STUDENT ATTITUDES TOWARD SCIENCE IN THE INTERMEDIATE SCIENCE CURRICULUM STUDY AND NON-INTERMEDIATE SCIENCE CURRICULUM STUDY JUNIOR HIGH SCHOOL SCIENCE PROGRAM

By

GAYLA SUE GUFFY

Bachelor of Science
Oklahoma Panhandle State University
Goodwell, Oklahoma
1963

Master of Science Education
Southwestern Oklahoma State University
Weatherford, Oklahoma
1975

Submitted to the Faculty of the Graduate College
of the Oklahoma State University
in partial fulfillment of the requirements
for the Degree of
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Thesis Approved:

Terence J. Mills
Thesis Adviser

Kenneth E. Wiggins

Russ Dobson

L. Herbert Bruneau

Donald A. Myers

Norman N. Durham
Dean of the Graduate College

DEDICATION

To my children:

Lori Ann, Leslie Ann and Scott Alan Guffy who were a constant reminder of my process of becoming.

PREFACE AND ACKNOWLEDGMENTS

The purpose of the study was to access attitudes of rural and urban ISCS and non-ISCS junior high school science students toward (a) science, (b) readability of science materials, (c) enjoyment of science, (d) suitability to "real world" situations, and (e) amount of science learned.

I wish to extend my sincere thanks to Dr. Kenneth E. Wiggins, my committee chairman, not only for his assistance and guidance in this research, but for his extreme encouragement throughout my doctoral program. Dr. Ted Mills provided not only dire assistance and showed extreme patience as my thesis adviser, but was responsible for making this study possible.

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Perhaps the most important acknowledgment needs to be made merely in the form of a simple "thank you" to my three beautiful children, Lori, Leslie and Scott for their patience, understanding, and love during the last two years. To them the "experience" is at last over, for me it has just begun.

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INTRODUCTION

In recent years there has been a dynamic shift occurring in the types of science courses taught at the junior high school level. The need for a new approach to science teaching at this level, however, was advocated in the K-12 program as early as 1947 (50).

At the time the Russians launched their first space satellite, Sputnik, in 1957, science was thought of as being an incidental part of the curriculum. The launching of Sputnik made the members of our society aware of the importance of science, thus came financial assistance and pressure to improve public school science programs for grades K-12.

The explosion of knowledge along with the population explosion has placed an ever increasing demand on public schools in an effort to give each student the best education possible. Hurd (35) has made an interesting observation concerning the knowledge explosion:

> Sometimes new scientific achievements are added to courses but seldom is anything dropped. The accepted rationalization is that what is now taught is fundamental or basic, whereas it is all too frequently only traditional (p. 6).

The new surge of knowledge in the sciences is making a drastic impact on the traditional approach to science teaching. New approaches to science teaching are needed to transmit the accumulated knowledge in the sciences. The following opinion regarding current attempts was expressed by Drummond (16):

> While these programs seem to represent significant advances in approach and organization, they cannot cope with the information explosion in science with the need to integrate into classroom activities what is going on today in the world's laboratories (p. 89).

There are a great number of new ideas regarding science education of today. Science educators differ in their viewpoints whether science is a body of knowledge as reflected in facts or concepts or whether science represents an approach to knowledge as reflected in heuristic procedures and attitudes.

During the summer of 1962, the American Association for the Advancement of Science made a recommendation that in the early grades instructional materials should stress the processes of science rather than science content alone.

Gagné (23) made this point concerning the instructional materials:

> The most striking characteristic of these materials is that they are intended to teach children the processes of science rather than what may be called science content. That is, they are directed toward developing fundamental skills required in scientific activities. The performances in which these skills are applied involve objects and events of the natural world; the children do, therefore, acquire information from various sciences as they proceed. The goal, however, is not an accumulation of knowledge about any particular domain, such as physics, biology, or chemistry, but competence in the use of processes that are basic to all science (p. 49).

Considerable attention was given to the processes of scientific inquiry as well as to science content. Gega (27) states:

> Most modern educators realize that for intelligent functioning it is at least as important to learn science thinking skills and attitudes (processes) as principles and facts of science (products) (p. 74).

A course in general science has been the traditional science course taught at the junior high school level, but in the last few years, educators in general and science educators in particular have taken a serious look at the curriculum in the various science courses at all levels of instruction as evidenced by the many new curricular revisions.

Those concerned with the education of students in science have attempted to integrate aspects of effective learning into the curricula and methods of instruction. Yet, the impact has not been great in comparison to the prevailing attitude of students toward the study of science. Educators must take a closer look at the attitudes of the consumers of the science curricula.

The Intermediate Science Curriculum Study, ISCS, was a result of a joint effort of scientists and educators working together to create an individualized approach to junior high school science.

The traditional general science course taught at the junior high school level places heavy emphasis on the lecture method of science teaching, and there is little or no student participation in the scientific process. Traditionally, science has been taught as a body of knowledge to be crammed into the heads of students.

The ISCS curriculum with self-pacing, individualized science instruction, activity-centered classroom, interest and enrichment excursions, and a core of action-oriented science activities can be an extreme change from the traditional science classroom environment.

Several studies have indicated that the curriculum materials produced by committees of authors and departmentally tested with appropriate populations of students have a more positive effect on student attitudes than do "traditional" materials (3).

According to a USOE publication, in October, 1974, there were approximately 5,450,000 junior high school students in the United States, and 2,000,000 of these students, or 45%, were involved in the ISCS program (28). The question can then be raised as to why the ISCS program has been so well accepted. Could it be because of state adoption laws, teacher awareness of the program, or student attitudes toward the program? With such a large number of students involved in ISCS, studies of student perceptions toward science may provide useful criteria in educational research and evaluation. It is difficult to be objective about one's own behavior; therefore, students' perceptions may provide the teacher with usable information. An awareness of rural, urban, ISCS and non-ISCS students' perceptions of science classroom environments is an important goal of this study.

The primary goal of the ISCS program is to give the student a valid understanding of the nature of science and of the way that knowledge in science has been accumulated. The underlying assumption of the ISCS program is that science at the junior high school level should serve a general educational function for all students. The ISCS program also believes that students best gain a real understanding of science and its methods by facing reasonably significant questions and working out ways to attack them. By letting major concepts arise out of students' investigations, aspects of science become more meaningful, thus the processes and the concepts of science should be presented to students simultaneously.

A balanced science program of concepts and processes is provided by the ISCS curriculum, thus providing a science program which is educationally sound. The inception of the ISCS Project was at Florida State University in the early 1960's. Financial support has been provided by the United States Office of Education and the National Science

Foundation. The ISCS Project differs from other junior high school science programs in that it is (a) aimed at general education, giving the student a sequential picture of the structure and process of science, (b) laboratory centered, (c) individualized to take care of the broad range of student ability, and (d) self-pacing, so that the student travels through the activities at his own speed.

The ISCS Project is divided into a three year sequence. Level I deals with energy, its forms and characteristics, measurement and operational definitions. Level II concepts are matter and its composition and model building. Level III materials cover the earth and biological sciences.

The ISCS program was developed for junior high school students and has the following program objectives.

The ISCS Commitment

1. ISCS supports the belief that science instruction in the junior high and middle schools should serve a general education function.

2. ISCS also supports the idea that science instruction should require active investigative behavior on the part of the students, not just passive studying about science.

3. The project further supports the notion that science content should be encountered according to logical sequences of problem-oriented activities and that science subject matter, together with the inquiry process of science, should be presented simultaneously.

4. Most importantly, ISCS is convinced that the goal and design of instruction should be to meet realizable needs of every student.

5. ISCS believes it is impractical to expect most teachers to design, develop, and implement a creative curriculum.

6. The project believes that special instructional materials designed to assist teachers in achieving the goals of instruction must be made available to teachers in a ready-to-use form if full potential of the materials as key agents in the education process is to be realized.

7. ISCS believes that teachers would prefer to have their students assume much greater responsibility for the self-management of their learning activities, rather than to preside over their students as disseminators of information (21).

Justification of the Study

This research was an attempt to determine the general attitudes of rural and urban ISCS and non-ISCS students concerning science: amount of science learned, enjoyment of science, readability of science materials, and suitability of science content learned to the "real world" situation.

Few studies have been conducted in the past in the aforementioned areas. Perhaps feedback from students as to their perception of readability would provide valuable information to supplement the traditional determination of textbook reading level. There is a need for studies and reports which attempt to evaluate the effectiveness of the contemporary programs in junior high school science education.

The writings of Bruner (5), Piaget (54), Gagné (22), Ausubel (4) and many others are emphasizing and focusing attention on the proposition that the manner in which a child learns is of great importance to future learning. The investigations and writings of these people are stimulating science educators in the area of junior high school science education.

Statement of the Problem

This study investigates the attitudes of rural and urban junior high school Intermediate Science Curriculum Study (ISCS) students, and a group of rural and urban non-ISCS junior high school students.

The primary problem is to determine if ISCS students' general attitude toward science, readability of science materials, amount of science learned, suitability to "real world" situations and enjoyment differ from non-ISCS students.

The study will involve the testing of the following null hypotheses:

ISCS to Non-ISCS

A. There is no significant relationship between perceptions of ISCS and non-ISCS students toward science.

B. There is no significant relationship between perceptions of ISCS and non-ISCS students toward level of enjoyment.

C. There is no significant relationship between perceptions of ISCS and non-ISCS students toward level of amount learned.

D. There is no significant relationship between perceptions of ISCS and non-ISCS students toward level of readability.

E. There is no significant relationship between perceptions of ISCS and non-ISCS students toward level of suitability.

Urban ISCS to Rural ISCS

F. There is no significant relationship between perceptions of urban ISCS and rural ISCS students toward science.

G. There is no significant relationship between urban ISCS student perception and rural ISCS student perception in degree of enjoyment.

H. There is no significant relationship between urban ISCS student perception and rural ISCS student perception in degree of amount learned.

I. There is no significant relationship between urban ISCS student perception and rural ISCS student perception in degree of readability.

J. There is no significant relationship between urban ISCS student perception and rural ISCS student perception in degree of suitability.

Urban Non-ISCS to Rural Non-ISCS

K. There is no significant relationship between urban non-ISCS and rural non-ISCS students toward science.

L. There is no significant relationship between urban non-ISCS student perception and rural non-ISCS student perception in degree of enjoyment.

M. There is no significant relationship between urban non-ISCS student perception and rural non-ISCS student perception in degree of amount learned.

N. There is no significant relationship between urban non-ISCS student perception and rural non-ISCS student perception in degree of readability.

O. There is no significant relationship between urban non-ISCS student perception and rural non-ISCS student perception in degree of suitability.

Basic Assumptions

The assumptions upon which this study will be based are:

1. Attitudes are measurable.

2. The attitudes of ISCS students and non-ISCS students can be measured by the Science Opinionnaire.

3. The population of science students from the state of Oklahoma used in this study are not significantly different from national science student populations.

4. The expressed responses of the students will reflect their true feelings and attitudes. As Thurston (69) states:

> All that we can do with an attitude scale is to measure the attitude actually expressed with the full realization that the subject may be consciously hiding his true attitude or that the social pressure of the situation has really made him believe what he expresses. This is a matter of interpretation. It is something probably worthwhile to measure an attitude expressed by opinions. It is another problem to interpret in each case the extent to which the subjects have expressed what they really believe. All that we can do is to minimize as far as possible the conditions that prevent our subjects from telling the truth, or else adjust our interpretations accordingly (p. 218).

General Procedures

The population in this study consists of rural and urban Intermediate Science Curriculum Study students from grades six through nine, Levels I, II, and III and rural and urban non-Intermediate Science

Curriculum Study students, grades six through nine in schools in the state of Oklahoma.

The Science Opinionnaire developed by the Michigan State Department of Education, consisting of a series of twenty statements regarding science attitudes, was used to collect data from students. This instrument, designed to gather a general opinion of science students, suited this study because it not only measured overall student attitudes toward science, but was an instrument which contained items dealing with readability, enjoyment of science, suitability of science to "real world" situations, and student perceptions of amount of science learned.

It is advantageous to utilize a feedback instrument which lends itself to application of the usual statistical comparison tools. The Likert-type rating scale is uniquely suited for this purpose. The Likert scale consists of a series of statements about a particular topic to which the respondent must mark one answer category such as "strongly agree," "agree," "uncertain," etc. The answer choices are weighted. Each statement was scored, totaled, and sums were derived for each of four clusters and the total instrument. The sums over all statements were used to compute group means, standard deviations and point-biserial coefficients of correlation.

The reliability of the instrument was checked by both the test-retest and the split-halves methods. In the test-retest method, a value of 0.793 was obtained. In the split-halves method, a value of 0.833 was obtained (20).

A point-biserial correlation was the statistic used to analyze the data. The point-biserial correlation statistic will determine if a relationship exists between opinion scores and group membership.

Limitations of the Study

There are several limitations which may affect this study and its results. These include:

1. There are factors outside the classroom situation that will influence attitudes toward science.
2. The teachers involved in this study were different in their personality, I.Q., knowledge of the subject being taught, knowledge of science teaching methods, philosophy of teaching, and in other characteristics that are inherent in each individual teacher.
3. Non-ISCS student responses were obtained from a non-randomized mailing list and only volunteers responded.
4. A high percentage of ISCS student responses were obtained from teachers who were part of an ISCS training program, conducted from 1974-1976. These teachers may not otherwise have volunteered.
5. The data was not collected nationally, but was specific to Oklahoma.

Clarification of Terms

Attitudes Toward Science

Attitudes toward science refers to how an individual feels about science; an emotional feeling for or against science as exhibited through the behavior of the individual as reported on the *Science Opinionnaire*.

Intermediate Science Curriculum Study

The Intermediate Science Curriculum Study (ISCS) refers to a course of study developed by scientists and educators which provide an individualized format for a three-year integrated junior high school science curriculum.

Classroom Environment

Students' perceptions of readability of science materials, amount of science learned, suitability to "real world" situations, and enjoyment of science, in urban and rural schools.

Readability

Student perceptions of readability as defined by items 1, 7, and 14 of the Science Opinionnaire. See Appendix A.

Suitability to "Real World" Situations

Student perceptions of suitability to "real world" situations as defined by items 4, 5, 11, 12, 17 and 18 of the Science Opinionnaire. See Appendix A.

Enjoyment

Student perceptions of enjoyment as defined by items 2, 6, 8, 10, 13, 16, and 20 of the Science Opinionnaire. See Appendix A.

Amount of Science Learned

Student perceptions of amount of science learned as defined by items 3, 9, 15 and 19 of the Science Opinionnaire. See Appendix A.

Urban Schools

The junior high schools in Oklahoma City and Tulsa, Oklahoma.

Rural Schools

The junior high schools other than those in Oklahoma City and Tulsa, Oklahoma.

Non-Intermediate Science Curriculum Students

Junior high school students in any science program other than ISCS.

CHAPTER II

REVIEW OF LITERATURE

In an effort to review literature pertinent to this study attention was given to comments by researchers and science education specialists, as well as science educators in areas related to rural and urban student perceptions toward science, readability of science materials, amount of science learned, suitability to "real world" situations and enjoyment of science. The literature reviewed represented studies from 1924 until present, 1977.

Science teaching goals changed with the advent of science curricular projects in the late 1950's and early 1960's. Traditional science courses were criticized for their deviations from conformity with current knowledge and scientific methods (9). "To know the theoretical, investigative, and conceptual basis of a particular discipline became the primary goals of the new science" (34).

Hurd (34) states, "The broad goal of science teaching for the 1970's needs to go beyond the restrictive content of the special disciplines and consider science in relation to the affairs of mankind, the activities of the 'real world', and the human condition."

Students in colleges, high schools, junior high schools and even elementary schools are demanding an education that places a greater emphasis upon the personal, human development of each individual. The study of science as a dehumanized, impersonal experience is now beginning to be replaced by placing more emphasis on the affective dimensions of learning (1).

All theories of learning rest on a concept of man and behavior. In essence there have been essentially two concepts of man. One postulates a mind endowed with certain capacities--such faculties as reasoning, remembering, imagining, which grow with exercise. The second concept postulates that man is an energy system--a system of dynamic forces--attempting to maintain a balance or equilibrium in response to other energy systems with which he interacts through his sense organs. This energy system encompasses his entire being; it includes his responses to stimuli, his motivation, feelings, and rational processes (44).

The basic concepts of learning are by no means discarded in practice. Much of teaching and curriculum selection in the public schools is based on theories of learning. Many of these theories of learning have related to the science education movement.

Three such major movements have been emphasized in science education:

<u>Behaviorism</u>

The behaviorist theory assumes that man is a collection of responses to specific stimuli. This theory is also known as stimulus-response (S-R) theory. Behavior is explained as a result of external stimuli to which the organism is subjected (8). Man is seen as passive, shaped and conforming.

<u>Freudianism</u>

Sigmund Freud was strongly influenced by the work of Charles Darwin. Biological determination (i.e., aggression, instincts, and drives) is the basis for man's behavior. Historically caused conflicts between sub-systems such as id, ego, and superego result in the organism or system moving away from homeostatic balance (8).

Humanistic Psychology

Humanistic psychology is a third force movement that is rapidly gaining prominence in science education.

Humanistic psychology began as an underground movement within the ranks of behaviorism and psychoanalysis. Freudianism and behaviorism did not fully explain human behavior. The definition of humanistic psychology is:

> Humanistic psychology is primarily an orientation toward the whole of psychology rather than a distinct area or school. It stands for respect for the worth of persons, respect for differences of approach, openmindedness of new aspects of human behavior. As a 'third force' in contemporary psychology it is concerned with topics having little place in existing theories and systems, e.g., love, creativity, self, growth, organism, basic need gratification, self-actualization, higher values, being, becoming, spontaneity, play, humor, affection, naturalness, warmth, egotranscendence, objectivity, autonomy, responsibility, meaning, fair play, transcendental experience, peak experience, courage and related concepts (67, p. 110).

In July, 1971, the National Science Teachers Association issued a position statement of curriculum development in science. Their goal of science education is to develop scientifically literate citizens with the necessary intellectual resources, values, attitudes, and inquiry skills to promote the development of man as a rational human being (53). The trend of science education of the 70's is indeed one of humanistic education. It poses the question: Do we each really appreciate and understand the affective dimension of science?

Emphasis on the development of the scientific attitudes was pointed out by Heiss (32) who stated that the development of the scientific attitudes and the ability to use the methods of science are major goals of science instruction. It was further pointed out that considerable attention has been given to ways of teaching the scientific method, whereas no attention has been given to the development of scientific attitudes.

"Changing values and attitudes through formal education is no small task. In addition, it almost automatically brings up the controversy on whose values should be changed and how they should be changed. There is great diversity in the definitions of the words 'value' and 'attitude'" (56).

This study used the operational definition of attitude as a "value indicator," and the definition of the "process of valuing" given by Raths, Harmin, and Simon (58).

Choosing: (1) freely
(2) from alternatives
(3) after thoughtful consideration of the consequences of each alternative

Prizing: (4) cherishing, being happy with the choice
(5) willing to affirm the choice publicly

Acting: (6) repeatedly, in some pattern of life

Dressel (51) has made an interesting observation of scientific attitudes:

> The principles of learning which are to be observed in teaching directly for the attitudes and methods of science are the same as those applicable for any other educational objective. The experiences should be psychologically sound, with due cognizance given to student aims and needs. There should be student activity, such as would be in agreement with the types of learning involved in the students' objective. There is also need for wise direction for the students' endeavors. The teacher's own attitudes and methods are certain to be influential in such learning situations (p. 126).

With reference to the acquisition of scientific methods and attitudes, it seems obvious that if students are to develop these abilities they must have practice in them. That is, situations should be designed to allow students to select worthwhile problems and attempt to solve them. They should have experiences in collecting data, making guesses, devising experiments, and checking for accuracy while cultivating methods and attitudes conducive to effective learning in the field of science.

As early as 1924 Curtis (12) made an analysis of scientific attitudes. Empirical studies related to scientific attitudes became important in 1935-36 with the studies of Davis (13), Noll (52), and Hoff (33). These studies investigated students who received high to average school grades and found that these students did not necessarily acquire a high score on science attitude tests. Thus, teaching for the sake of knowledge alone is not enough. Students must be given the real values of science instruction.

The development of favorable attitudes toward science depends on the curriculum and on the teachers' attitudes and practices in the classroom (3). The fact that the teacher must change can also be inferred from data reported by the Intermediate Science Curriculum Study, indicating a positive change in attitude toward science and scientists resulting from the inservice instruction provided (38). The role of the ISCS teacher is so drastically different from that of the traditional teacher that, quite possibly, even those teachers who did not teach in a manner completely consistent with the ISCS model had nevertheless changed considerably.

In this unique role, the ISCS teacher has primary responsibility to individual students and small groups as the instructional coordinator, content and process consultant, inquiry specialist, and key evaluator. Carrying out these new roles requires the teacher to be aware of and to possess a repertoire of characteristics crucial to successful development of an inquiry environment in which individuals may progress at their own rate.

Readability

From the very beginning of development the ISCS Project has been deeply concerned with the many aspects of readability. Because of existing state textbook adoption laws, school budget limitations, and the general lack of elaborate equipment in most schools, such as filmstrips, video tapes, cassette tapes, and other audio visual materials which could have been alternate methods of communication, the printed materials were chosen. ISCS chose from the start to use printed materials as the primary vehicle for communicating with the student (38). It was found that materials would have to be made more attractive and readable than those in general use.

Readability became the critical factor in determining the format for the ISCS materials. The ISCS text contains multiple illustrations on a page, with few sentences per page and large areas of white space. These factors make the material more readable, although readability formulas do not recognize any of these factors, but consider only some combination of the factors such as word length, sentence length, and the familiarity of the vocabulary (74).

ISCS materials have been subjected to readability tests to see how the materials score. In a recent study (1974) the Dale-Chall Readability Formula, the Fry Readability Graph, and the SMOG Formula were applied to all three levels of ISCS student materials under tightly controlled conditions. The Dale-Chall test and the Fry test both rank all but one ISCS text at or below the level for which it was intended. The SMOG ranked fifty percent of the texts at or below their intended level. The evaluation of printed instructional material and determination of appropriate grade level placement apparently involved much controversy. Dawson (14) felt there were several biases which make readability tests invalid. One such bias was the selection of passages for evaluation by the testor, another bias that the testor can introduce is in his definition of "sentence." Dawson stated that the real problem with using reading tests lies in which is or is not being measured. Reading tests do not take into account the number of complex ideas that are packed into a single paragraph. Perhaps feedback from students as to their perception of readability would provide valuable information to supplement the traditional determination of textbook reading level.

Many teachers which use the ISCS materials have observed that the reading skills of their students seemed to improve during the course. There is no doubt that a student needs to read to perform the ISCS experiments. Possibly, the ISCS student has a reason to read and to make sense of what he or she reads in order to manipulate the materials and get the desired results (61).

Victor (72) stated that:

> The use of reading in science can also make a valuable contribution to the reading program in the public school. It can help develop the children's vocabulary, increase their enjoyment in reading, and stimulate their desire to read for information (p. 82).

Caren and Sund (10) further stated that while first-hand experimental inquiry is the best method by which children learn, effective development of science problem-solving skills requires reading to be a vital and necessary "appendage" to science experiences.

As a student achieves a greater understanding of the words in the context areas of science, his or her ability to use and comprehend these in both written and oral communication is enhanced. Thus reading in science becomes an avenue whereby students may discover and experience learning patterns and styles unique to the field of science.

It can be postulated that science classes possess the potential for providing a formulation of basic and essential experiences which can result in improvement and development of reading skills and abilities.

To promote readability, the ISCS project made liberal uses of illustrations to clarify and intensify the meaning of the printed word. Also, how-to-diagrams for "activities" were used to provide stimultaneous verbal and pictorial instructions on how to carry out various procedures. A high degree of redundancy between the printed and the pictorial message was permitted at such points to aid in communicating with the poor reader. "Iggy," a cartoon character, especially developed for ISCS, further enlightens the text (38).

No pretense is made that the ISCS texts meet the reading needs of every student, but extensive efforts in materials design have been made by the Project to assist the poor reader. In many classrooms there are those students who cannot read at their assigned grade level. Some are even nonreaders. Reports from the field indicate that the average reading level in many seventh grade classes is below the fourth grade level (59).

The reading levels of several selected junior high school science textbooks were determined using the Readability Graph. The results which were obtained are summarized in Figure 1.

Textbook Title	Expected Grade Placement of Text	Calculated Reading Average Level	Level Range
ESCP			
Investigating the Earth	8	8	6-11
HS Biological Science	7		
Vol. 1, Inquiry		7	5-11
Vol. 2, Evolution		9	6-college
Vol. 3, Genetics		7	6-9
Vol. 4, Homeostasis		6	4-7
Vol. 5, Ecology		7	7-8
HS Physical Science	9		
Vol. 1, Predicting		5	4-7
Vol. 2, Matter		7	7
Vol. 3, Energy		6	4-9
Vol. 4, Interaction		4	3-6
Vol. 5, Technology		6	3-8
ISCS			
Interaction Earth and Time	7	7	6-8
Interaction Man and Biosphere	8	10	8-college
Interaction Matter and Energy	9	12	9-college
ISCS			
Probing the Natural World/1	7	8	6-10
Probing the Natural World/2	8	8	8
What's Up	9	9	8-9
Well-Being	9	7	7
Winds and Weather	9	7	6-8
Investigating Variation	9	8	7-9
Why You're You	9	7	6-8
Environmental Science	9	college	9-college
Crusty Problems	9	8	7-9
In Orbit	9	7	7-8
PSG			
Introductory Physical Science	9	9	7-college

Figure 1. Readability Graph

An examination of the figure showes that, in general, with the exception of ISCS's Environmental Science, the average reading level is not more than one grade level higher than the grade level of the intended user. The same can be said for the range of reading levels with the addition of ISCS's Probing the Natural World--Level I.

Recently, studies have been conducted on ISCS texts which support the notion that ISCS students when compared with control groups of students, experience reading level gains which exceed those of the control groups. Researchers have stated that students exposed to ISCS do in fact improve their reading skills as measured by various standardized reading tests (13).

Student Perceptions of Science Learned

A review of literature from 1924 to 1977 revealed that most of the research was in the area of studies of students' achievement and very little information regarding student perception of amount of science learned. The only study speaking specifically to students' perceptions of amount of science learned was a study by Littlefield (45) involving an individualized high school biology program. Several questionnaires were administered to inventory the students' feelings and attitudes toward the individualized learning biology program and the teaching methodology. Analysis of the student questionnaires revealed that the students participating in an individualized, discovery method of science had a more positive self-image regarding the amount of biology they felt they had learned.

Support is available from science educators and learning psychologists for the inclusion of scientific thought in the curriculum as opposed to the learning of science as an organized body of knowledge.

According to Gagné (23), discovery is a very fundamental condition of all learning. Gruber (28) agrees when he says that science, in short, is taught too much as a body of knowledge, too little as a way of thought. The student who has not caught a glimpse of science as a form of creative thought has not seen science at all. Sund and Trowbridge (66), stated that the purpose of the discovery approach is to involve the student in the process of a scientist really uses in discovering new knowledge.

Renner and Ragan (59) emphasized that a common ingredient in the new science programs is that their role includes the provision of opportunities for experiences and acquisitions of process skills instead of memorization of factual knowledge. Strong, McCullough, and Traxler (65) stated that "the process of discovery stimulates learning." Learning occurs when the individual is engaged in the process and sees purpose in his or her activity. It is futile to attempt to force purpose upon the individual. The ISCS program provides learning options to the student that meet or facilitate him or her in establishing new options.

Jerome S. Bruner (5) stated that the first object of the act of learning is that it should serve us in the future. Three processes of the act of learning are: acquisition of new information, transformation, and evaluation. Human development can be described as the culminative effects of experience; what is learned is strictly a function of the imprint that experience makes upon this blank slate. Therefore, learning is something that is added and connected to what was learned before (54).

The learning of science precedes in a meaningful way for all students when the emphasis is redirected from science to children. One of the characteristics of science teaching that is known to "turn off" students is the demand by teachers that students learn large quantities of non-relevant material. Students' complaints in this direction seem justified on the basis of one of the oldest studies in science education which showed that students forget most of what they "learn" in the typical science course (18).

In studies conducted by Kline (41) of junior high school students learning of science, the learning of science was found to be at its best when the student himself initiates actions and interprets the results of the data. Curriculum materials which can be expected to provide a valuable learning experience must be stimulating and interesting to students.

Champagne and Klopfer (11) conducted studies which added insight to the learning of science. Students' participation of the classroom environment was found to be especially important for his or her learning of science. Unless the student is quite comfortable in the environment, it is unlikely that much meaningful science learning will occur, and he or she will not develop a liking for science.

Toews (71) stated that students' perceptions of science conceptual schemes allow the student to form internal associations of knowledge in an organized fashion. The process of arriving at a structuring of the conceptual schemes is not a single short-termed phenomenon but occurs over a long period of concept building and concept reorganization. To ensure that the student form acceptable cognitive structure throughout his or her schooling, it is imperative that the science teacher be very familiar with the philosophic-theoretic framework of the total curriculum, that he or she not only see the "trees"--the day-to-day facts and concepts--but that he or she also continually hold in focus the "forest" --the conceptual schemes of the total curriculum package. In order for the student to learn meaningfully he or she must be allowed to operate within a framework of inquiry, and in order for the student to acquire the desired conceptual schemes, a suitable learning environment must be provided.

The ISCS project is based on the belief that science materials at the junior high school level should be activity-centered. Pupils in these formative years learn better by doing. Faster and longer lasting learning occurs in a laboratory-centered program.

Behavioral objectives have been written for the three levels of ISCS. These are the basis of the self-evaluating program and the Individual Testing System (ITS) developed by ISCS. When a student finishes a chapter in the text, he or she takes a self-test known as a self-evaluation check. Parts of this test requires written answers; other parts of the test ask for actual performance with the materials. When the student has completed the test, he or she scores it, using an answer key, and determines his or her mistakes. If he or she has had any trouble, encouragement is given to go back and review the activities involved before going to the next chapter.

ISCS is laboratory-centered. The content and process themes are developed through investigations. Students begin to investigate with the first activity in Level I. As soon as necessary skills and processes are developed, students are given more opportunity to design and carry out independent investigations.

The ISCS developers have recognized that students vary both in their capacity to learn and in the rate at which they learn. ISCS has built a practical program of individualized science instruction. The learning pace of the program is set by the student, with the level of instruction adjusted to his or her ability.

According to Burkman (7), an important part of the mission that the ISCS materials were designed to accomplish was to help the student make the transition from the concrete-operational stage to what Piaget has called the formal-operational stage in which the student is quite able to operate on a hypothetical proposition rather than being constrained to think of what he has experienced or what is before him. The materials were designed to help the student to gain the ability to think more abstractly.

Research has shown that the level of thought of elementary school students, junior high school students, college freshmen and sophomores can be changed by providing them with inquiry-centered (exploration, invention, discovery) experiences in science. Actual involvement with the materials and ideas of science, being allowed to find out something for themselves, and being allowed to regulate at their own rate accounts for the movement toward and into formal thought (43).

In an individualized, self-paced, laboratory oriented science course at the junior high school level evaluation of learning requires that students be informed of what they are to learn to do. Self-paced students should be given performance objectives for each chapter and each excursion, and they should be given the opportunity to decide when they are ready to demonstrate the achievement of each objective to the teacher.

The number of chapters and the number of enrichment excursions that a student completes in this manner are indicators of how much he has learned and are called quantity of learning indicators. Thus, quantity of learning indicator is the mean of scores on all of their successful attempts (15).

Studies by McCurdy (47) of ISCS junior high school science students found that students assume a more active rather than passive responsibility for their own learning--working on laboratory activities, reading, listening to auto-tutorial devices, consulting with the teacher or other students.

In an unpublished study by Mills (49) over 50% of 275 6th grade middle school science students perceived they did not learn much in the classroom and over 80% of the students felt their schoolwork assignment was not very clear to them. It is of the author's opinion that students' perceptions of the amount of science which they learn could be valuable information in regard to the success of a science program.

Enjoyment of Science

Investigation in the area of students' perceptions of his or her enjoyment of science has proven to be an almost fruitless attempt. This area of the students' affective domain has now been taken into consideration by many curricula designers and teachers. It appears to the author that perceptions of students' enjoyment of science has too long been ignored.

Recent research concerning student interest has been conducted in an attempt to describe "enjoyment" according to the degree of interest a student has toward science.

Several studies have reported a decline in student interest as a result of their participation in science classes. Lawrenz (42) reported that one variable which might be affecting student interest is the learning environment of the science classroom. It seems likely that a student's perception of his classroom environment would affect his opinion of the course. Lawrenz further stated that the loss of interest appeared to be more pronounced in the physical sciences.

Many students tend to lose interest and not enjoy things they find particularly difficult (42). Perhaps interest loss could be abated by presenting science material in such a way that students would find it easier, therefore, less threatening and more enjoyable.

Gardner (25) conducted research concerning high school physics students' enjoyment of physics. He hypothesized that a student at the positive extreme of the continuum would view physics as an important activity for himself; he would be committed to searching actively for an understanding of physical phenomena, and he would gain enjoyment in the process. The negative extreme would be represented by students who possessed a personal antipathy toward the study of physical phenomena. The major finding of the study was a sharp decline in enjoyment of physics displayed by most pupils. The decline in enjoyment was not displayed by all students. Intellectual, achievement-motivated pupils with intellectual, achievement-pressing teachers maintained a high level of enjoyment.

Declining test scores in science, and other subjects, have been of recent concern to teachers and science educators. Several explanations have been proposed including (1) invalid tests, (2) failure of schools to do their job properly, (3) out-of-school influences, (4) less time spent on science, and (5) reduction in intelligence related to genetic factors and increasing family size. Welch (73) suggested that while achievement scores in science have, indeed, dropped, there has been a concomitant increase in the affective outcomes of schooling. Perhaps teachers feel a need to make school a more satisfying experience with increased emphasis on games, science fiction, laboratory exercises, and fewer tests, while diminishing those activities associated with traditional content work: lecture, problem assignments, and testing.

The findings by Welch emphasized that students of today are enjoying science more, but possibly learning less.

It is hopeful that this study of students' perceptions of enjoyment of science will increase communication between teachers and students in a place called "school" and be of some value to educational researchers.

Suitability to "Real World" Situations

Many individuals do not view science as being meaningful. For them, there is a gap between science curriculum and the "real world." Hurd (36) states:

> The broad goal of science teaching for the 1970's needs to go beyond the restrictive content of the special disciplines and consider science in relation to the affairs of mankind, the activities of the 'real world,' and the human condition (p. 768).

Traditionally, we have taught science in a way that tends to develop technicians and specialists. Although we must not neglect those who will become specialists in science, we must be able to fulfill the needs of the large majority of children which are not interested in becoming specialists. If all students are helped to the full utilization of their intellectual powers, we will have a better chance of surviving as a democracy in an age of enormous technological and social complexity (6).

Hurd (37) further states:

> Science teaching ought to foster emergence of citizenry that is capable of utilizing science and technology to promote the development of man as a human being (p. 14).

The task set before education also consists not only in giving students the all-round knowledge necessary to turn them into a good citizen, but also in developing in them independence of thought necessary for a creative awareness of the surrounding world (39).

> Science education should make its greatest contribution to the total educational program in the area of critical thinking and the process of inquiry. Through this sort of development a person is prepared not only for today's problems but also for those of the future (p. 431).

Bringing the world to the classroom forces the student to participate in society and arms him with first-hand experience for making decisions as a citizen. Bruner (5) relates the following:

> It is only through the exercise of problem solving and the effort of discovery that one learns the working heuristics of discovery, and the more one has practice, the more likely is one to generalize what one has learned into a style of problem solving or inquiry that serves for any kind of task one may encounter.... (p. 27).

Students involved in a problem solving situation within a science classroom using an individualized, self-paced, and activity centered approach find the science classroom in many ways like real life in which people must take responsibilities for their own directions, but can share resources with each other and can call on help when needed. In this laboratory setting, students gradually learn the valuing skills and the learning skills that will serve them throughout their lives.

Students can and should achieve many important goals as a consequence of studying science. The science student should better understand the world around him and have a greater appreciation for what he sees. He should realize that he or she, as an individual, can do much to shape his own environment and the events which occur in it.

The three-year ISCS sequence begins with fundamental ideas which apply to many situations then proceeds to relating these ideas to each other as well as new situations. There is then a transition from the laboratory situation to complex problems that extend well beyond the classroom.

A new educational challenge has been made by the National Science Teachers Association. It is one of developing learning environments to prepare young people to cope with a society characterized by rapid change, in other words, to prepare them for "real world" situations (62).

Rural-Urban Environment

Studies have shown that rural or urban residence is strongly related to educational status. Urban residents are almost always better educated than rural residents, regardless of sex, age, maturity, race or parentage. Rural pupils are characterized by poor educational achievement as compared with urban pupils (57).

The rural student and the characteristics which may be unique to him and his situation have tended to be overlooked by researchers. Ackerson (2) stated at the National Outlook Conference on Rural Growth that the incidence of incentive to remain in high school or in college was evidently not as great in rural America, as shown by the high dropout rate, and the educational and vocational opportunities offered to rural young people were quite limited.

On all socioeconomic levels, children may be hampered by characteristics resulting, directly or indirectly, from their parents' situations. Thurston (69) concluded on this basis that living in rural areas with low income seemed to be particularly conducive to the development of "disadvantagement." For rural and urban U.S.A., as economic status rises, educational achievement levels rise (17).

Rural youth on the whole receive less preparation for successful entry into the world of work and have a much smaller range of occupational aspirations.

Sperry (64) found a relationship between standards of living and interests of rural youth. Youth from high and middle economic status group backgrounds display more scientific interest than youth from lower standards of living backgrounds. Sperry felt that scientific interest was explainable in that certain cultural advantages, generally more prevalent among high and middle status groups, were known to stimulate an interest in discovering new facts and solving problems.

Rural children bring certain attitudes to school which seem to be associated with their home life and economic status. These attitudes carry over into school activities (17).

The United States Department of Agriculture (USDA, 1967) reported that about 19% of the rural youth had fallen behind at least one year in educational achievement and that only 12% of rural youth were that educationally retarded (71).

It was indicated that the curriculum was not adequate to prepare rural students for higher education or employment. Related to socioeconomic status are other attitudes found among rural youth which may hinder their progress: low self-esteem, feelings of helplessness in the face of seemingly unconquerable environmental handicaps, and impoverished confidence in the value and importance of education as an answer to their problems. Curricula in rural schools are frequently inadequate for and irrelevant to the needs of students (17).

Studies by Randhawa and Michaylick (57) indicated that rural classrooms are characterized by cohesiveness, cliqueness, disorganization and competitiveness. Whereas, urban classrooms are characterized by better environment, high level of difficulty and low level of satisfaction. Cohesiveness of a class relates to learning criteria differentially depending upon the norms of the cohesive class. Disorganization is characterized by reduction in pupil learning while cliqueness of a class can lead to less than optimal group productivity. Rural classes manifest pupils' perceptions of the learning environment which are not facilitative of productive learning outcomes. The urban classrooms are perceived to provide sufficient challenge to the learning, to be abundantly equipped, and to be satisfying (57). In other words, urban classes tend to be oriented toward learning more than the rural classes.

Summary

There can be no question that science education at all levels involves a myriad of complex affective behaviors. Today, perhaps more than any other time in our history, instructional strategies, and curricula in science reflect fundamental human needs and societal issues. The basic tenets of science are being intertwined with philosophical, psychological and sociological entities, forming new multi-disciplinary bases on which students of the future will have to operate (63).

Attitudes and values associated with science are playing increasingly important roles in our society. The "feelings," attitudes," and "values" students take from their science courses may be of more consequence--both immediately and ultimately--than anything else the curriculum embodies.

It is of the researcher's opinion that knowledge of subject matter is not the only area to be considered in science curricula. Certainly student attitudes constitute an important consideration. This study, to assess student attitude, will hopefully provide insight to junior high students' perceptions of science.

CHAPTER III

DESIGN AND METHODOLOGY

This study sought to establish the degree of relationship between selected attitudes of junior high school students toward science and other dichotomous variables: ISCS and non-ISCS, rural and urban. The design called for a relational study between scores on the instrument and group membership.

Subjects Included in the Study

The subjects for this study consisted of rural and urban junior high school science students, grades six, seven, eight, and nine, who were enrolled during the spring semester, 1976, in schools in the state of Oklahoma.

No attempt was made to secure a random sample since no frame for the population was available, thus information was secured in part from volunteers. The frame for the study was derived from two sources: (1) a non-randomized list of teachers that was secured from the Oklahoma State Department of Education, and (2) a roster of participants in ISCS training programs.

All non-ISCS student responses were from students of teachers listed by the Oklahoma State Department of Education. Only students of teacher volunteers responded to the opinionnaire from both sources. A high percentage of the ISCS student responses were from students of teachers who were part of an ISCS training program, conducted from 1974-1976. No distinction was made between ISCS teachers which participated in the ISCS training program and those ISCS teachers which did not.

Each student in the sample was then enrolled in a science course when he or she responded to the survey instrument. Only those students present on the day that the Science Opinionnaire was administered were considered part of the sample. Data from students who were absent during the data gathering were not included.

The urban responses were obtained from students in the Oklahoma City and Tulsa area. Rural student responses were obtained from other schools in the state of Oklahoma.

The data for this study were secured from 4063 student responses that were available for analysis. Rural-urban ISCS student responses represented 2133 of the total number. Non-ISCS rural and urban student responses represented 1929 of the total responses.

Instrumentation

The instrument used in this study was the Science Opinionnaire designed by the Michigan State Department of Education for use in monitoring attitudes toward science (Appendix A). The instrument consisted of twenty items dealing with student perceptions of science. For the purpose of this study the items were clustered to obtain students' perceptions of (a) readability of science materials, (b) amount of science learned, (c) suitability of science to "real world" situations, (d) enjoyment of science, and (e) science as an entity.

The items were clustered as follows:

(a) Student perceptions of readability of science materials--Items 1, 7, and 14.

(b) Student perceptions of amount of science learned--Items 3, 9, 15 and 19.

(c) Student perceptions of suitability to "real world" situations--Items 4, 5, 11, 12, 17, and 18.

(d) Student perceptions of enjoyment of science--Items 3, 6, 8, 10, 13, 16, and 20.

The overall reliability of the instrument was checked by both the test-retest and the split-halves methods, with scores from seventh and eighth grade students. In the latter case, a value of 0.833 was obtained (21). Since no reliability data were available for the clusters of scores, split-halves reliability coefficients were derived from the subjects of this study. The coefficients are as follows: 0.280 -- Items 2, 6, 8, 10, 13, 16, and 20 (enjoyment); 0.497 -- Items 4, 5, 11, 12, 17, and 18 (suitability); 0.405 -- Items 3, 9, 15, and 19 (amount of science learned); 0.220 -- Items 1, 7, and 14 (readability). These are comparatively low as would be expected from instruments consisting of only three to seven items.

The Science Opinionnaire is a summated rating scale. The Likert-type scale consisted of a series of items about a particular topic to which the respondent marked a one-answer category such as "strongly agree", "agree", "uncertain", etc. The answer choices were then weighted -2, -1, 0, +1, and +2, respectively, with the +2 assigned to the answer which, if checked, would reflect a favorable attitude. Seven of the twenty items were stated negatively, thirteen of the items were stated positively.

The weights of the positively stated items were reversed for ease in scoring. The sum of the twenty ratings yielded the score used to express the student's perception of science as an entity. The clusters of items were summed in a like fashion to yield scores regarding (a) readability of science materials, (b) amount of science learned, (c) suitability to "real world" situations, and (d) enjoyment of science.

The computer program also computed means, standard deviations, sums of squares, and ranges of responses for each item, item clusters, and all items.

Collection of Data

The ISCS and non-ISCS samples were drawn from school systems in the state of Oklahoma.

The opinionnaires, accompanied by a letter of explanation (Appendix B), instruction sheet (Appendix C), fifty computer cards on which students responded to each item, and a stamped, self-addressed return envelope were sent to one hundred junior high schools. Within ten days after receiving the instruments the teachers administered the opinionnaire to their students.

Seventy-one percent of the instruments were returned and scored by a computer program.

Returned opinionnaires were dichotomized into three divisions: ISCS to non-ISCS; Urban ISCS to Rural ISCS; and Urban non-ISCS to Rural non-ISCS. Within each of these divisions, student responses were analyzed in the areas of (a) readability of science materials, (b) amount of science learned, (c) suitability to "real world" situations, and (d) enjoyment of science, as well as (e) science as an entity.

Statistical Analysis

A Statistical Analysis System program (SAS 762) was employed in analyzing the data. The tabulation and analysis of the twenty items, the four clusters of items, and the total instrument were completed by December of 1976.

The coefficient of correlation used in this study was the point-biserial correlation. When one of the two variables in a correlation problem is a genuine dichotomy, or when it is doubtful that the dichotomous one stems from a normal distribution, the appropriate type of coefficient to use is the point-biserial (30).

The formula used for computing the point-biserial coefficient's correlation was,

$$pbi = \frac{M_p - M_q}{t} \qquad \sqrt{pq}$$

Where M_p = mean of X values for the higher group in the dochotomous variable, the one having more of the ability in which the sample is divided into two subgroups.

M_q = mean of X values for the lower group.

p = proportion of the cases in the higher group.

q = proportion of the cases in the lower group.

t = standard deviation of the total sample in the continuously measured variable, X.

pbi = point-biserial correlation coefficient.

The point-biserial coefficient of correlation assumes that the variable which has been classified into two categories can be thought of as concentrated at two distinct points along a graduated scale of continuum. The point-biserial coefficient of correlation makes no assumptions regarding the form of distribution in the dichotomized variable, it may be used in a regression equation, and its standard error can be determined exactly (25).

The point-biserial coefficient of correlation permits one to predict group membership on the basis of relationship expressed by the coefficient. A positive correlation would record a tendency for high scores to be associated with memberships in the ISCS, urban ISCS, and urban non-ISCS groups and low scores to be associated with membership in the non-ISCS, rural ISCS, and rural non-ISCS groups. A negative correlation would reflect the opposite tendency. A zero correlation would reflect no discernable relationship between high and low scores and group membership. Point-biserial coefficients were obtained for each of the fifteen stated hypotheses. Perfect prediction of a continuous variable from a two-categoried variable is obviously impossible (19). The 0.05 level of confidence was arbitrarily selected for rejecting the hypotheses.

Summary

The primary purpose of this study was to initiate an inquiry into rural and urban, ISCS and non-ISCS student attitudes toward readability of science materials, amount of science learned, suitability of science to "real world" situations, enjoyment of science, and science as an entity.

The sample of 4063 subjects was non-random, but was selected with as much care as can be exercised in a field-based research. The instrument selected was one that has been proven in a similar study. The use of cluster scores necessitated additional analysis to establish the reliability of those scores.

The study described in this chapter provided the guidelines within which the role of the statistical design could function. Fifteen relational hypotheses were tested by computing point-biserial coefficients of correlation. These were tested for significance at the 0.05 level of confidence.

CHAPTER IV

ANALYSIS OF THE DATA

As indicated in the previous chapters, the primary purpose of this study was to assess attitudes of rural and urban ISCS and non-ISCS junior high school science students toward (a) enjoyment of science, (b) amount of science learned, (c) readability of science materials, (d) suitability to "real world" situations, and (e) science as an entity.

In this chapter, selected information from the Science Opinionnaire and analyses of that information will be presented.

The principal statistical tool used in this study was the point-biserial coefficient of correlation. The 0.05 level of confidence was used in rejecting or not rejecting hypotheses.

In this chapter the data are reported and evaluated with respect to three dichotomies: (a) ISCS and non-ISCS, (b) urban ISCS and rural ISCS, (c) urban non-ISCS and rural non-ISCS. Five hypotheses were tested with respect to each dichotomy. The results of these tests will be presented in tabular form.

The computer program yielded means, standard deviations, point-biserial coefficients of correlation, sums of squares, and ranges of responses for each item, each cluster and all items. Listed in Table I are the ISCS and non-ISCS number of respondents, means and standard deviation of each of the twenty items composing the Science Opinionnaire. As reported in Table I there were 4063 total responses. The mean trend

TABLE I

MEANS AND STANDARD DEVIATION OF SCIENCE OPINIONNAIRE ITEMS
ALL SUBJECTS

Item	Number	Mean	Standard Deviation
1.	4049	-0.121	1.154
2.	4049	-0.907	1.174
3.	4025	-0.660	1.180
4.	4029	0.415	1.133
5.	4012	-0.104	1.258
6.	4011	-0.273	1.347
7.	4021	-0.754	1.277
8.	4013	-0.868	1.210
9.	4012	-0.544	1.099
10.	3991	-0.377	1.156
11.	4012	-0.657	1.226
12.	4022	-0.007	1.298
13.	4012	0.136	1.418
14.	4001	-0.150	1.290
15.	3978	-0.165	1.190
16.	3979	0.424	1.154
17.	3984	-0.608	1.279
18.	3994	-0.415	1.147
19.	3995	-0.481	1.184
20.	3949	-0.116	1.186
Total Respondents	4063	0.475	0.499

was toward the negative end of the -2, -1, 0, +1, +2 continuum. All of the means were negative with the exception of items 4, 13, and 16 which dealt with students' perceptions of suitability to "real world" situations and level of enjoyment.

Shown in Table II are the total number of respondents, means, and standard deviation of each of the clusters of items from the Science Opinionnaire. The mean trend of the clusters of items was toward the negative end of the continuum.

Listed in Table III are the ISCS means and standard deviation of each of the twenty items composing the Science Opinionnaire. As reported in Table III, there were 2123 total responses. The mean trend was toward the negative end of the continuum. All of the means were negative with the exception of items 4, 5, 12, 13, and 16 which dealt with students' perceptions of enjoyment of science and suitability to "real world" situations.

Shown in Table IV are the rural and urban ISCS number of respondents, means, and standard deviation for each of the clusters of items from the Science Opinionnaire. The mean trend was toward the negative end of the continuum.

Listed in Table V are the rural and urban non-ISCS number of respondents, means, and standard deviation of each of the twenty items composing the Science Opinionnaire. As reported in Table V, there were 1915 total responses. The mean trend was toward the negative end of the continuum. All of the means were negative with the exception of items 4, 13, and 16 which dealt with students' perceptions of enjoyment of science and suitability to "real world" situations.

Shown in Table VI are the rural and urban non-ISCS number of

TABLE II

MEANS AND STANDARD DEVIATION OF CLUSTERS OF ITEMS
ISCS AND NON-ISCS

Clusters	Number	Mean	Standard Deviation
A. Enjoyment (Items: 2, 6, 8, 10, 13, 16, and 20)	3689	-1.980	5.197
B. Amount learned (Items: 3, 9, 15, and 19)	3849	-1.848	3.201
C. Readability (Items: 1, 7, and 14)	3947	-1.028	2.527
D. Suitability (Items: 4, 5, 11, 12, 17, and 18)	3771	-1.368	4.567

TABLE III

MEANS AND STANDARD DEVIATION OF SCIENCE OPINIONNAIRE ITEMS
ALL SUBJECTS

Item	Number	Mean	Standard Deviation
1.	2123	-0.089	1.165
2.	2122	-0.587	1.302
3.	2112	-0.654	1.220
4.	2105	0.298	1.174
5.	2089	0.112	1.277
6.	2102	-0.314	1.350
7.	2104	-0.754	1.313
8.	2101	-0.674	1.279
9.	2105	-0.496	1.142
10.	2087	-0.198	1.196
11.	2103	-0.522	1.282
12.	2106	0.103	1.322
13.	2102	0.114	1.456
14.	2095	-0.104	1.313
15.	2084	-0.087	1.221
16.	2088	0.390	1.178
17.	2084	-0.557	1.299
18.	2092	-0.364	1.185
19.	2092	-0.413	1.228
20.	2061	-0.106	1.194
Total Respondents	2123	0.476	0.499

TABLE IV

MEANS AND STANDARD DEVIATION OF CLUSTERS OF ITEMS
RURAL AND URBAN ISCS

Clusters	Number	Mean	Standard Deviation
A. Enjoyment	1919	-1.390	5.613
B. Amount Learned	2022	-1.645	3.407
C. Readability	2065	-0.951	2.558
D. Suitability	1954	-0.919	4.865

TABLE V

MEANS AND STANDARD DEVIATION OF <u>SCIENCE OPINIONNAIRE</u> ITEMS
ALL SUBJECTS

Item	Number	Mean	Standard Deviation
1.	1919	-0.156	1.141
2.	1920	-1.261	0.891
3.	1907	-0.665	1.134
4.	1917	0.544	1.072
5.	1916	-0.340	1.194
6.	1902	-0.228	1.342
7.	1911	-0.751	1.237
8.	1906	-1.081	1.092
9.	1902	-0.597	1.046
10.	1898	-0.573	1.079
11.	1903	-0.807	1.143
12.	1910	-0.130	1.260
13.	1905	0.161	1.374
14.	1902	-0.202	1.266
15.	1888	-0.251	1.148
16.	1886	0.463	1.128
17.	1894	-0.665	1.256
18.	1896	-0.471	1.099
19.	1897	-0.555	1.128
20.	1882	-0.127	1.179
Total Respondents	1915	0.649	0.478

TABLE VI

MEANS AND STANDARD DEVIATION OF CLUSTERS OF ITEMS
RURAL AND URBAN NON-ISCS

Clusters	Number	Mean	Standard Deviation
A. Enjoyment	1765	-2.619	4.624
B. Amount Learned	1822	-2.069	2.944
C. Readability	1878	-1.111	2.492
D. Suitability	1811	-1.852	4.171

respondents, means, and standard deviations for each of the clusters of items from the Science Opinionnaire. The mean trend was toward the negative end of the -2, -1, 0, +1, +2 continuum.

Specific Hypotheses Tested

Coefficients of correlation are reported in this section. A positive correlation indicates that there was a relationship between high scores on the opinionnaire and membership in the ISCS group and low scores on the opinionnaire and membership in the non-ISCS group. A negative correlation indicates just the opposite, i.e., a relationship between high scores and membership in the non-ISCS group.

ISCS and Non-ISCS

A: There is no significant relationship between perceptions of ISCS and non-ISCS students toward science as an entity.

Items one through twenty of the Science Opinionnaire were used to determine the coefficient of correlation. As reported in Table VII, the coefficient of correlation was 0.104, which for this number of subjects was significant at the 0.05 level. Thus, the hypothesis of no relationship was rejected.

B: There is no significant relationship between perceptions of ISCS and non-ISCS students toward level of enjoyment.

Items 2, 6, 8, 10, 13, 16, and 20 were clustered and used to determine the coefficient of correlation. The items are as follows:

2. We spend too much time doing experiments.

6. I dislike coming to science class.

8. I enjoy doing the science experiments.

10. My friends enjoy doing science experiments.

TABLE VII

ISCS AND NON-ISCS

Hypothesis	pbi
A: Science	01.04*
B: Enjoyment	0.118*
C: Amount Learned	0.065*
D: Readability	0.032*
E: Suitability	0.103*

*Significant at 0.05 Level

13. I do not want to take any more science classes than I have to take.

16. Science is dull for most people.

20. Most people like science classes.

The coefficient of correlation was 0.118, which for this number of subjects was significant at the 0.05 level. Thus, the hypothesis of no relationship was rejected.

C: There is no significant relationship between perceptions of ISCS and non-ISCS students toward level of amount learned.

Items 3, 9, 15, and 19 were clustered and used to determine the coefficient of correlation. The items are as follows:

3. I am learning a lot in science this year.

9. I can solve problems better than before.

15. Experiments are hard to understand.

19. I learn a lot from doing my science experiments.

The coefficient of correlation was 0.065, which for this number of subjects was significant at the 0.05 level. Thus, the hypothesis of no relationship was rejected.

D. There is no significant relationship between perceptions of ISCS and non-ISCS students toward level of readability.

Items 1, 7, and 14 were clustered and used to determine the coefficient of correlation. The items are as follows:

1. Reading science is difficult.

7. I read more science materials than I did in the sixth grade.

14. Reading science is more fun than it used to be.

The coefficient of correlation was 0.032, which for this number of subjects was significant at the 0.05 level. Thus, the hypothesis of no relationship was rejected.

E: There is no significant relationship between perceptions of ISCS and non-ISCS students toward level of suitability.

Items 4, 5, 11, 12, 17, and 18 were clustered and used to determine the coefficient of correlation. The items are as follows:

4. What we do in class is what a real scientist would do.

5. In science class we study "Today's Problems".

11. What I am learning in science will be useful to me outside school.

12. I think about things we learn in science class when I'm not in school.

17. The things we do in this class are useless.

18. The kinds of experiments I do in class are important.

The coefficient of correlation was 0.103, which for this number of subjects was significant at the 0.05 level. Thus, the hypothesis of no relationship was rejected.

Urban ISCS and Rural ISCS

F: There is no significant relationship between perceptions of urban ISCS and rural ISCS students toward science as an entity.

Items one through twenty of the Science Opinionnaire were used to determine the coefficient of correlation. As reported in Table VIII, the coefficient of correlation was 0.118, which for this number of subjects was significant at the 0.05 level. Thus, the hypothesis of no relationship was rejected.

G: There is no significant relationship between urban ISCS student perception and rural ISCS student perception in degree of enjoyment.

Items 2, 6, 8, 10, 13, 16, and 20 were clustered and used to determine the coefficient of correlation.

TABLE VIII

URBAN ISCS AND RURAL ISCS
POINT-BISERIAL CORRELATION

Hypothesis	pbi
F: Science	0.118*
F: Enjoyment	0.147*
H: Amount Learned	0.065*
I: Readability	0.105*
J: Suitability	0.080*

*Significant at 0.05 Level

2. We spend too much time doing experiments.

6. I dislike coming to science class.

8. I enjoy doing the science experiments.

10. My friends enjoy doing science experiments.

13. I do not want to take any more science classes than I have to take.

16. Science is dull for most people.

20. Most people like science classes.

The coefficient of correlation was 0.147, which for this number of subjects was significant at the 0.05 level. Thus, the hypothesis of no relationship was rejected.

H: There is no significant relationship between urban ISCS student perception and rural ISCS student perception in degree of amount learned.

Items 3, 9, 15, and 19 were clustered and used to determine the coefficient of correlation.

3. I am learning a lot in science this year.

9. I can solve problems better than before.

15. Experiments are hard to understand.

19. I learn a lot from doing my science experiments.

The coefficient of correlation was 0.065, which for this number of subjects was significant at the 0.05 level. Thus, the hypothesis of no relationship was rejected.

I: There is no significant relationship between urban ISCS student perception and rural ISCS student perception in degree of readability.

Items 1, 7, and 14 were clustered and used to determine the coefficients of correlation.

1. Reading science is difficult.

7. I read more science materials than I did in the sixth grade.

14. Reading science is more fun than it used to be.

The coefficient of correlation was 0.105, which for this number of subjects was significant at the 0.05 level. Thus, the hypothesis of no relationship was rejected.

J: There is no significant relationship between urban ISCS student perception and rural ISCS student perception in degree of suitability.

Items 4, 5, 11, 12, 17, and 18 were clustered and used to determine the coefficient of correlation.

4. What we do in class is what a real scientist would do.

5. In science class we study "Today's Problems".

11. What I am learning in science will be useful to me outside school.

12. I think about things we learn in science class when I'm not in school.

17. The things we do in this class are useless.

18. The kinds of experiments I do in class are important.

The coefficient of correlation was 0.080, which for this number of subjects was significant at the 0.05 level. Thus, the hypothesis of no relationship was rejected.

Urban Non-ISCS and Rural Non-ISCS

K: There is no significant relationship between urban non-ISCS and rural non-ISCS students toward science as an entity.

Items one through twenty of the Science Opinionnaire were used to determine the coefficient of correlation. As reported in Table IX, the coefficient of correlation was 0.086, which for this number of subjects was significant at the 0.05 level. Thus, the hypothesis of no

TABLE IX

URBAN NON-ISCS AND RURAL NON-ISCS
POINT-BISERIAL CORRELATION

Hypothesis		pbi
K:	Science	0.086*
L:	Enjoyment	0.118*
M:	Amount Learned	0.046
N:	Readability	0.058*
O:	Suitability	0.066*

*Significant at 0.05 Level

relationship was rejected.

L: There is no significant relationship between urban non-ISCS student perception and rural non-ISCS student perception in degree of enjoyment.

Items 2, 6, 8, 10, 13, 16, and 20 were clustered and used to determine the coefficient of correlation.

2. We spend too much time doing experiments.

6. I dislike coming to science class.

8. I enjoy doing the science experiments.

10. My friends enjoy doing science experiments.

13. I do not want to take any more science classes than I have to take.

16. Science is dull for most people.

20. Most people like science classes.

The coefficient of correlation was 0.118, which for this number of subjects was significant at the 0.05 level. Thus, the hypothesis of no relationship was rejected.

M: There is no significant relationship between urban non-ISCS student perception and rural non-ISCS student perception in degree of amount learned.

Items 3, 9, 15, and 19 were clustered and used to determine the coefficient of correlation.

3. I am learning a lot in science this year.

9. I can solve problems better than before.

15. Experiments are hard to understand.

19. I learn a lot from doing my science experiments.

The 0.046 coefficient of correlation was not significant at the 0.05 level. Thus, the hypothesis of no relationship was not rejected.

N: There is no significant relationship between urban non-ISCS student perception and rural non-ISCS student perception in degree of readability.

Items 1, 7, and 14 were clustered and used to determine the coefficient of correlation.

1. Reading science is difficult.

7. I read more science materials than I did in the sixth grade.

14. Reading science is more fun than it used to be.

The coefficient of correlation was 0.058, which for this number of subjects was significant at the 0.05 level. Thus, the hypothesis of no relationship was rejected.

O: There is no significant relationship between urban non-ISCS student perception and rural non-ISCS student perception in degree of suitability.

Items 4, 5, 11, 12, 17, and 18 were clustered and used to determine the coefficient of correlation.

4. What we do in class is what a real scientist would do.

5. In science class we study "Today's Problems".

11. What I am learning in science will be useful to me outside school.

12. I think about things we learn in science class when I'm not in school.

17. The things we do in this class are useless.

18. The kinds of experiments I do in class are important.

The coefficient of correlation was 0.066, which for this number of subjects was significant at the 0.05 level. Thus, the hypothesis of no relationship was rejected.

Summary

This chapter included a presentation of the results obtained from this study. The point-biserial coefficient was utilized for analysis of the data.

Fourteen of the fifteen hypotheses were rejected at the 0.05 level. The hypothesis stating the relationship between urban non-ISCS and rural non-ISCS on the amount of science learned was not rejected at the 0.05 level of confidence. It should be noted however that this level of confidence, 0.0502, was close to the arbitrarily selected 0.05 figure in its fourth decimal place.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

This study was designed to assess rural, urban, ISCS, and non-ISCS junior high school science students' attitudes toward (a) readability of science materials, (b) suitability of science to "real world" situations, (c) enjoyment of science, (d) amount of science learned, and (e) science as an entity.

The subjects for this study consisted of rural, urban, ISCS and non-ISCS junior high school science students, grades 6, 7, 8, and 9, who were enrolled during the spring semester, 1976, in schools in the state of Oklahoma. No attempt was made to secure a random sample since no frame for the population was available, and information was secured in part from volunteers. The frame for the study was derived from two sources: (1) non-randomized list of teachers that was secured from the Oklahoma State Department of Education and (2) a roster of participants in ISCS training programs.

All non-ISCS student responses were from students of teachers on the Oklahoma State Department of Education list. Only students of teacher volunteers responded to the opinionnaire from ISCS and non-ISCS classrooms. A high percentage of ISCS student responses were from students of teachers who were participants in an ISCS training program conducted from 1974-1976.

The Science Opinionnaire was the instrument used in this study. This twenty item instrument was mailed to 100 junior high schools in Oklahoma. Seventy-one percent of the instruments were returned and scored by a computer program. The data for this study were secured from 4063 students' responses that were available for analysis. The tabulation and analysis of the twenty items, the four clusters of items, and the total instrument were completed by December of 1976.

The coefficient of correlation used in this study was the point-biserial correlation. Coefficients were obtained for each of the fifteen stated hypotheses to predict group membership. A positive correlation would record a tendency for high scores to be associated with membership in the ISCS, urban ISCS, and urban non-ISCS groups and low scores to be associated with membership in the non-ISCS, rural ISCS, and rural non-ISCS groups. A negative correlation would reflect the opposite tendency.

Conclusions

ISCS-Non-ISCS

All five relational hypotheses regarding the ISCS and non-ISCS groups were rejected at the 0.05 level of confidence. The coefficient of correlation for the clusters and group membership were as follows:

(a)	level of enjoyment	0.118
(b)	amount of science learned	0.065
(c)	readability	0.032
(d)	suitability	0.103

The coefficient of correlation for science as an entity was 0.104.

The magnitude of relationship is quite small though indicating a general trend of ISCS students having a more positive attitude toward these facets of science than non-ISCS students.

Urban ISCS and Rural ISCS

All five relational hypotheses regarding the urban ISCS and rural ISCS groups were rejected at the 0.05 level of confidence. The coefficient of correlation for the clusters and group membership were as follows:

(a)	level of enjoyment	0.147
(b)	amount of science learned	0.065
(c)	readability	0.105
(d)	suitability	0.080

The coefficient of correlation for science as an entity was 0.118.

The magnitude of relationship is again quite small though indicating a general trend of urban ISCS students having a more positive attitude toward these facets of science than rural ISCS students.

Urban Non-ISCS and Rural Non-ISCS

Four of the five relational hypotheses regarding urban non-ISCS and rural non-ISCS were rejected at the 0.05 level of confidence. The coefficient of correlation for the clusters and group membership were as follows:

(a)	level of enjoyment	0.118
(b)	readability	0.058
(c)	suitability	0.066
(d)	amount of science learned	0.046

The coefficient of correlation for science as an entity was 0.086.

There is no evidence that a relationship exists between the cluster dealing with amount of science learned and group membership.

The magnitude of relationship is quite small though indicating a general trend of rural non-ISCS students having a more positive attitude toward these facets of science than urban non-ISCS students.

Recommendations

This study was undertaken to assess rural, urban, ISCS, non-ISCS junior high school science students' attitudes toward (a) readability of science materials, (b) suitability of science to "real world" situations, (c) enjoyment of science, (d) amount of science learned, and (e) science as an entity.

Level of enjoyment, readability, suitability to "real world" situations, amount of science learned as well as the overall attitude toward science, was generally more positive for ISCS students than for non-ISCS students. Based upon the results of the investigation, even a slight positive attitude could be educationally significant, due to the fact that 45% of all junior high school science students are presently involved or have been involved with the ISCS program.

As a result of this study, the writer makes the following recommendations:

1. Subject the research question to an experimental design to access differences experimentally.
2. Studies should be undertaken to identify sources of negative attitudes of junior high school science school students.

3. Attention should be given to the development of various instruments that may be used in measuring student attitudes.
4. Experimental studies should be conducted to determine the factor which causes the apparent difference of opinions of ISCS and non-ISCS junior high school science students.
5. Large scale research should be conducted by the Oklahoma State Department of Education in the area of junior high school science students' attitudes.
6. Data on which correlations were established showed that mean attitudes toward science, for the most part, were negative, thus a task of further research would be to attempt to improve attitudes of junior high school science students.

The key to success of improvement of science education can be found not only within the teacher's understanding of his or her students, the environment in which the student must function, but most important, the teacher must be aware of himself or herself.

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APPENDIXES

APPENDIX A

SCIENCE OPINIONNAIRE

Read the following statements carefully. Darken in the box which agrees with your answer. For example, if you strongly agree with a question, you would darken box number one, if you disagreed, you would darken in box four, and so on. EXAMPLE: Most people like science. If you strongly agree, you would darken box one.

Box 1 2 3 4 5

KEY: Your attitude toward statement
SA -- Strongly agree -- Box 1
A -- Agree -- Box 2
N -- Neither agree nor disagree -- Box 3
D -- Disagree -- Box 4
SD -- Strongly disagree -- Box 5

No one will know how you answered unless you tell, as your paper should not be signed.

1. Reading science is difficult.	SA	A	N	D	SD
2. We spend too much time doing experiments.	SA	A	N	D	SD
3. I am learning a lot in science this year.	SA	A	N	D	SD
4. What we do in class is what a real scientist would do.	SA	A	N	D	SD
5. In science class we study "Today's Problems".	SA	A	N	D	SD
6. I dislike coming to science class.	SA	A	N	D	SD
7. I read more science materials than I did in sixth grade.	SA	A	N	D	SD
8. I enjoy doing the science experiments.	SA	A	N	D	SD
9. I can solve problems better than before.	SA	A	N	D	SD
10. My friends enjoy doing science experiments.	SA	A	N	D	SD
11. What I am learning in science will be useful to me outside school.	SA	A	N	D	SD
12. I think about things we learn in science class when I'm not in school.	SA	A	N	D	SD
13. I do not want to take any more science classes than I have to take.	SA	A	N	D	SD
14. Reading science is more fun than it used to be.	SA	A	N	D	SD

15. Experiments are hard to understand.	SA	A	N	D	SD
16. Science is dull for most people.	SA	A	N	D	SD
17. The things we do in this class are useless.	SA	A	N	D	SD
18. The kinds of experiments I do in class are important.	SA	A	N	D	SD
19. I learn a lot from doing my science experiments.	SA	A	N	D	SD
20. Most people like science classes.	SA	A	N	D	SD

APPENDIX B

LETTER OF EXPLANATION

Oklahoma State University

DEPARTMENT OF CURRICULUM AND INSTRUCTION

STILLWATER, OKLAHOMA 74074
GUNDERSEN HALL
(405) 372-6211, EXT. 6202

May 12, 1976

Dear Science Teacher:

The Intermediate Science Curriculum Study has been described as the most well-accepted National Science Foundation curriculum ever. Estimates as high as 45% of all junior high school age pupils in the nation are receiving some instruction in the ISCS curriculum. It becomes imperative under these circumstances to determine student perception of these materials as well as other junior high school science curriculum programs.

Would you please assist us in this endeavor. We wish to gather data on student perception of their science curriculum and are asking if you would have 2 or 3 of your 7th, 8th, or 9th grade science classes, preferably non-ISCS classes, react to the enclosed 20-item opinionnaire. An instruction as to how the opinionnaire and computer cards are to be administered are included. For your convenience, we have enclosed a self-addressed and stamped return envelope.

We would be pleased to forward the results of this survey to you. If you wish the results, please indicate your name and school.

Respectfully,

Ted J. Mills
Associate Professor

Gayla Guffy
Graduate Assistant

APPENDIX C

SCIENCE OPINIONNAIRE INSTRUCTIONS

A. Please give each of your students an opinionnaire and computer card, reminding them

1. Not to put answers on the opinionnaire. Answers go on the computer card.
2. Not to put their name on either the computer card or the opinionnaire.
3. Use a #2 pencil to block out responses (pencils are provided).

B. The opinionnaire has "Box 1, 2, 3, 4, 5," while the computer card is designated "A, B, C, D, E". Please instruct students that for items 1-20, A represents the number 1, B number 2, and so forth.

C. On the computer card, have students mark:

Item 26 A = ISCS
B = non-ISCS

Item 27 A = 6th grade
B = 7th grade
C = 8th grade
D = 9th grade
E = 10th grade

Item 28 A = ISCS level I
B = ISCS level II
C = ISCS level III

Item 29 A = urban - Oklahoma City & Tulsa schools only
B = rural - All other schools

D. Please check cards to see if students have responded correctly, and bring the completed cards and the blank opinionnaire to the May 23 session at Clinton.

E. Attach a note to the materials you return indicating if you were a participant in the ISCS training program at OSU, and your school system.

I wish to personally thank you for your cooperature in this venture!

Ted Mills
Gayla Guffy

VITA

Gayla Sue Guffy

Candidate for the Degree of

Doctor of Education

Thesis: STUDENT ATTITUDES TOWARD SCIENCE IN THE INTERMEDIATE SCIENCE CURRICULUM STUDY AND NON-INTERMEDIATE SCIENCE CURRICULUM STUDY JUNIOR HIGH SCHOOL SCIENCE PROGRAM

Major Field: Curriculum and Instruction

Biographical:

Personal Data: Born in Kingfisher, Oklahoma, April 26, 1941, the daughter of Bill and Jewel Pierson.

Education: Graduated from Kingfisher High School, Kingfisher, Oklahoma, in May, 1959; received the Bachelor of Science degree in Biology from Oklahoma Panhandle State University in May, 1963; received the Master of Education in Science degree from Southwestern Oklahoma State University in 1975; completed requirements for the Doctor of Education degree at Oklahoma State University in July, 1977.

Professional Experience: Junior and senior high school science teacher, Forgan, Oklahoma, 1964-1969; junior and senior high science teacher, Perkins, Oklahoma, 1969-1971; graduate assistant, Southwestern Oklahoma State University, Weatherford, Oklahoma, 1973-1974; elementary teacher, Custer City, Oklahoma, 1974-1975; graduate assistant, Oklahoma State University, 1975-1977.

Professional and Honorary Organizations: Delta Kappa Gamma; Beta Beta Beta; Kappa Delta Pi; National Science Teachers Association; High School Science & Mathematics Association.