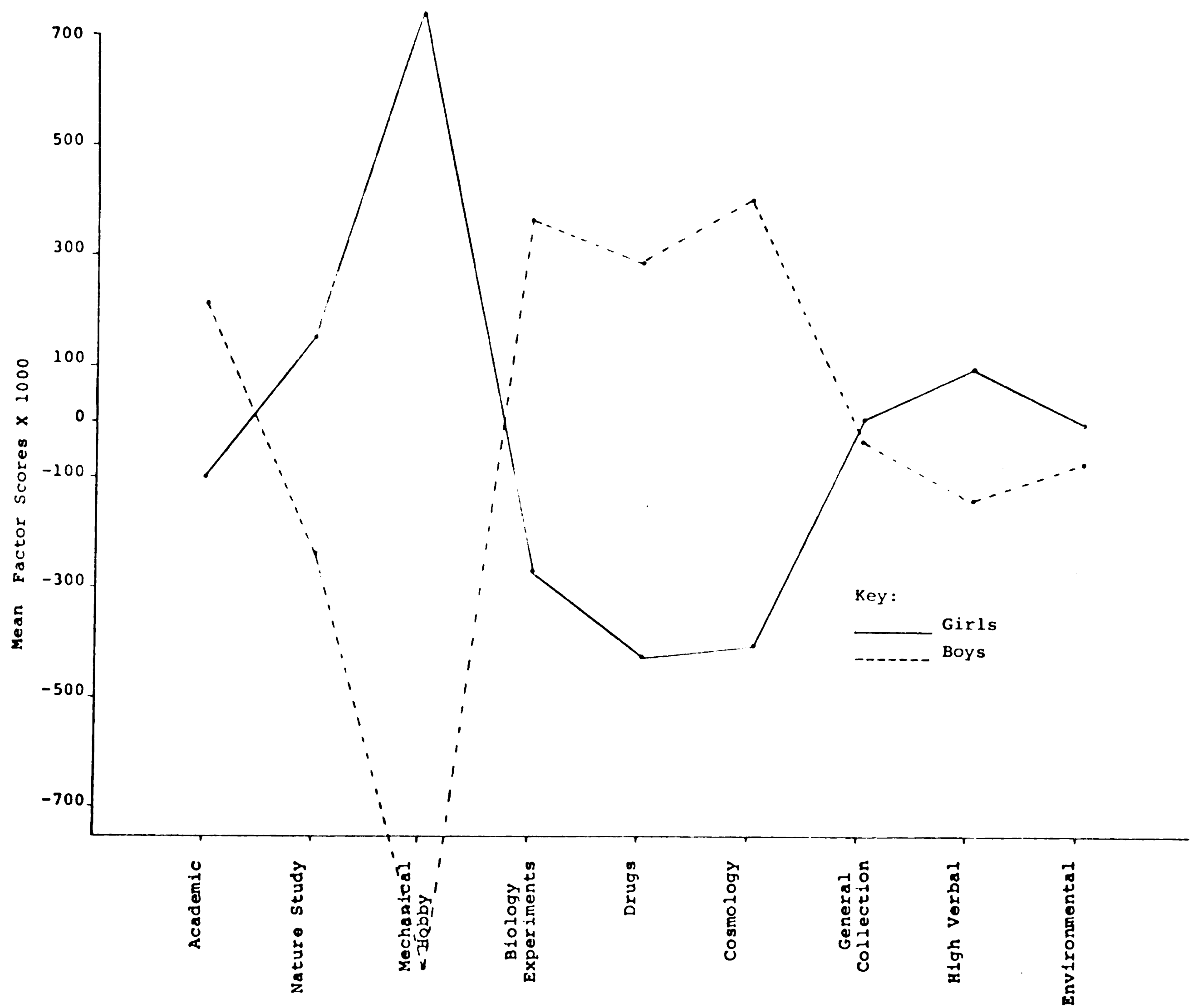
B-schools, respectively, except that the positions are reversed for the Cosmology factor.

The histograms of whites and blacks from M-schools may also be compared with those for W-schools and B-schools, respectively (Graphs 16 and 17) to see if there are major shifts in the degree of expressed interest by students in the several factors. It is found that there is considerable shift for both blacks and whites for the Drug factor and only for the whites in the Cosmology factor. This difference was significant for the whites in both the factors. For the blacks the difference was significant only for the Drug factor.

In other factors, the shift is not appreciable and the intermediateness of the histogram points for the M-schools is apparently produced by an averaging effect of the scores of students by race. At least the scores appear to be similar to those in schools with large racial populations.

Graph 18

This graph includes two histograms, one each for boys and girls. The boys are significantly higher on Academic, Biology Experiment, Drugs, and Cosmology factors, while the girls are higher on Nature Study, Mechanical Hobby, and High Verbal factors. These findings are also shown in Table 17.



Graph 18.--Comparison of the Science Interests of Boys and Girls.

Table 17.--Visual representation of significant factors for sex.

	Academic	Nature Study	Mech. Hobbies	Biology Exp.	Drugs	Cosmology	Collection	High Verbal	Environment
Boys are significantly higher in:	x			x	x	x			
Girls are significantly higher in:		x	x					x	

Graphs 19, 20, 21, and 22

These graphs contain a series of pairs of histograms showing variation due to sex. All the following combinations are shown:

Graph 19: White boy vs. white girl

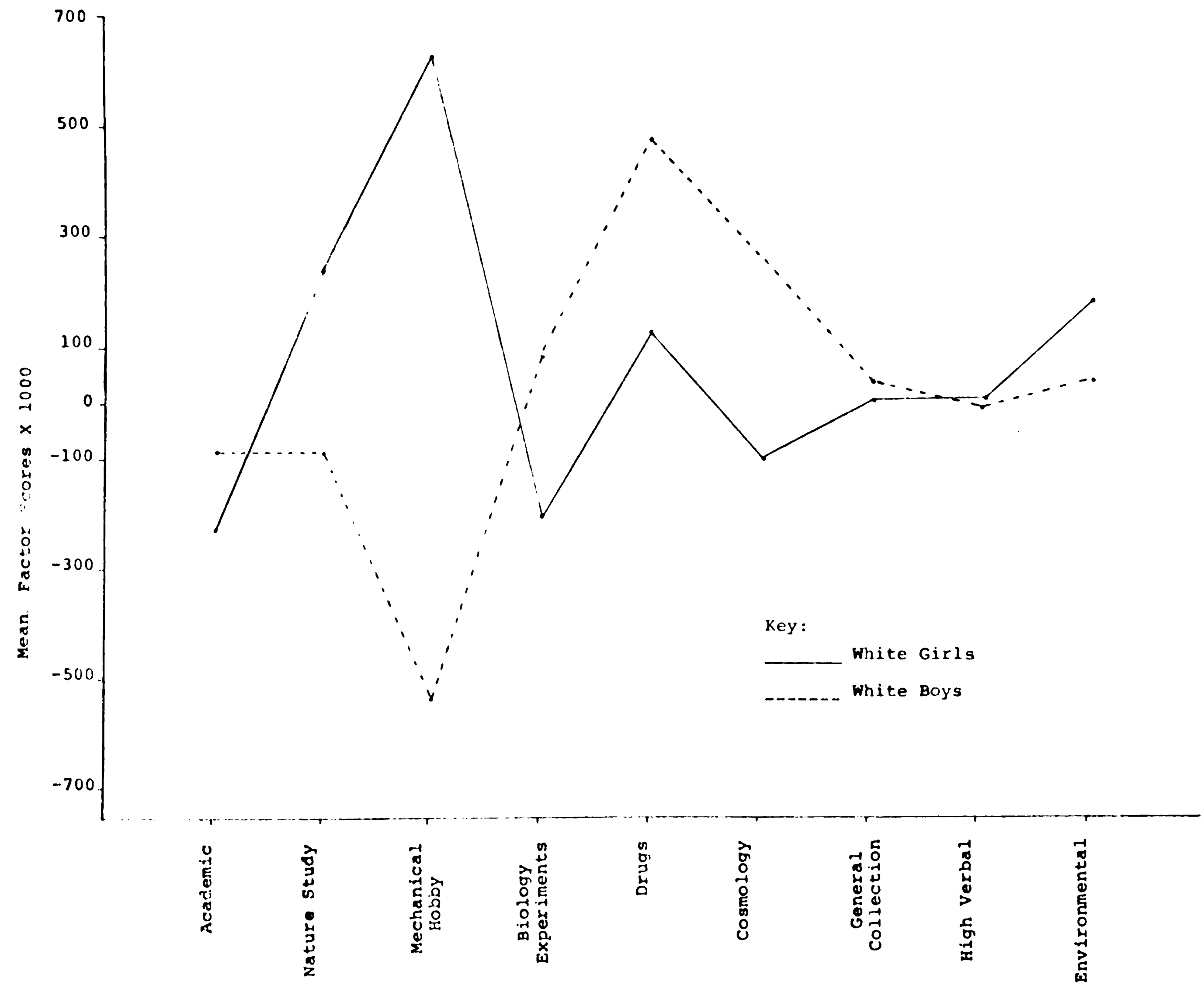
Graph 20: Black boy vs. black girl

Graph 21: Black boy vs. white boy

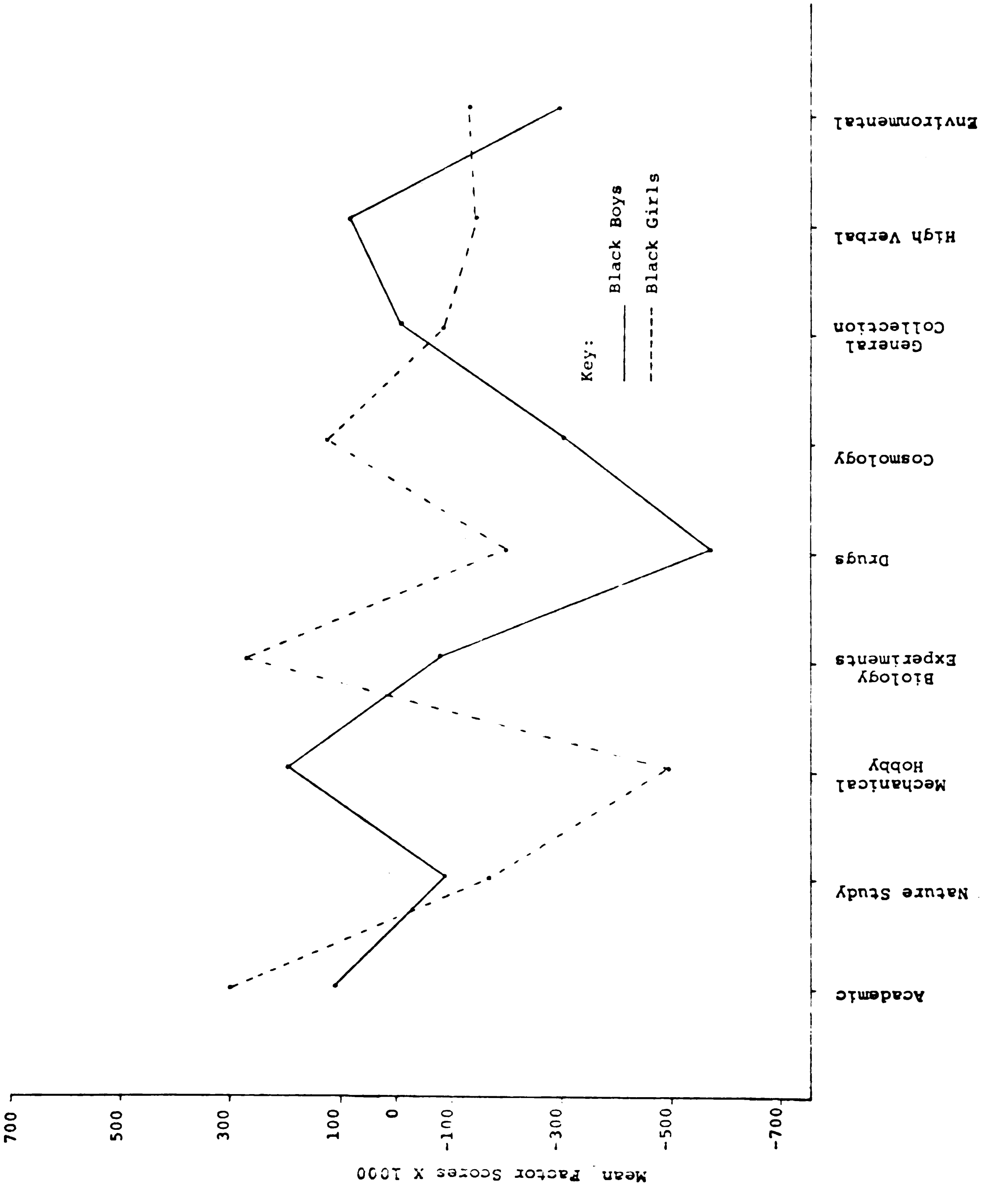
Graph 22: Black girl vs. white girl

The histograms for the white boys and girls run parallel to each other in some places. Four factors show significant differences. Boys are significantly higher in Biological Experiments, Drugs, and Cosmology, while the girls are significantly higher on Mechanical Hobby Interest.

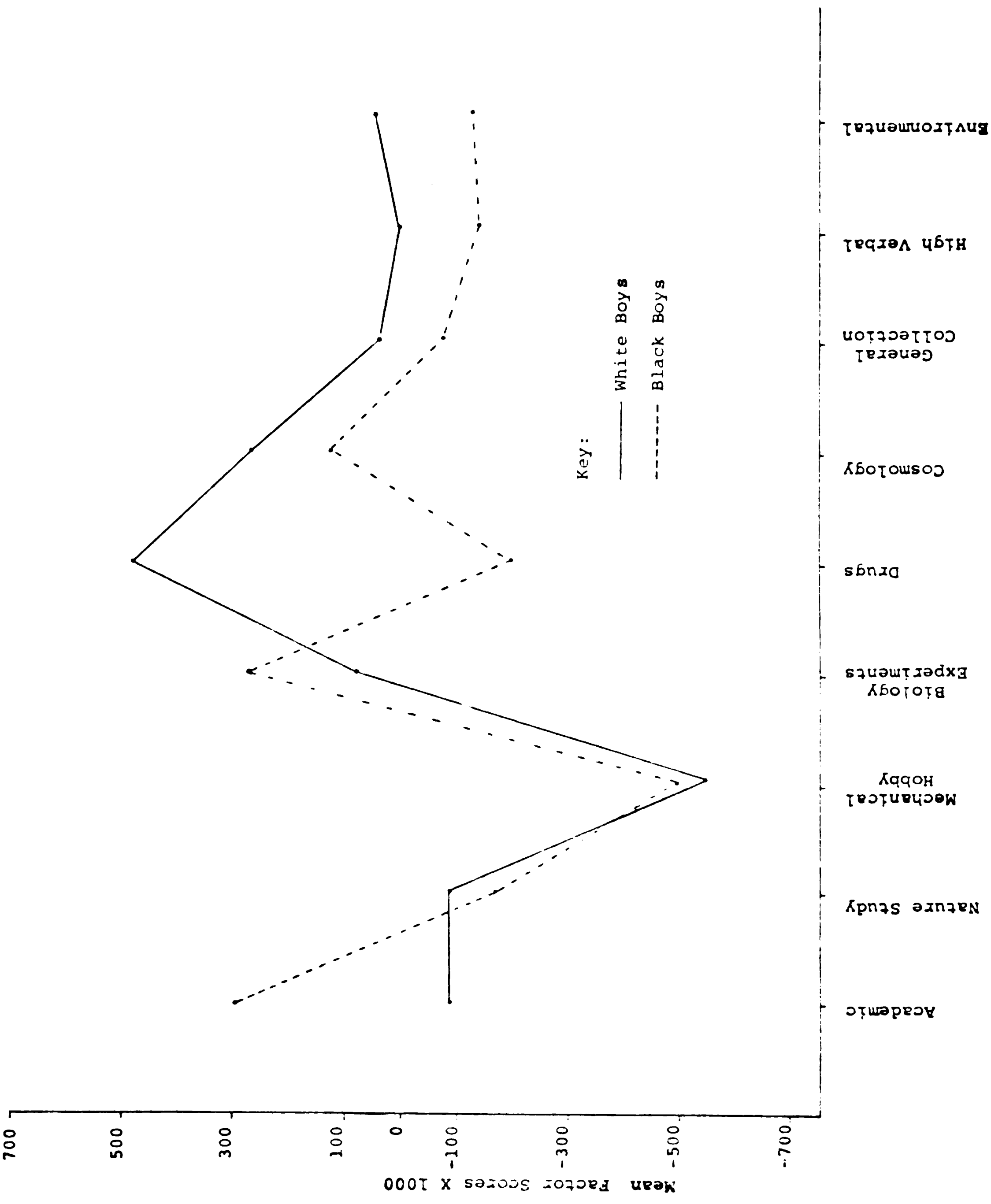
The histograms of black boys and girls cross each other in four places. Five factors show significant differences, and except for the High Verbal factor, these are the



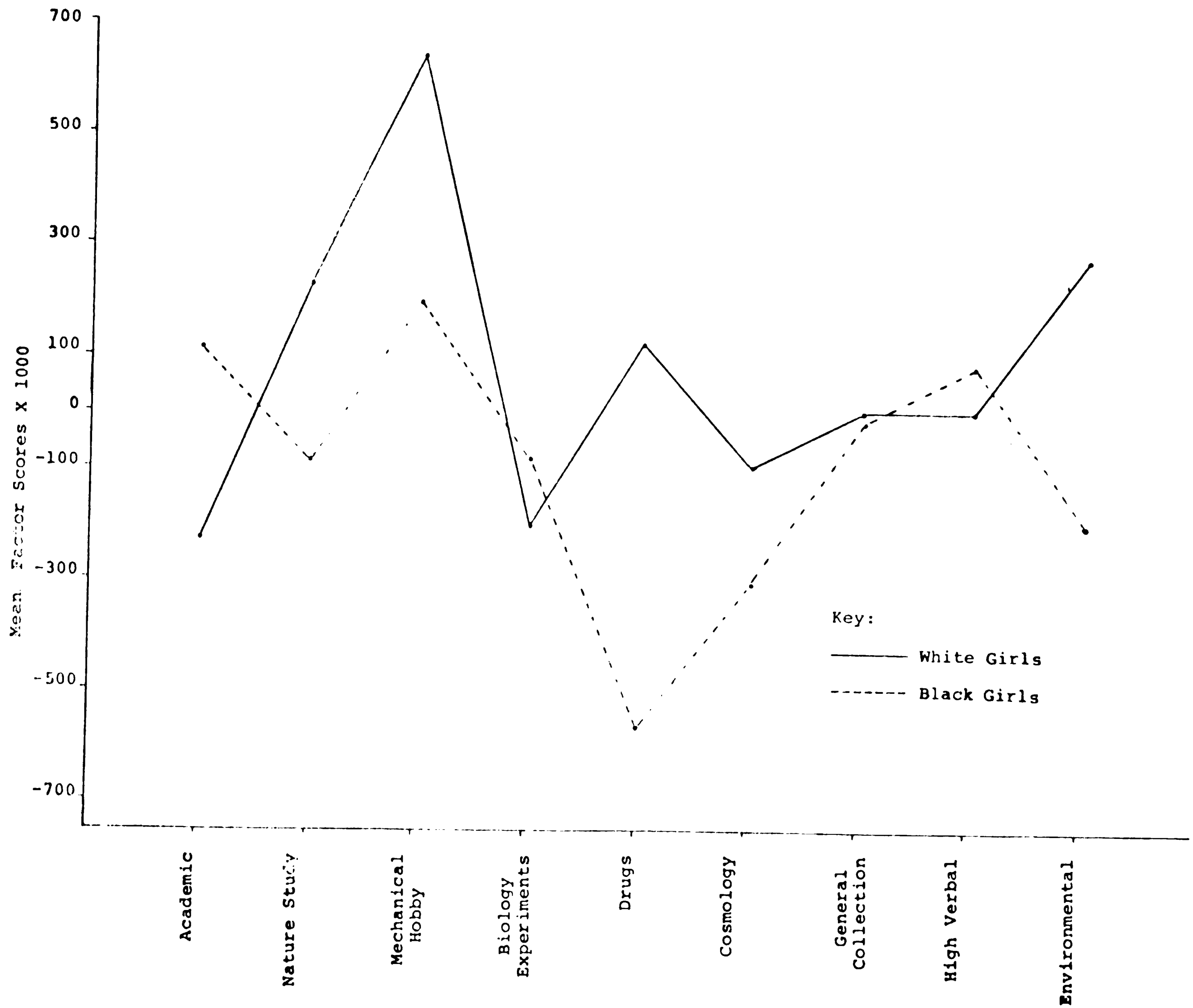
Graph 19.--Comparison of the Science Interests of White Boys and Girls.



Graph 20.--Comparison of the Science Interests of Black Boys and Girls.



Graph 21.--Comparison of the Science Interests of Black and White Boys.



Graph 22.--Comparison of the Science Interests of Black and White Girls.

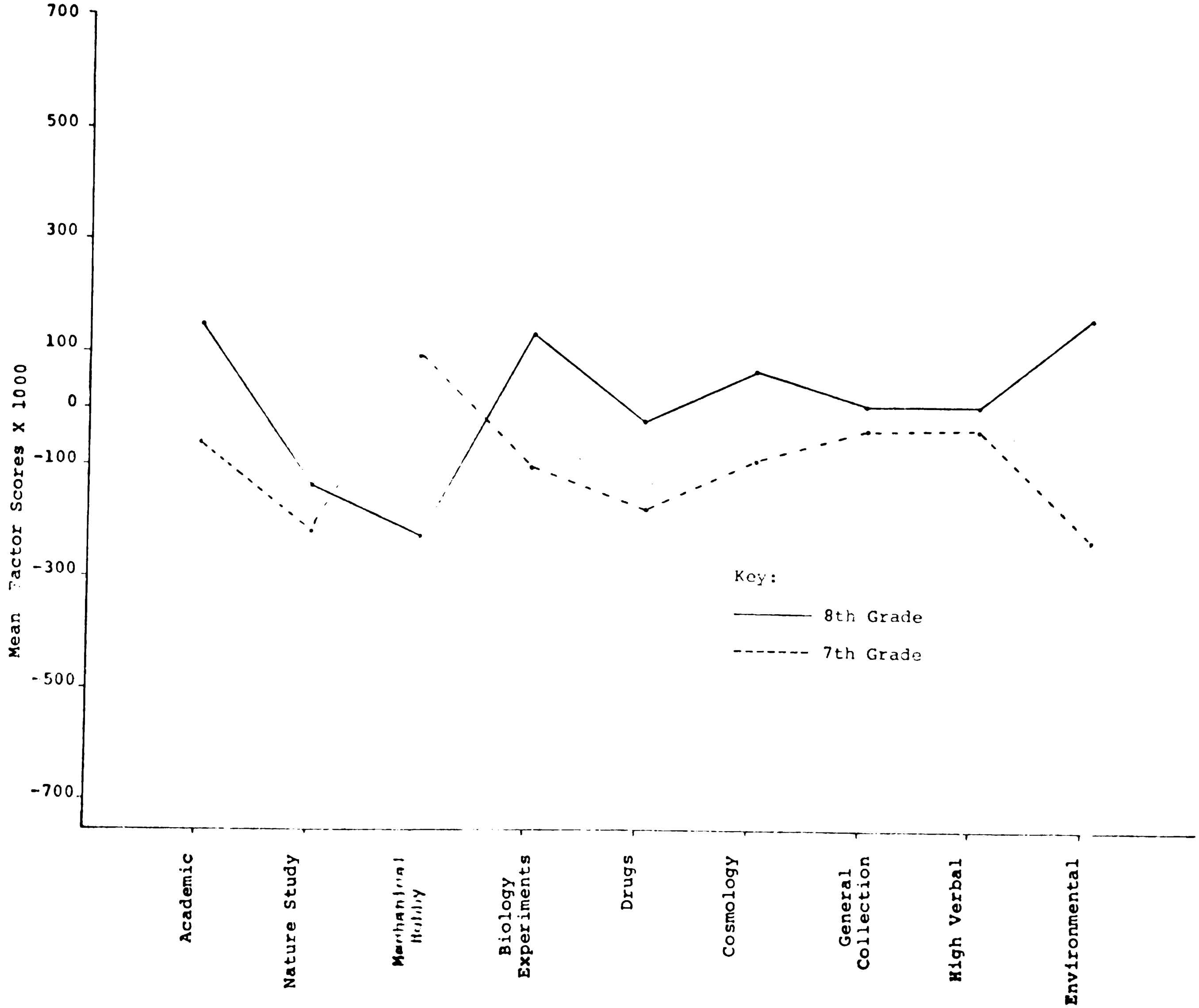
same as the four significantly different factors between white boys and girls. The pattern of relationships among these four factors of interest is the same for black boys and girls as for white boys and girls. The black girls are significantly higher on High Verbal factor. The fact remains, however, that the means of the factors for the black students for the most part are lower than those of the corresponding sex in the white sample.

The histograms of black and white boys run parallel to each other in most places, although the means for the black boys are below those of white boys in most places. Only two factors are significantly different between them. Black boys are higher on Academic Interest activities, while the white boys are significantly higher on Drug interests.

The histograms of black and white girls cross each other in five places. The differences in science interest activities seem to be most pronounced between girls. Five factors are significantly different between them. The expressed participation of white girls on Nature Study, Mechanical Hobby, Drugs, and Environmental activities is significantly higher than that of the black girls, while the black girls are significantly higher on Academic interests.

Graph 23

This graph includes the histograms for seventh and eighth grades. The histograms are parallel to each other for the most part. Eighth grade children are significantly



Graph 23.--Comparison of the Science Interests of Seventh and Eighth Grade Students.

higher on Environmental factor and may be on Biology Experiments, while the seventh graders are higher on Mechanical Hobby Interests.

Summary

In this chapter the findings of the study have been presented. Nine distinct factors of voluntary science activities with high reliability have been identified in the population of differential racial composition. The factors have been described one by one, and the factorial loadings for the individual items presented. Results of the discrimination of the factors among predominantly white, mixed, and predominantly black schools; between blacks and whites; and between boys and girls have been presented. The process has been accomplished by subjecting the factor scores generated for individuals during factor analysis to a MANOVA technique. The variation in the expressed participation of specific groups within the sample population has been further studied by constructing eleven histograms using the cell means of factor scores as dependent variables and the factors themselves as independent variables.

CHAPTER V

SUMMARY, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS FOR FURTHER RESEARCH

The undirected, voluntary science activities of children in their out-of-school environment have potential for supplements and complements to school science programs. If these are accurately known and incorporated into the curriculum, science teaching in schools, perhaps, becomes more purposeful, relevant, and consonant with the needs and aptitudes of the children. An examination of several studies related to the areas and degree of interest showed that although differences between boys and girls have slowly narrowed down as time generally has passed, they still have specific interests associated with sex. Therefore, in the public school setting, boys and girls are still two distinct groups with specific interests in topics and activities related to science.

The Reed study in 1959 confirmed the differences in the responses of boys and girls to a list of science activities. His study related these activities to certain teacher personality variables, and opened a whole new field of research. Factor analysis of some responses from the study by Cooley obtained six independent clusters of activities. Subsequently, the results of the Reed-Cooley study were confirmed. Thus the presence of dimensions of voluntary science activities of children have been established. These dimensions of interest have been related to certain student and teacher variables primarily by the members of the Project Physics team. These types of studies need to be updated, since the dimensions and the degree of interest in them might change with time for similar populations of students.

A survey of literature showed that there is a dearth of published studies on the science interest of minority groups, specifically the blacks. In a multiracial society, the dimensions of voluntary science activities of boys and girls in a population of differential racial distribution need to be identified and the degree of interest on these dimensions compared in order to provide the common as well as particular interests of the children. Such a study is long overdue. Hence, the two major objectives of this study were: (1) to identify the dimensions of voluntary, undirected science activities of the off-school setting among boys and girls in grades seven and eight from schools with differential racial composition, based on their reported participation during school year 1971-1972 in a list of general science activities that normally could be expected of them; and (2) to determine if the degree of participation in activities around a particular dimension of interest varied among samples of students from predominantly white, mixed, and predominantly black schools, or more specifically, between boys and girls from black and white races.

The study task, therefore, involved the development of a suitable instrument, the selection of a sample of children and administration of the instrument to them, and appropriate analysis of the data.

In order to construct a suitable instrument of sufficient reliability, an initial list of 98 items was arrived at by taking ideas from several sources, especially from the Reed Inventory. This list was reduced and reorganized to arrive at a final list of 70 items that formed the instrument used in the study, according to the suggestions and evaluation of a panel of judges and the information obtained by pilot testing.

The process of selecting the sample for the administration of the instrument involved the identification of school districts that contained 20 per cent or more black children. All the individual school buildings in these school districts that contained seventh or eighth grades or both were identified and stratified into predominantly white, mixed, and predominantly black categories of schools, based on their racial compositions. The Inventory was administered by the science teachers in 17 school buildings in seven school districts; 2,711 seventh and eighth grade children adequately completed it.

A comparative study of the 17 schools participating in the study on 12 chosen variables including racial composition, geographic location, and socio-economic status revealed that the schools were generally homogeneous in terms of the other nine variables.

Determination of the reliability coefficient according to Hoyt's technique yielded values between .9550 and .9553, which indicated internal consistency of the items, and consistency of each pupil's responses.

The responses of the 2,711 subjects were coded on IBM cards and subjected to a principal component analysis of the intercorrelation matrix, followed by varimax rotation using standard procedures. A nine factor solution was accepted as the most appropriate, and the Hoyt reliability coefficient was determined for each factor. Factor scores were generated for each individual and used as dependent variables in the testing of main effects for schools, race, and sex, using the Finn MANOVA technique. From the low intercorrelation matrix of the factors, it was established that the factors were independent of each other.

Several histograms were drawn, taking the factors as independent variables and the cell means of factor scores as dependent variables to study visually the variation in the expressed participation in activities around the factors in specific groups within the sample.

The findings of the study can be itemized as follows:

1. Nine distinct independent clusters of voluntary science activities were identified in the sample population. They may be labeled as Academic, Nature Study, Mechanical

Hobby, Biology Experiment, Drugs, Cosmology, General Collection, High Verbal, and Environmental factors.

2. In the sample, children from predominantly white schools have expressed significantly higher participation in activities involving Nature Study, Drugs, Cosmology, and Environmental factors than children in mixed schools, and significantly greater expressed involvement in activities centered around Nature Study, Mechanical Hobby, Drugs, Cosmology, and Environmental factors than children in predominantly black schools.

3. In the sample, children from mixed schools are significantly higher in their expressed interest in activities involving Academic and Biology Experiment factors than children from predominantly white schools and significantly higher on Mechanical Hobby, Drugs, and Environmental factors than children from predominantly black schools.

4. Children from predominantly black schools expressed significantly higher participation in activities involving Academic and Biology Experiment factors than children from predominantly white schools and significantly higher involvement in Academic and Nature Study factors than children in mixed schools.

5. Black children in the sample expressed significantly higher participation in activities involving Academic and Biology Experiment factors than white children.

6. White students expressed significantly higher participation in activities centered around Nature Study,

Mechanical Hobby, Drugs, Cosmology, and Environmental factors than black children.

7. Boys in the sample expressed significantly higher interest in activities involving Academic, Biology Experiment, Drugs, and Cosmology factors than girls.

8. Girls in the sample are significantly higher on their expressed participation in activities centered around Nature Study, Mechanical Hobby, and High Verbal factors than boys.

9. White boys in the sample expressed significantly greater participation in activities involving Biology Experiment, Drugs, and Cosmology factors than white girls.

10. White girls reported significantly greater participation in activities involving Mechanical Hobby factor than white boys.

11. Black boys in the sample reported significantly greater participation in activities involving Biology Experiment, Drugs, and Cosmology factors than black girls.

12. Black girls in the sample expressed significantly greater participation in activities involving Mechanical Hobby and High Verbal factors than black boys.

13. White boys in the sample expressed significantly greater participation in activities involving Drugs factor than black boys.

14. Black boys in the sample expressed significantly greater participation in activities centered around Academic factor than white boys.

15. White girls in the sample expressed significantly higher participation in activities involving Nature Study, Mechanical Hobby, Drugs, and Environmental factors than black girls.

16. Black girls in the sample expressed significantly higher participation in activities involving Academic factor than white girls.

17. White children from the mixed school sample expressed significantly greater participation in activities centered around Nature Study, Mechanical Hobby, Drugs, and Environmental factors than black children from the same sample.

18. Black children from the mixed school sample expressed significantly greater participation in activities involving Academic, Biology Experiment, and Cosmology factors than white children from the same sample.

19. Eighth grade children in the sample expressed significantly greater participation in activities involving Environmental and perhaps Biology Experiment factors than seventh grade children.

20. Seventh grade children in the sample expressed significantly more participation in Mechanical Hobby activities than eighth grade children.

21. The expressed participation of girls in activities involving Nature Study factor decreased from predominantly white school through mixed school to predominantly black school, while that of the boys decreased from

predominantly white school to mixed school, but increased from the mixed school to the predominantly black school.

22. The expressed participation of girls in activities centered around Nature Study factor decreased faster than that of the boys from white to black samples.

23. The expressed participation in Mechanical Hobby activities of girls decreased from predominantly white school through mixed school to predominantly black school; however, that of the boys <u>increased</u> from predominantly white school to mixed school and then decreased to the predominantly black school.

24. The expressed interest of boys in Mechanical Hobby activities increased, but that of the girls decreased from white to black samples.

25. The expressed participation of girls in activities centered around the Biology Experiment factor increased from predominantly white school through mixed school to predominantly black school; however, that of the boys increased from predominantly white school to mixed school and then decreased to the predominantly black school.

26. The expressed participation of girls in activities centered around the High Verbal factor increased, but that of the boys decreased from white to black samples.

27. The expressed participation in Environmental activities of girls decreased faster than that of boys from white to black samples.

The significant findings can be summarized as shown in Table 18.

Conclusions and Implications

Sufficient stability in interest is a requirement if interest is to form one of the bases for curriculum. In this study, as in some previous studies, one is able to conclude that there is a certain stability and permanency in the interest factors. For example, Academic, Nature Study, Mechanical Hobby, Cosmology, and High Verbal factors were also identified in the earlier Reed-Cooley and the Walberg studies. It appears that interest in certain factors and activities related to science has persisted among children regardless of time, grade, sex, or race. Boys and girls have been and remain interested in nature exploration; tinkering with appliances; extra science reading, writing, and reporting; working with chemical and biological specimens; and so on. These types of activities seem to form the basic and primary interests of all children, and should be sufficiently imbedded into the curriculum to form its core and foundation. On the other hand, interest in drugs and recycling is of recent origin. These are secondary interest activities and change with time, place, and persons. The curriculum needs to be constantly revised in order to adjust to the degree and nature of changes in the secondary interests of specific groups for whom it is prepared.

Table 18.--Summary of significant differences, arranged by decreasing means of factor scores.

	Academic	Nature Study	Mech. Hobby	Biology Exper.	Drugs	Cosmology	General Collect.	High Verbal	Environ.
W-schools	B-school	W-school	W-school	B-school	W-school	W-school	...	...	W-school
vs.	↓	V			V				↓
M-schools	M-school	B-school	M-school	M-school	M-school	M-school	...	...	M-school
vs.	V	V	V	V	↓				↓
B-schools	W-school	M-school	B-school	W-school	B-school	B-school	...	...	B-school
White	Black	White	White	Black	White	White	...	...	White
vs.	V	↓	V	↓	↓	V			↓
Black	White	Black	Black	White	Black	Black	...	...	Black
Boys	Boys	Girls	Girls	Boys	Boys	Boys	...	Girls	...
vs.	↓	↓	V	V	V	V		V	
Girls	Girls	Boys	Boys	Girls	Girls	Girls	...	Boys	...
White boys	...	...	Wh. girls	Wh. boys	Wh. boys	Wh. boys	...	...	...
vs.			↓	V	V	↓			
White girls	...	...	Wh. boys	Wh. girls	Wh. girls	Wh. girls	...	...	...
Black boys	...	...	Bl. girls	Bl. boys	Bl. boys	Bl. boys	...	Bl. girls	...
vs.			V	↓	V	↓		↓	
Black girls	...	...	Bl. boys	Bl. girls	Bl. girls	Bl. girls	...	Bl. boys	...
White boys	Bl. boys	...	...	...	Wh. boys	...	...	...	...
vs.	↓				↓				
Black boys	Wh. boys	...	...	...	Bl. boys	...	...	...	...
White girls	Bl. girls	Wh. girls	Wh. girls	...	Wh. girls	...	...	...	Wh. girls
vs.	↓	↓	↓		↓				↓
Black girls	Wh. girls	Bl. girls	Bl. girls	...	Bl. girls	...	...	...	Bl. girls
Blacks in M-school vs. Whites in M-school	M Black ↓ M White	M White ↓ M Black	M White V M Black	M Black V M White	M White ↓ M Black	M Black ↓ M White			M White V M Black
Seventh Grade	...	...	Seventh	Eighth	...	...	...	...	Eighth
vs.			V	V					↓
Eighth Grade	...	...	Eighth	Seventh	...	...	...	...	Seventh

Key: V = Groups are not significantly different.

↓ = Groups are significantly different.

White children and children from the predominantly white school category have expressed significantly higher participation in Nature Study, Mechanical Hobby, Drugs, Cosmology, and Environmental factors than black children and children from the predominantly black category of schools. The latter, however, are significantly higher on Academic and Biology Experiment factors. Black girls are the highest on the High Verbal activity factor, which includes items pertaining to asking questions about science and discussing science topics. It was stated in the previous chapter that activities that form the Academic factor are not necessarily purely voluntary activities in some schools. They may be required as part of the school science program, and students may participate in such activities for a course grade. One could speculate that if the school program were more traditional and such requirements more prevalent, then students would be more likely to express their participation. Further speculation on this leads to an idea that predominantly black schools may involve little teaching and learning based on active experimentation and investigation.

Biology experiments are a strong interest area for the black children. This may be due to the presence of experimentation and investigation in the biology taught in the predominantly black schools. However, there is no evidence in this study to support that idea.

White children in predominantly white schools seem more likely to be exposed to the modern curriculum based on experimentation and inquiry techniques. They are very much interested, as shown in this study, in nature exploration, tinkering activities, atomic and space science, and environmental preservation. Also, they seem to show a breadth of activities, which perhaps results from their being exposed in school. Studies cited in Chapter II tend to demonstrate that science programs in schools do have a bearing on the nature and degree of participation in science activities outside school. Black children in this study did not exhibit similar patterns except for Biology Experiment and Academic Interest. This observation tends to lend further support to our previous speculations.

Teachers tend to believe that children develop interests when properly introduced to them in school. If this is so, the predominantly black schools need to introduce breadth of activities into their science programs and reorganize their curriculum and teaching strategy according to the modern techniques of experimentation, investigation, and discovery.

The histograms of blacks and whites from mixed schools are not as far apart as those of W-schools and B-schools or blacks and whites in the total sample. They generally occupy a middle position and are not confined to the lower or upper positions on the graph. There are still significant differences between the groups on several factors. The pattern of significant differences between the W-schools and B-schools is also found between the blacks and whites from the mixed schools, except that in the Cosmology factor the interest is reversed; blacks are significantly higher in their expression of interest on this factor. If the histograms for blacks and whites from mixed schools are compared with the histograms of B-schools and W-schools, respectively, it is noticed that significant shifts have occurred in some factors. For example, there is a significant downward shift in the Drugs and Cosmology factors for whites and an upward shift for blacks on the Drugs factor. A total of five downward shifts occurred for the whites and four upward shifts for the blacks. This shows that there is a tendency (significant only in two factors) for the activity interest of children in a mixed school setting to change toward a more common pattern. In this sample, the intermediate nature of the histogram of mixed schools is due to a combination of shifts and averaging of factor scores. Two of the schools in the mixed category from which most of the responses came have been integrated only for one year. More lengthy exposure to interracial interactions could make the children attain a more common pattern of behavior. For the time being, however, in the mixed school setting in the sample, a curriculum should be designed to suit both black and white children which is similar to that of their peers in predominantly black and predominantly white schools.

If the nine mean factor scores for boys and girls from the two race groups are added and then arranged according to decreasing order of interest by race and sex, the white girl, white boy, black boy, and black girl. In previous studies, girls were thought to have a low level of interest in science, but this study indicates the contrary. The total sample of boys are significantly higher in their expression of participation in activities involving Academic, Biology Experiment, Drugs, and Cosmology factors than the total sample of girls. On the other hand, girls are higher on Nature Study, Mechanical Hobby, and High Verbal factors. A few traditionally sex-associated interests are reversed in this study. For example, girls traditionally excel in Academic-type activities and boys in Mechanical Hobby interests; however, here exactly the opposite was observed. Perhaps, much of this change in the character and level of interest of girls in science activities is due to the Women's Liberation Movement. Whatever may be the cause, we need to design science curriculum in keeping with the changed attitudes of girls toward science activities.

The white and black boys are significantly different only in their expression of interest on the Drugs factor, although the means for black boys are below those of white boys in most places. This means that the black and white boys in the sample have generally common patterns of interest. On the other hand, the black girls are significantly different from the white girls in the sample on several factors. Black girls have the lowest factor scores of all groups on several factors. Somehow, school programs, teachers, and parents have not been successful in stimulating science interest or science activities for these girls. Special attention probably should be given to this population in the development of curriculum and school science activities.

Recommendations for Further Research

Several questions arise that may be of interest for further research.

1. The development of an appropriate curriculum should involve both the out-of-class activities and the in-class activities of children. The out-of-class interests of the children in this study did vary by race and sex. A parallel investigation related to their classroom interests in science should help complete the picture for future curriculum makers.

2. The inventory developed in this study perhaps does not include the real typical out-of-class activities of the students. One means of identifying these may be to administer many other items to a large population of students, using a randomized data-collection system. The items with the highest factorial loadings may then be grouped and included in the inventory.

3. Validation of the activities in this inventory seems particularly critical before further steps are taken in curriculum development. Interviews with children, parents, and other observers could help determine if these items or others accurately reflect out-of-class activities for the pupils in the sample.

4. The instrument in this study identified and compared the interests of specific groups within a large sample population. A question that comes naturally to mind is: What is the use of such an instrument for a classroom teacher? How can she make use of the same instrument to generate the interests of the class as a whole, and those of each individual pupil in particular?

5. The whole purpose of the study was to identify and study the variation of interest in the out-of-class activities of students within a sample population. The result of the study was thought to be of use to curriculum makers; however, nobody has really come up with a method by which these activities could be effectively incorporated into the school program. Such a task should be the object of further research.

6. This study showed variation between black children in predominantly black schools and white children in predominantly white schools. There is some reason to expect that socioeconomic conditions might be a factor in this difference. A study to relate directly the socioeconomic status of the child's family and his activities or interests is indicated.

7. In this study we investigated the variation in interest patterns between blacks and whites in predominantly white, mixed, and predominantly black schools. One possible further investigation is to determine the variation, if any,

in the interest patterns of a given race among these three types of schools.

8. The analysis of the National Assessment results indicates great differences by race, sex, and geographical variables. A study relating the interests of blacks to these results might reveal what relationship exists between observed achievement and expressed interests.

Conclusion

The major observations that stand out from this study are the stability of interests through time and the variations in interest by race and sex. It is clear that such a study should become standard procedure prior to curriculum planning for a specific or mixed population. It is hoped that the results of this study will effectively stimulate the recognition of differences in predominantly white, black, and integrated schools as these schools reformulate their general science curriculum.

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APPENDICES

APPENDIX A

REED SCIENCE INTEREST ACTIVITY INVENTORY

PART ONE

INSTRUCTIONS FOR MARKING ANSWERS:

This part of the Inventory deals with activities of a scientific sort. Show how often you have done these things voluntarily, because you were interested, during this school year. Of course, no pupil does all the things listed.

1. If since the start of school last fall, you did not voluntarily do the thing listed, just circle the zero under Never, and go on to the next line.
2. If during this school year, you have done the thing listed, show how often you have done it by circling the letter that is your answer.
3. Answer every item. There will be one circle for each item--either a circle under Never, or a circle showing how often you have done it.

THINGS I HAVE DONE THIS YEAR BECAUSE I AM INTERESTED	I HAVE DONE THIS THING					
	Never	Almost Never	Few Times	Some-times	Often	Very Often
1. Read newspaper articles concerning scientific things, because I like to.	0	a	b	c	d	e
2. Visited the pet section of stores of watch birds, fish, etc.	0	a	b	c	d	e
3. Spent my own money for scientific things.	0	a	b	c	d	e
4. Built or repaired radio sets or other electronic equipment.	0	a	b	c	d	e
5. Tried to predict the weather from clouds, temperature, and other signs.	0	a	b	c	d	e
6. Made extra drawings of animals or plants.	0	a	b	c	d	e
7. Used a home chemistry set.	0	a	b	c	d	e

THINGS I HAVE DONE THIS YEAR BECAUSE I AM INTERESTED	I HAVE DONE THIS THING					
	Never	Almost Never	Few Times	Some-times	Often	Very Often
8. Listened to scientific talks on the radio because I am interested.	0	a	b	c	d	e
9. Worked on my rock collection or tried to figure out reasons for local land formations.	0	a	b	c	d	e
10. Made extra drawings of scientific equipment.	0	a	b	c	d	e
11. Read Popular Science, Popular Mechanics, National Geographic, or other science magazines, because I like to.	0	a	b	c	d	e
12. Attempted to work out inventions.	0	a	b	c	d	e
13. Tried to find out about the lives of scientists.	0	a	b	c	d	e
14. Watched science programs on TV.	0	a	b	c	d	e
15. Talked with adults about science because I am interested.	0	a	b	c	d	e
16. Tried to find out about scientific occupations such as aviation, engineering, farming, medicine.	0	a	b	c	d	e
17. Took notes on extra science reading.	0	a	b	c	d	e
18. Experimented with photographic equipment or developed prints.	0	a	b	c	d	e
19. Used a microscope at home.	0	a	b	c	d	e

THINGS I HAVE DONE THIS YEAR BECAUSE I AM INTERESTED	I HAVE DONE THIS THING					
	Never	Almost Never	Few Times	Some-times	Often	Very Often
20. Did extra reading about inventions.	0	a	b	c	d	e
21. Did extra problems in my school science work.	0	a	b	c	d	e
22. Talked with fellow students about scientific topics, because I am interested.	0	a	b	c	d	e
23. Tried to find out about atomic energy.	0	a	b	c	d	e
24. Hung around with people who work with scientific things.	0	a	b	c	d	e
25. Studied pictures of scientific things in books and magazines because I am interested.	0	a	b	c	d	e
26. Watched scientific explanations of weather on TV.	0	a	b	c	d	e
27. Tried to find out about the science of space travel.	0	a	b	c	d	e
28. Volunteered to answer questions in science class because I am interested in the topics.	0	a	b	c	d	e
29. Experimented with batteries, vinegar, salt, soda, or other common things.	0	a	b	c	d	e
30. Asked questions in science class, because I am interested.	0	a	b	c	d	e
31. Spent time writing extra reports or articles about scientific things.	0	a	b	c	d	e

THINGS I HAVE DONE THIS YEAR BECAUSE I AM INTERESTED	I HAVE DONE THIS THING					
	Never	Almost Never	Few Times	Some-times	Often	Very Often
32. Tried to find out about such things as earth-quakes, volcanoes, moun-tains, rivers, or deserts.	0	a	b	c	d	e
33. Spent time with a friend because we are both interested in science.	0	a	b	c	d	e
34. Thought about problems like how the earth, the sun, the stars, or life came to be.	0	a	b	c	d	e
35. Tried to find out about fish and other sea life.	0	a	b	c	d	e
36. Experimented at home with things dealing with heat, sound, or light.	0	a	b	c	d	e
37. Tried to find out about how science can help in raising children.	0	a	b	c	d	e
38. Observed and studied wild animal and bird life, because I like to.	0	a	b	c	d	e
39. Did extra reading about the way different parts of the human body work.	0	a	b	c	d	e
40. Thought about such ques-tions as "What is time?" "What is gravity?" "What is space?" "What is energy?"	0	a	b	c	d	e
41. Cultivated and cared for vegetables or flowers, because I like to.	0	a	b	c	d	e
42. Worked on a collection of insects, bird nests, or other animal speci-mens.	0	a	b	c	d	e

THINGS I HAVE DONE THIS YEAR BECAUSE I AM INTERESTED	I HAVE DONE THIS THING					
	Never	Almost Never	Few Times	Some-times	Often	Very Often
43. Tried to find out about the moon, sun, planets, or stars.	0	a	b	c	d	e
44. Visited a science museum, because I like to.	0	a	b	c	d	e
45. Collected parts of plants such as leaves and flowers, because I am interested.	0	a	b	c	d	e
46. Repaired electric lamps and cords, because I like to.	0	a	b	c	d	e
47. Did extra reading about unusual places and people in the world.	0	a	b	c	d	e
48. Went on nature exploring trips, because I like to.	0	a	b	c	d	e
49. Put out food for wild birds.	0	a	b	c	d	e
50. Took quite active part in class discussions about science, because I am interested.	0	a	b	c	d	e
51. Tried to find out about the history of scientific discoveries.	0	a	b	c	d	e
52. Spent extra time on the science homework, because I like it.	0	a	b	c	d	e
53. Listened to extra lectures on science.	0	a	b	c	d	e
54. Investigated how electric motors and appliances work, because I am interested.	0	a	b	c	d	e

THINGS I HAVE DONE THIS YEAR BECAUSE I AM INTERESTED	I HAVE DONE THIS THING					
	Never	Almost Never	Few Times	Some-times	Often	Very Often
55. Tried to find out how science is used in cooking.	0	a	b	c	d	e
56. Spent time on preparing an exhibit for a science fair.	0	a	b	c	d	e
57. Paid special attention in science class, because I am interested.	0	a	b	c	d	e
58. Did extra science lab work in school.	0	a	b	c	d	e
59. Memorized extra things in science.	0	a	b	c	d	e
60. Looked over the science books in libraries.	0	a	b	c	d	e
61. Brought extra things to science class.	0	a	b	c	d	e
62. Went to science movies like "Conquest of Everest" and "Twenty Thousand Leagues Under the Sea."	0	a	b	c	d	e
63. Made extra science models and equipment.	0	a	b	c	d	e
64. Tried to find out about national parks and wildlife areas.	0	a	b	c	d	e
65. Visited flower gardens or greenhouses, because I am interested.	0	a	b	c	d	e
66. Visited the zoo because I like to.	0	a	b	c	d	e

THINGS I HAVE DONE THIS YEAR BECAUSE I AM INTERESTED	I HAVE DONE THIS THING					
	Never	Almost Never	Few Times	Some-times	Often	Very Often
67. Planted and cared for lawns, shrubs, or trees because I am interested in them.	0	a	b	c	d	e
68. Used field glasses to study nature.	0	a	b	c	d	e
69. Went to the movies to see science pictures of wild life such as Disney makes.	0	a	b	c	d	e
70. Tried to find out about the science of nutrition and how the body uses food.	0	a	b	c	d	e

APPENDIX B

TENTATIVE INVENTORY SUBMITTED TO A

PANEL OF JUDGES

Michigan State University
April 6, 1972

Dear Sir,

This is to request you to be a judge in the rating of the items included in the tentative science interest inventory enclosed herein. The inventory thus developed is to be used as an instrument to identify, measure and compare the science interest activities of seventh and eighth graders. In this study, the focus is not on subject matter per se, though each activity can be identified with certain specific areas in science. It is the activities of the child outside class hours engaged in purely because he is interested in them that I wish to study. In other words, I wish to find out what are the science activities of boys and girls outside school hours and how they differ across age, sex, and race variables.

Several of the items included in the list are taken from the Reed Scientific Interest Inventory developed at Harvard in 1958. This inventory has been adapted in the evaluation of the Project Physics. Here, I am only trying to revise and update the Reed Inventory as advised by Professor Reed himself in his recent letter to me.

The population for the study consists of seventh and eighth graders in the state of Michigan. The sample is to be drawn from both the Black and White race groups. I hope to get the response of 1500 to 2000 children to the inventory being developed.

The responded items in the inventory are to be subjected to rotational analysis and the factors that are identified can be compared and contrasted between the variables mentioned above. Also, the percentage of common factor variance can be determined so that we can identify those activity factors that are most prominent among the children.

The study is toward a dissertation in partial fulfillment of the doctoral program in Science Education at Michigan State University. Please respond to the items at your earliest convenience. I hope and wish I could collect the response from the children before the school year is out. I gratefully appreciate your cooperation.

Thank you.

Yours faithfully,

Joseph Matchanickal

A SCIENTIFIC INTEREST STUDY OF CHILDREN IN GRADES 7 & 8

(An abstract of the Proposal)

This study has three purposes: (1) Update scientific interest studies--such studies are important in the teaching of science because, if the teacher knows the children's interests, he may be able to plan a more vital program; pupils will enjoy and accomplish more by doing those things in which they are interested; (2) Study the present-day science interest factors of junior high school children in grades 7 and 8; (3) Compare these factors across racial groups (specifically black and white), grade levels, and sex.

In this study, the focus is not on the areas of science interest, but primarily on the science activities of the children. Certain activities, of course, may be identified with one or more specific areas in science. A commonly used method of measuring interests from activities is to obtain a quantitative score based on a respondent's subjective statements of likes and dislikes of items from an activity inventory. However, it has been demonstrated that the correlation between a respondent's actual participation and his verbal statements of preference is rather low. Scores based on reported voluntary participation may be a better indicator of interest in science since they reflect actual expenditures of time and effort.

The first study of this kind was done by Professor Reed at Harvard in 1959. The inventory that he developed needs to be updated and modified, as interests and the corresponding activities of the children vary with new discoveries in science. Surely, the world has witnessed several new discoveries in science and felt their technological impacts in the sixties. In the inventory that I am trying to develop, several activities from the Reed Inventory have been retained and new ones added. The tentative list of items thus derived has been submitted to a panel of judges consisting of professors, science educators, and teachers. The final list of items arrived at on the basis of the panel rating is to be pilot tested and adjusted for the reading comprehension of the children.

The population under consideration is to be studied in three levels: children from schools containing 0-33% blacks, 33.3-66.6% blacks, and 66.6-100% blacks. The sample will consist of all the students in the 7th and 8th grades of schools that volunteer to participate in the study. Once the sample has been determined, the inventory will be administered by the researcher himself; if this is not possible for some reasons, participating teachers may be asked to administer the inventory, as all the required instructions for pupils will be included in it.

The response from each pupil will be punched on IBM cards and subjected to factor analysis. Factor scores and univariate statistics for the three levels of the population, boys and girls, and the two grades can be calculated separately. The means for the various factors for any two groups can be contrasted using standard t-tests. Also, the percentage of common factor variance can be determined for each level, sex, and grade. This will give us an idea about the predominant scientific activity factors within a given group.

This is not a racial study, although two different races are included and compared on a criterion variable. This study does not in any way try to make projections into the attitudes and values of pupils involved. What I am interested in is the predominant types of scientific activities which children engage in during off-class hours and whether these factors differ by sex, grade, and race. The findings of the study, I hope, will make a significant contribution toward building curricula in public schools that are on the threshold of integration by busing or other means.

Joseph Matchanickal
Science and Math Teaching Center
Michigan State University
East Lansing, Michigan

Dear Sir:

Would you please rate the items included in this inventory, giving careful consideration to the following two questions: (1) Does the item represent a genuine voluntary scientific activity? (2) Is it within the range of such activities that could normally be expected from 7th and 8th graders?

Please feel free to make any suggestions which could improve any of the items; space has been left between items for this purpose. We welcome you to suggest new items that are not included in this list. Space is left for that as you go along and at the end.

In order to determine the scientific interest factors of the children under consideration, the inclusion of the item is:

Items	Unimp.	Rather Imp.	Impor- tant	Very Imp.
1. During this school year read newspaper articles on science topics at home, school library or any other place.				
2. Visited the pet section of stores to watch birds, fish, etc. because I wanted to know more about them.				
3. Spent my own money to buy articles that are of scientific use to me.				
4. Tried to assemble electronic equipment like transistor radio or tried to repair such broken equipment by myself.				
5. Disassembled old appliances like clocks, etc. to find out how they are made.				

Comments, questions, additions?

Items	Unimp.	Rather Imp.	Impor- tant	Very Imp.
6. Tried to predict the weather for the day from clouds, temperature and other signs.				
7. Made extra drawings of animals, plants, or equipment by consulting sources other than my texts.				
8. Made use of common household materials like vinegar, salt, soda, etc. or a home chemistry set to perform some simple experiments.				
9. During the school year, tried to collect or collected several types of rocks to study them more closely.				
10. Got interested in identifying and studying fossils.				
11. Read magazines like Popular Science, Popular Mechanics, National Geographic, or any other such magazines at home, school or any other place.				
12. Attempted to work out my own inventions or perform new types of experiments, maybe taking ideas from books, magazines, or any other sources.				
13. Tried to find out more about the life and activities of one or more scientists.				
14. Watched some of the science programs on TV because I was especially interested in them.				

Comments, questions, additions?

Items	Unimp.	Rather Imp.	Impor- tant	Very Imp.
15. Asked questions on science to grown-up persons because I had always wanted the answers for them.				
16. During the year I read science fiction books.				
17. Got interested in one or more of the scientific occupations like aviation, engineering, medicine, farming, etc. and learned more about them myself.				
18. Took pictures and tried to develop them by myself.				
19. Used a microscope at home.				
20. During this year I did extra problems;i.e., more than I was required to in my school science work.				
21. Talked with fellow students about scientific topics.				
22. Located major cities in other countries on the map and compared their time with Michigan time.				
23. Tried to learn as much as possible about the moon rocks or went to see them on display.				
24. Tried to follow the latest developments in U.S. and Russian space explorations.				
25. Tried to find out the depth of the soil and the land formations in my locality.				

Comments, questions, additions?

Items	Unimp.	Rather Imp.	Impor- tant	Very Imp.
26. Cut out and saved articles of scientific interest to me from newspapers or other sources.				
27. Attempted to offer scientific explanations of the change in the dress or clothes that people wear or the plentiful availability of certain fruits and vegetables as the season changes.				
28. Tried to repair a broken bike or a lawnmower or vacuum cleaner or any such household articles because I liked doing such things.				
29. Tried to make musical instruments from cheap materials like empty boxes and rubber bands.				
30. Tried to find out how atomic energy is used for power production.				
31. Tried to keep up with the latest developments in the exploration of the structure of the atom.				
32. During this year, visited greenhouses or gardens or parks to observe and study different varieties of plants.				
33. Collected frog eggs or cocoons to study the changes that take place in them.				

Comments, questions, additions?

Items	Unimp.	Rather Imp.	Impor-tant	Very Imp.
34. Tried to find out how water is purified for my locality.				
35. Walked into the woods or collected pictures to study the change of color in leaves during the Fall.				
36. Collected various samples of soil to study how they differed.				
37. Browsed through science books in the library or the book stores.				
38. Discussed with teachers and adults current news items on man's exploration of space.				
39. Tried to learn about the misuse of drugs and cautioned my friends on the dangers of smoking cigarettes and marijuana.				
40. Brought to class current news of space events and suggested discussions on them.				
41. Made large pictures and/or drawings which illustrate some special science interest to me.				
42. Acted as observers when the teacher performed an experiment which involved close observation.				

Comments, questions, additions?

Items	Unimp.	Rather Imp.	Impor-tant	Very Imp.
43. Brought to class some materials or books of scientific interest so that the whole class could benefit from them.				
44. Took time out to study the lab manual or sheets in order to be better prepared for the lab.				
45. Visited antique stores or museums.				
46. Visited places like factories, bakeries, gas stations, etc. (where several machines are use for various purposes) to observe and study the use of these machines.				
47. Engaged in individual projects in science which required extra reading or writing or interviewing, etc.				
48. Entered into science contests to compete for awards.				
49. Spent away time dreaming about questions like "What is energy," "What is space," etc. without meaning to do so.				
50. Have been active with groups interested in environmental preservation.				

Comments, questions, additions?

Items	Unimp.	Rather Imp.	Impor- tant	Very Imp.
51. Hung around with people who work with scientific things.				
52. Participated in classroom discussions and volunteered to answer questions in class.				
53. Watched the explanations of weather on TV.				
54. Helped younger students and classmates with problems and projects in science.				
55. Spent time with a friend outside the class because we are both interested in science.				
56. Tried to find out how sci- ence can help in raising children.				
57. Got interested to know more about heart surgery and tried to learn more about it.				
58. Cultivated and cared for vegetables and flowers.				
59. Worked on a collection of insects, bird nests, or animal specimens.				
60. Collected and pressed leaves and flowers.				
61. Repaired electric lamps and cords and any appli- ance that works on elec- tricity.				

Comments, questions, additions?

Items	Unimp.	Rather Imp.	Impor- tant	Very Imp.
62. Went on nature exploring trips.				
63. Put out food for birds.				
64. Tried to find out about the history of one or more scientific discoveries.				
65. Tried to find out how sci- ence is used in cooking.				
66. Spent time preparing for a science class or a science fair.				
67. Performed more labs than were required of me.				
68. Went to see science movies like "2001 Space Odyssey," etc. in the local theater or any other place.				
69. Had fun making rockets, guns, color sprays, etc. out of simple materials found at home.				
70. Tried to find out about national parks and wild life areas in the state.				
71. Visited places where ani- mals and birds are kept.				
72. Planted and cared for lawns and trees because I am interested in such things.				

Comments, questions, additions?

Items	Unimp.	Rather Imp.	Impor- tant	Very Imp.
73. Used field glasses to study nature.				
74. Went to the movies to see science pictures of wild life such as Disney makes.				
75. Tried to find more about the science of nutrition and food preservation.				
76. Deliberately brought up science topics during meals at home.				
77. Tried to find out the effect of insecticides and pesti- cides on wild life.				
78. Collected litter from the ground because I care to have a less polluted earth.				
79. Took the lead to collect old newspapers and magazines for recycling so that fewer trees would be cut down to make paper.				
80. Experimented with mouthwash and antiseptics to find out whether they really prevent infection.				
81. Kept caterpillars and watched them develop into moths and butterflies.				
82. Experimented on plants with different chemical ferti- lizers.				

Comments, questions, additions?

Items	Unimp.	Rather Imp.	Important	Very Imp.
83. Tried to find out how dangerous bacteria may be kept out of water, milk, and other foods.				
84. Tried to determine the common spreadable diseases in the U.S. in general and Michigan in particular.				
85. Grew my own sample of bacterial and plant culture.				
86. Determined what certain substances like soap, plastic, paint, etc. are made of.				
87. Worked with magnets, batteries, wire, electric motor, etc. at home to determine how electricity and magnetism are related.				
88. After the experiment, cleaned up my place and helped the teacher put away the materials and clean up the lab.				
89. Learned more about and worked with organizations that are interested in population control.				
90. Got concerned about and worked with friends to find out more about VD.				
91. Tried to learn what is being done to control and cure sickle cell anemia.				

Comments, questions, additions?

Items	Unimp.	Rather Imp.	Impor-tant	Very Imp.
92. Tried to find the agents of air and water pollution in my locality.				
93. I have thought about what I could do to prevent further pollution and clean up the mess.				
94. Tried to get into the scien-tific explanations of the words like calories, exer-cise, diet commonly used among women and men.				
95. Tried to find out more about the effect of excessive use of drugs and alcohol on the proper functions of the brain.				
96. Tried to take sides on mod-ern issues like nuclear testing, space exploration, SST, etc.				
97. Tried to find out the scientific reason for the difference in skin color among people.				
98. I have tried to verify cer-tain scientific statements of the teacher and other per-sons in one or several of the ways I could.				

Comments, questions, additions?

APPENDIX C

PILOT TEST INSTRUMENT

I. CHECK ONE:

I am in 7th grade______ I am in 8th grade______

II. CHECK ONE:

I am a boy______ I am a girl______

III. CHECK ONE:

I belong to black____ white____ other____ ethnic group.

IV. Instructions for marking answers:

1. If since the start of school last fall, you did not voluntarily do the thing listed, just circle the letter A under Never, and go on to the next line.
2. If during this school year you have done the thing listed, show how often you have done it by circling the letter that is your answer.
3. Answer every item; there will be one circle for each item--either a circle under Never, or a circle showing how often you have done it.
4. If you do not understand a word or a whole item, raise your hand and the teacher will help you.

THINGS I HAVE DONE THIS YEAR BECAUSE I AM INTERESTED	I HAVE DONE THIS THING: Never	Once or Twice	Often	Very Often
1. During this school year read newspaper articles on science topics at home, school library or any other place.	A	B	C	D
2. Spent my own money to buy articles that are of scientific use to me.	A	B	C	D
3. Tried to assemble electronic equipment like transistor radio or tried to repair such broken equipment by myself.	A	B	C	D
4. Disassembled old appliances like clocks, etc. to find out how they are made.	A	B	C	D

THINGS I HAVE DONE THIS YEAR BECAUSE I AM INTERESTED	I HAVE DONE THIS THING: Never	Once or Twice	Often	Very Often
5. Made extra drawings of animals, plants, or equipment by consulting sources other than my texts.	A	B	C	D
6. Made use of common household materials like vinegar, salt, soda, etc. or a home chemistry set to perform some simple experiments.	A	B	C	D
7. During this school year, collected several types of shells, rocks, leaves or any such materials to study them more closely.	A	B	C	D
8. Got interested in identifying and studying fossils.	A	B	C	D
9. Read magazines like Popular Science, Popular Mechanics, National Geographic or any other such magazines at home, school or any other place.	A	B	C	D
10. Attempted to work out my own inventions or perform new types of experiments, maybe taking ideas from books, magazines or any other sources.	A	B	C	D
11. Watched some of the science programs on TV like "Mr. Wizard," "Star Trek," "Under Water World," "Jacques Cousteau," etc. because I am especially interested.	A	B	C	D
12. Asked questions on science to grownup persons because I had always wanted the answers for them.	A	B	C	D
13. Got interested in one or more of the scientific occupations like aviation, engineering, medicine, farming, etc. and learned more about them myself.	A	B	C	D

THINGS I HAVE DONE THIS YEAR BECAUSE I AM INTERESTED	I HAVE DONE THIS THING: Never	Once or Twice	Often	Very Often
14. Used a microscope at home.	A	B	C	D
15. During this year I did extra problems; i.e., more than I was required to in my school science work.	A	B	C	D
16. Talked with fellow students about scientific topics.	A	B	C	D
17. Tried to learn as much as possible about the moon rocks or went to see them on display.	A	B	C	D
18. Tried to follow the latest developments in U.S. and Russian space explorations.	A	B	C	D
19. Cut out and saved articles of scientific interest to me from newspapers or other sources.	A	B	C	D
20. Tried to repair a broken bike or a lawnmower or vacuum cleaner or any such household articles because I liked doing such things.	A	B	C	D
21. Tried to find out how atomic energy is used for power production.	A	B	C	D
22. During this year, visited greenhouses, gardens, parks, woods, creek-banks, vacant lots, back yards, etc. to watch, observe and learn more about different varieties of plants and animals.	A	B	C	D
23. Collected frog eggs, tadpoles or cocoons to study the changes that take place in them.	A	B	C	D
24. Walked into the woods or collected pictures to study the change of color in leaves during the fall.	A	B	C	D

THINGS I HAVE DONE THIS YEAR BECAUSE I AM INTERESTED	I HAVE DONE THIS THING Never	Once or Twice	Often	Very Often
25. Browsed through science books in the library or the book stores.	A	B	C	D
26. Discussed with teachers and adults current news items on man's exploration of space.	A	B	C	D
27. Tried to learn about the misuse of drugs and cautioned my friends on the dangers of smoking cigarettes and marijuana.	A	B	C	D
28. Brought to class current news of space events and suggested discussions on them.	A	B	C	D
29. Made large pictures and/or drawings which illustrate some special science interest to me.	A	B	C	D
30. Watched very closely when the teacher performed a demonstration experiment in class.	A	B	C	D
31. Brought to class some materials or books of scientific interest so that the whole class could benefit from them.	A	B	C	D
32. Took time out to study the lab manual or sheets in order to be better prepared for the lab.	A	B	C	D
33. Visited places like factories, bakeries, gas stations, etc. (where several machines are used for various purposes) to observe and study the use of these machines.	A	B	C	D
34. Engaged in individual projects in science which required extra reading or writing or interviewing, etc.	A	B	C	D
35. Entered into science contests to compete for awards.	A	B	C	D

THINGS I HAVE DONE THIS YEAR BECAUSE I AM INTERESTED	I HAVE DONE THIS THING Never	 Once or Twice	 Often	 Very Often
36. Spent time dreaming about questions like "What is energy," "What is space," etc. without meaning to do so.	A	B	C	D
37. Have been active with groups interested in environmental preservation.	A	B	C	D
38. Hung around with people who work with scientific things.	A	B	C	D
39. Participated in classroom discussions and volunteered to answer questions in class.	A	B	C	D
40. Helped younger students and classmates with problems and projects in science.	A	B	C	D
41. Spent time with a friend out-side the class because we are both interested in science.	A	B	C	D
42. Got interested to know more about heart surgery and tried to learn more about it.	A	B	C	D
43. Cultivated and cared for vegetables and flowers.	A	B	C	D
44. Worked on a collection of insects, bird nests or animal specimens.	A	B	C	D
45. Collected and pressed leaves and flowers.	A	B	C	D
46. Repaired electric lamps and cords and any appliance that works on electricity.	A	B	C	D
47. Went on nature exploring trips.	A	B	C	D
48. During the school year, I tried to find out how science can make housekeeping chores easier and give me more time to play.	A	B	C	D

THINGS I HAVE DONE THIS YEAR BECAUSE I AM INTERESTED	I HAVE DONE THIS THING: Never	Once or Twice	Often	Very Often
49. Spent time preparing for a science project not required for class or a science fair.	A	B	C	D
50. Performed more labs than were required of me.	A	B	C	D
51. Had fun making rockets, guns, color sprays, etc. out of simple materials found at home.	A	B	C	D
52. Tried to find out about national parks and wild life areas in the state.	A	B	C	D
53. Visited places where animals and birds are kept.	A	B	C	D
54. Deliberately brought up science topics during meals at home.	A	B	C	D
55. Tried to find out the effect of insecticides and pesticides on wild life.	A	B	C	D
56. Collected litter from the ground and participated in organized cleanup campaigns.	A	B	C	D
57. Took the lead to collect old newspapers and magazines for recycling so that fewer trees would be cut down to make paper.	A	B	C	D
58. Experimented with mouthwash and antiseptics to find out whether they really prevent infections.	A	B	C	D
59. Kept caterpillars and watched them develop into moths and butterflies.	A	B	C	D
60. Experimented on plants with different chemical fertilizers.	A	B	C	D
61. Tried to find out how dangerous bacteria may be kept out of water, milk, and other foods.	A	B	C	D

THINGS I HAVE DONE THIS YEAR BECAUSE I AM INTERESTED	I HAVE DONE THIS THING Never	Once or Twice	Often	Very Often
62. Grew my own sample of bacterial and plant culture.	A	B	C	D
63. Worked with magnets, batteries, wire, electric motor, etc. at home to determine how electricity and magnetism are related.	A	B	C	D
64. Tried to learn what is being done to control and cure sickle cell anemia.	A	B	C	D
65. Tried to find the agents of air and water pollution in my locality.	A	B	C	D
66. I have thought about what I could do to prevent further pollution and clean up the mess.	A	B	C	D
67. Tried to find out more about the effect of excessive use of drugs and alcohol on the proper functions of the brain.	A	B	C	D
68. Tried to take sides on modern issues like nuclear testing, space exploration, SST, etc.	A	B	C	D
69. Tried to find out the scientific reason for the difference in skin color among people.	A	B	C	D
70. I have tried to verify certain scientific statements of the teacher and other persons in one or several of the ways I could.	A	B	C	D

APPENDIX D

PUPIL INVENTORY

MICHIGAN STATE UNIVERSITY

Science and Mathematics Teaching Center

Dear Students:

This is not a test; you are not going to be graded on what you do for the next few minutes. The booklet contains a list of science activities you may or may not have done at home or during your off-school hours. We would like to know if you have done any of these activities yourself, since the start of school last fall. We are asking several thousand students, throughout Michigan to mark the list of activities just as you are going to do. By pooling together the responses from all of you, we hope to arrive at the type of things you do. The knowledge obtained by this survey may be useful in making science programs which include the science activities which interest you most. The first three items on the list are not science activities. They are about you. Please mark all your answers only on the green IBM sheet found inside this booklet. Please use the pencil supplied to you to mark your answers. Here is an example how to mark the items.

The baseball team in Detroit is called

A) Pistons B) Tigers C) Lions.

The answer of course is B, the Tigers, and so we mark B as shown here. T F [A] [■] [C] [D] [E]

Please read through the first three items below and mark the answers that applies to you.

1. I am at present in the

   A. 7th grade B. 8th grade

2. I belong to

   A. the black race group B. The white race group C. other race group

3. I am

   A. a girl B. a boy

Now that you have finished marking the items that tell us about you go on to mark the items in the list of science activities (4 though 73). Marking for these items is the same as what you did for the first three items. Let us give you another example.

	Never	Once or twice	Often	Very often
During this year I went to spooky movies	A	B	C	D

Let us say your answer is 'often', The letter below "often" is C and so you mark letter C on your green IBM sheet, as shown here. T F [A] [B] [■] [D] [E]

Mark all the items choosing the answer which tells how often you did the activity. If there are any questions, raise your hand and the teacher will help you. Good luck.

THINGS THAT I HAVE DONE THIS YEAR BECAUSE I AM INTERESTED	NEVER	ONCE OR TWICE	OFTEN	VERY OFTEN
4. During this school year read newspaper articles on science topics at home, school library or any other place.	A	B	C	D
5. Spent my own money to buy articles that are of scientific use to me.	A	B	C	D
6. Tried to assemble electronic equipment like transistor radio or tried to repair such broken equipment by myself.	A	B	C	D
7. Disassembled old appliance like clocks, etc. to find out how they are made.	A	B	C	D
8. Made extra drawings of animals, plants, or equipment by consulting sources other than my texts.	A	B	C	D
9. Made use of common household materials like vinegar, salt, soda, etc. or a home chemistry set to perform some simple experiments.	A	B	C	D
10. During this school year, collected several types of shells, rocks, leaves or any such materials to study them more closely.	A	B	C	D
11. Got interested in identifying and studying fossils.	A	B	C	D
12. Read Magazines like Popular Science, Popular Mechanics, National Geographic or any other such magazines at home, school or any other place.	A	B	C	D
13. Attempted to work out my own inventions or perform new types of experiments, may be taking ideas from books, magazines or any other sources	A	B	C	D
14. Watched some of the science programs on TV like "Mr. Wizard", "Star Trek", "Under Water World", "Jacque Cristeau" etc.	A	B	C	D
15. Asked questions on science to grown-up persons because I had always wanted the answers for them.	A	B	C	D
16. Got interested in one or more of the scientific occupations like aviation, engineering, medicine, farming, etc. and learned more about them myself.	A	B	C	D
17. Used a microscope at home.	A	B	C	D
18. During this year I did extra problems i.e., more than I was required to in my school science work.	A	B	C	D
19. Talked with fellow students about scientific topics	A	B	C	D

	NEVER	ONCE OR TWICE	OFTEN	VERY OFTEN
20. Tried to learn as much as possible about the moon rocks or went to see them on display	A	B	C	D
21. Tried to follow the latest developments in U.S. and Russian space explorations.	A	B	C	D
22. Cut out and saved articles of scientific interest to me from newspapers or other sources.	A	B	C	D
23. Tried to repair a broken bike or a lawnmower or vacuum cleaner or any such household articles because I like doing such things.	A	B	C	D
24. Tried to find out how atomic energy is used for power production.	A	B	C	D
25. During this year, visited greenhouses, gardens, parks, woods, creek-banks, vacant lots, back yards, etc. to watch, observe and learn more about different varieties of plants and animals.	A	B	C	D
26. Collected frog eggs, tadpoles or cocoons to study the changes that take place in them.	A	B	C	D
27. Walked into the woods or collected pictures to study the change of color in leaves during the Fall.	A	B	C	D
28. Browsed through science books in the library or the book stores.	A	B	C	D
29. Discussed with teachers and adults current news items on man's exploration of space.	A	B	C	D
30. Tried to learn about the misuse of drugs and cautioned my friends on the dangers of smoking cigarettes and marijuana.	A	B	C	D
31. Brought to class current news of space events and suggested discussions on them.	A	B	C	D
32. Made large pictures or drawings which illustrate some special science interest to me.	A	B	C	D
33. Watched very closely when the teacher performed a demonstration experiment in the class.	A	B	C	D
34. Brought to class some materials or books of scientific interest so that the whole class could benefit from them.	A	B	C	D
35. Took time out to study the lab manual or sheets in order to be better prepared for the lab.	A	B	C	D

THINGS THAT I HAVE DONE THIS YEAR BECAUSE I AM INTERESTED	NEVER	ONCE OR TWICE	OFTEN	VERY OFTEN
36. Visited places like factories, bakeries, gas stations, etc., (where several machines are used for various purposes) to observe and study the use of these machines.	A	B	C	D
37. Engaged in individual projects in science which required extra reading or writing or interviewing, etc.	A	B	C	D
38. Entered into science contest to compete for awards.	A	B	C	D
39. Spent away time dreaming about questions like 'What is energy', 'What is space', etc. without meaning to do so.	A	B	C	D
40. Has been active with groups interested in environmental preservation.	A	B	C	D
41. Hung around with people who work with scientific things.	A	B	C	D
42. Participated in classroom discussions and volunteered to answer questions in class.	A	B	C	D
43. Helped younger students and classmates with problems and projects in science.	A	B	C	D
44. Spent time with a friend outside the class because we are both interested in science.	A	B	C	D
45. Got interested to know more about heart surgery and tried to learn more about it.	A	B	C	D
46. Cultivated and cared for vegtables and flowers.	A	B	C	D
47. Worked on a collection of insects, bird nests or animal specimens.	A	B	C	D
48. Collected and pressed leaves and flowers.	A	B	C	D
49. Repaired electric lamps and cords or any appliance that works on electricity.	A	B	C	D
50. Went on Nature exploring trips.	A	B	C	D
51. During this school year, I tried to find out how science can make house keeping chores easier and give me more time to play.	A	B	C	D
52. Spent time preparing for a science project not required for class or a science fair.	A	B	C	D
53. Performed more labs than were required of me.	A	B	C	D

	NEVER	ONCE OR TWICE	OFTEN	VERY OFTEN
54. Had fun making rockets, guns, color sprays, etc. out of simple materials found at home.	A	B	C	D
55. Tried to find out about national parks and wild life areas in the state.	A	B	C	D
56. Visited places where animals and birds are kept.	A	B	C	D
57. Deliberately brought up science topics during meals at home.	A	B	C	D
58. Tried to find out the effect of insecticides and pesticides on wild life.	A	B	C	D
59. Collected litter from the ground and participated in organized cleanup campaigns.	A	B	C	D
60. Took the lead to collect old newspapers and magazines for recycling so that less number of trees would be cut down to make paper.	A	B	C	D
61. Experimented with mouthwash and antiseptics to find out whether they really prevent infections.	A	B	C	D
62. Kept caterpillars and watched them develop into moths and butterflies.	A	B	C	D
63. Experimented on plants with different chemical fertilizers.	A	B	C	D
64. Tried to find out how dangerous bacteria may be kept out of water, milk, and other foods.	A	B	C	D
65. Grew my own sample of bacterial and plant culture.	A	B	C	D
66. Worked with magnets, batteries, wire, electric motor, etc. at home to determine how electricity and magnetism are related.	A	B	C	D
67. Tried to learn what is being done to control and cure sickle cell anemia.	A	B	C	D
68. Tried to find the agents of air and water pollution in my locality.	A	B	C	D
69. I have thought about what I could do to prevent further polution and clean up the mess.	A	B	C	D
70. Tried to find out more about the effect of excessive use of drugs and alcohol on the proper functions of the brain.	A	B	C	D
71. Tried to take sides on modern issues like nuclear testing, space exploration, SST, etc.	A	B	C	D

GO ON TO NEXT PAGE

THINGS THAT I HAVE DONE THIS YEAR BECAUSE I AM INTERESTED	NEVER	ONCE OR TWICE	OFTEN	VERY OFTEN
72. Tried to find out the scientific reason for the difference in skin color among people.	A	B	C	D
73. I have tried to verify certain scientific statements of the teacher and other persons in one or several of the ways I could.	A	B	C	D

Please Leave the green IBM sheet inside the booklet.
Thank you for participating in this study.

APPENDIX E

EXPLANATION OF SELECTED VARIABLES

EXPLANATION OF SELECTED VARIABLES[1]

Pupil-Teacher Ratio

The information to compute this measure was taken from the "Fourth Friday Report." The total number of pupils was obtained by counting all pupils enrolled in grades one through twelve except special education pupils. Pupils who attended the school for a portion of the day and attended a nonpublic school for the remainder of the day, were included on a full time equivalency basis. The total number of teachers was obtained by adding the number of elementary and secondary classroom teachers. Kindergarten teachers, special education teachers, and non-classroom teachers were not included in the total. In order to obtain the pupil-teacher ratio, the total number of pupils was divided by the total number of teachers.

Percent of Teachers with Five or More Years Experience

The information to compute this measure was taken from the "Fourth Friday Report." It was obtained by dividing the number of classroom teachers (full-time and part-time) with five years or more teaching experience, by the total number of classroom teachers (full-time and part-time). The resultant value was multiplied by 100 to convert to a percent figure.

K-12 Instructional Expense per Pupil (1969-70)

The information to compute this measure was taken from records provided by the local districts and filed with the Michigan Department of Education. The financial information was reported for the fiscal year which ended

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[1] The Michigan State Assessment, IVth Report, pp. 167-170.

June 30, 1970. The total K-12 instructional expense included expenditures for salaries and supplies connected with elementary education, secondary education, special education, summer school, and adult education. Expenditures associated with community colleges were omitted from the calculation. In order to obtain a value for instructional expense per pupil, total K-12 instructional expense was divided by the total number of pupils enrolled in the district as shown in the "Fourth Friday Report."

Percent of Racial-Ethnic Minority Students

was computed for each school in the state. The information to compute this measure was taken from the "Fourth Friday Report." The total number of racial-ethnic minority students included all racial-ethnic minority students in the school except pre-kindergarten students. Kindergarten students, special education students and part-time students were all included in the total. Since the information was expressed in terms of a head count, part-time students were not counted differently from full-time students. Students were classified as belonging to a racial-ethnic minority group if they were considered by the school to be of that group. The total number of students included all students except pre-kindergarten students. Again kindergarten students, special education students, and part-time students were included in the total. In order to calculate the percent of racial-ethnic minority students, the total number of racial-ethnic minority students was divided by the total number of students and the resultant figure was multiplied by 100.

Student Socioeconomic Background

Students' Estimate of Socioeconomic Status was computed for each school in the state. The assessment battery included twenty-five questions designed to indirectly assess group socioeconomic background. The questions concerned biographical information, educational attainment of parents, quality housing, family structure and stability, occupation, income, and possessions. For this measure, the questions asked of the fourth graders and the questions asked of the seventh graders were identical. It is important to note that the students anonymously responded to these questions; only the school name--not the student's name--was recorded on the answer sheet. Thus, it is impossible for anyone to ascertain the responses of a particular individual. Indeed, the purpose of the instrument is to arrive at a group measure not individual pupil measures.

Performance on Attitude Measures

Three students attitude measures were included in the 1970-71 educational assessment battery. These were: (1) importance of school achievement; (2) self-perception; and (3) attitude toward school. For these three measures, students in the fourth and seventh grades received identical questions. As in the case of the student socioeconomic background measure, the purpose of the attitude instrument is to arrive at a group measure not individual pupil measures. Each is discussed below.

Importance of School Achievement

The assessment battery included eight questions regarding the importance of school achievement. Here, too, it is important to note that the students anonymously responded to these questions; only the school name--not the student's name--was recorded on the answer sheet. Thus, again it is impossible for anyone to ascertain the response of a particular individual. A high score indicates that on the average pupils believe good school achievement is important.

Self-Perception

The assessment battery included seven questions designed to measure the student's self-perception. Again, the students responded anonymously. A high score indicates that on the average pupils believe themselves to be quite capable in school situations.

Attitude Toward School

The assessment battery included seven questions designed to measure the student's attitude toward school. Responses were anonymous. A high score indicates that on the average pupils have a positive attitude toward school.

APPENDIX F

MEANS AND STANDARD DEVIATIONS OF

THE ACTIVITY ITEMS

Activity Items	Mean	Standard Deviation
14. Watched some of the science programs on TV like "Mr. Wizard," "Star Trek," "Under Water World," "Jacques Cousteau," etc.	1.8907	.9644
33. Watched very closely when the teacher performed a demonstration experiment in the class.	1.7692	.9933
23. Tried to repair a broken bike or a lawnmower or vacuum cleaner or any such household articles because I like doing such things.	1.6174	1.0987
30. Tried to learn about the misuse of drugs and cautioned my friends on the dangers of smoking cigarettes and marijuana.	1.5022	1.1103
12. Read magazines like Popular Science, Popular Mechanics, National Geographic, or any other such magazine at home, school or any other place.	1.4180	1.0088
46. Cultivated and cared for vegetables and flowers.	1.4040	1.0429
42. Participated in classroom discussions and volunteered to answer questions in class.	1.3501	.9447
56. Visited places where animals and birds are kept.	1.3416	.9704
70. Tried to find out more about the effect of excessive use of drugs and alcohol on the proper functions of the brain.	1.2803	1.0457
4. During this school year read newspaper articles on science topics at home, school library or any other place.	1.2626	.8321
69. I have thought about what I could do to prevent further pollution and clean up the mess.	1.2448	.9805
25. During this year, visited greenhouses, gardens, parks, woods, creek-banks, vacant lots, back yards, etc. to watch, observe and learn more about different varieties of plants and animals.	1.1850	1.0538

Activity Items	Mean	Standard Deviation
6. Tried to assemble electronic equipment like transistor radio or tried to repair such broken equipment by myself.	1.0753	1.0029
59. Collected litter from the ground and participated in organized cleanup campaigns.	1.0668	.9484
9. Made use of common household materials like vinegar, salt, soda, etc. or a home chemistry set of perform some simple experiments.	1.0569	1.0023
15. Asked questions on science to grown-up persons because I had always wanted the answers for them.	1.0561	.9201
43. Helped younger students and classmates with problems and projects in science.	1.0528	.9249
8. Made extra drawings of animals, plants, or equipment by consulting sources other than my texts.	1.0325	.9818
36. Visited places like factories, bakeries, gas stations, etc. (where several machines are used for various purposes), to observe and study the use of these machines.	1.0284	.9929
50. Went on nature exploring trips.	1.0089	.9349
16. Got interested in one or more of the scientific occupations like aviation, engineering, medicine, farming, etc. and learned more about them myself.	1.0041	1.0341
28. Browsed through science books in the library or the book stores.	1.0026	.9476
55. Tried to find out about national parks and wild life areas in the state.	.9697	.9701
66. Worked with magnets, batteries, wire, electric motor, etc. at home to determine how electricity and magnetism are related.	.9675	1.0245
19. Talked with fellow students about scientific topics.	.9638	.8942

Activity Items	Mean	Standard Deviation
13. Attempted to work out my own inventions or perform new types of experiments, maybe taking ideas from books, magazines or any other sources.	.9265	.9649
48. Collected and pressed leaves and flowers.	.9147	.9411
54. Had fun making rockets, guns, color sprays, etc. out of simple materials found at home.	.8449	1.0190
27. Walked into the woods or collected pictures to study the change of color in leaves during the Fall.	.8423	.9454
7. Disassembled old appliances like clocks, etc. to find out how they are made.	.8290	.9777
29. Discussed with teachers and adults current news items on man's exploration of space.	.8253	.8817
39. Spent away time dreaming about questions like "What is energy," "What is space," etc. without meaning to do so.	.8227	.9492
68. Tried to find the agents of air and water pollution in my locality.	.8069	.9186
40. Was active with groups interested in environmental preservation.	.8065	.8988
49. Repaired electric lamps and cords or any appliance that works on electricity.	.7976	.9945
41. Hung around with people who work with scientific things.	.7932	.8779
10. During this school year, collected several types of shells, rocks, leaves or any such materials to study them more closely.	.7607	.9167
37. Engaged in individual projects in science which required extra reading or writing or interviewing, etc.	.7570	.8711
47. Worked on a collection of insects, bird nests or animal specimens.	.7437	.9298

Activity Items	Mean	Standard Deviation
51. During this school year, I tried to find out how science can make housekeeping chores easier and give me more time to play.	.7408	.9560
22. Cut out and saved articles of scientific interest to me from newspapers or other sources.	.7341	.8971
58. Tried to find out the effect of insecticides and pesticides on wild life.	.7326	.8888
67. Tried to learn what is being done to control and cure sickle cell anemia.	.7212	.9576
70. Tried to find out the scientific reason for the difference in skin color among people.	.7157	.8976
18. During this year I did extra problems, i.e., more than I was required to in my school science work.	.7064	.8377
17. Used a microscope at home.	.7024	.9683
21. Tried to follow the latest developments in U.S. and Russian space explorations.	.6928	.9238
32. Made large pictures or drawings which illustrate some special science interest to me.	.6891	.8829
71. I have tried to verify certain scientific statements of the teacher and other persons in one or several of the ways I could.	.6750	.8505
45. Got interested to know more about heart surgery and tried to learn more about it.	.6736	.9116
62. Kept caterpillars and watched them develop into moths and butterflies.	.6736	.8811
44. Spent time with a friend outside the class because we are both interested in science.	.6400	.8895
57. Deliberately brought up science topics during meals at home.	.6174	.8288
71. Tried to take sides on modern issues like nuclear testing, space exploration, SST, etc.	.6171	.8899

Activity Items	Mean	Standard Deviation
35. Took time out to study the lab manual or sheets in order to be better prepared for the lab.	.6130	.8540
60. Took the lead to collect old newspapers and magazines for recycling so that fewer trees would be cut down to make paper.	.6112	.9035
26. Collected frog eggs, tadpoles or cocoons to study the changes that take place in them.	.5997	.9003
52. Spent time preparing for a science project not required for class or a science fair.	.5731	.8449
64. Tried to find out how dangerous bacteria may be kept out of water, milk, and other foods.	.5639	.8081
20. Tried to learn as much as possible about the moon rocks or went to see them on display.	.5487	.8648
5. Spent my own money to buy articles that are of scientific use to me.	.5462	.7997
61. Experimented with mouthwash and antiseptics to find out whether they really prevent infections.	.5454	.8434
11. Got interested in identifying and studying fossils.	.5395	.8402
24. Tried to find out how atomic energy is used for power production.	.5247	.8297
63. Experimented on plants with different chemical fertilizers.	.5188	.8213
34. Brought to class some materials or books of scientific interest so that the whole class could benefit from them.	.4453	.7515
38. Entered into science contest to compete for awards.	.4420	.7882
53. Performed more labs than were required of me.	.4136	.7574
31. Brought to class current news of space events and suggested discussions on them.	.4010	.7380
65. Grew my own sample of bacterial and plant culture.	.3726	.7153