The purpose of this study was to investigate one of the effects of the SCIS program in the Corvallis Public Schools. The investigation was based on a comparison of students' ability to construct a logical theoretical model from a discrepant event.

The total sample consisting of 289 students, was obtained with no known systematic bias through a table of random numbers and district teacher lists. The SCIS sample consisted of 136 students stratified by grade level with one first grade, one first-second split grade, two second grades, and two third grades represented. The non SCIS sample consisted of 153 students stratified along similar grade level lines. The experimental sample had one semester of SCIS prior to the present study.

The data gathering session consisted of the researcher
presenting the students with a discrepant event in the form of a "theory box." The theory box was a modified shoe box with a funnel on top and a hose visible on the bottom to the students. The students observed the researcher pour a clear liquid into the funnel and the liquid came out blue. After some unobtrusive manipulation by the researcher with the theory box, the students observed the clear liquid (from the same original container) being poured into the funnel. The liquid came out of the bottom hose yellow.

The students were asked to draw what they thought could be inside of the theory box to explain what they had observed. The data collected was classified as to logical, probably-logical, or non-logical from criteria developed by the researcher in conjunction with members of the Department of Science Education at Oregon State University.

Using chi-square analysis, after Siegel, it was concluded that:

1. There was no statistical evidence approaching the .05 level to support that SCIS was a factor in the ability of primary children to construct a logical theoretical model from a discrepant event when compared on the first and first-second split grade, second grade, and total first through third grade level.

2. It was not possible to analyze the third grade data alone due to lack of high enough expected
frequencies in the non-logical cells for valid use of chi-square.

3. The combined second and third grade SCIS to non SCIS sample was significant beyond the .10 level, one tailed. This would suggest a weak possibility that SCIS could be a factor in the ability of the combined second and third grade samples to logically explain a discrepant event.

4. Comparison of grade level as a factor obtained significance beyond the .10 level, two-tailed, for the first and first-second split grade sample to the second grade sample; beyond the .05 level for the second to third grade sample; and way beyond the .001 level of significance for the first and first-second split grade sample to the third grade sample. Significant results from chi-square analysis indicated a strong possibility that the grade level of a child was a factor in the ability of young children to construct a logical theoretical model from a discrepant event.

Based upon the data gathered in this study, the researcher recommends that a similar study be conducted using a larger sample and covering more grade levels. It also appears logical, to this researcher, to compare the SCIS to non SCIS students after more than just one semester of experience with SCIS materials. To replicate such a
study, further refinement of the researcher designed instruments is indicated.

Along the line of further research, the researcher recommends that the factors of Sex and I.Q. be explored with the ability of SCIS and non SCIS students to construct a logical theoretical model from a discrepant event. It also seems to this researcher that a significant follow-up study might be a comparison of student ability to construct a logical theoretical model from a discrepant event between students who were classified as pre-operational and concrete operational in terms of the Piaget conservation tasks.
A Comparison of Theoretical Model Construction Between Primary Students Using Science Curriculum Improvement Study Materials (SCIS) and Non SCIS Primary Students

by

Kenneth Kiely Harms

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Analysis of variance for comparison of the first and first-second split grade level to the third grade level on ability to construct a logical theoretical model from a discrepant event.
A COMPARISON of THEORETICAL MODEL CONSTRUCTION BETWEEN PRIMARY STUDENTS USING SCIENCE CURRICULUM IMPROVEMENT STUDY MATERIALS (SCIS) and NON SCIS PRIMARY STUDENTS

I. INTRODUCTION

The implementation of appropriate elementary science programs has long been a concern of educators. The programs have traditionally consisted of the basal text approach with some teacher demonstrations. The texts were essentially reading programs with memorization of scientific facts, principles, and laws. The text book approach suggested a type of finality and conclusiveness about scientific concepts.

Even scientists, armed with their scientific methods were brought up in a kind of expositional authoritarian approach that Schwab (1962) has labeled as a rhetoric of conclusions. Ivany (1964, p. 36) illustrated the dogma of the rhetoric of conclusions with the famous law about the inert gases:

Inert gases just would not react, and the reason seemed obvious. Inert gases had a full outer shell of electrons, they were quite content as there was no need for them to react. It was our religio-philosophic sense that inhibited our organization of research into the inert gases. Consequently, in the early 1960's we were quite shocked and surprised that not only had the scientists at the University of British Columbia achieved inert gas reactions, but they had done so with remarkable ease. We had suffered from an incorrect view of what kind of knowledge we were dealing with.

Obviously scientific concepts are very tenative in
nature. The concept of truth in the religo-philosophic sense has no validity in science for as Piaget (Ivany, 1964) has noted: "Scientific concepts are continually being reorganized, modified, and at times completely thrown out."

The launching of Sputnik in 1958 stimulated extensive federal funding and an emergence of new inquiry based-materials centered elementary science programs. While many funded projects failed, three main programs have succeeded and are fully developed or are in the final stages of test editions. These are American Association for the Advancement of Science (AAAS); Elementary Science Study (ESS); and Science Curriculum Improvement Study (SCIS). Among other major innovations, the new programs eliminated the traditionally held dogma of finality and conclusiveness and provided for the development of the idea that concepts are tenative in nature.

Recognizing the need for improving elementary science instruction, Corvallis Public School District 509J in conjunction with the Department of Science Education, Oregon State University, initiated a pilot study with SCIS in fifteen classrooms in September, 1970. Because of the vast difference between the traditionally used text book approach and the inquiry based approach of SCIS, the district conducted a summer workshop for the SCIS pilot teachers to acquaint the teachers with the SCIS philosophy and materials before the programs were presented to
elementary students.

The district is currently evaluating the pilot SCIS program. If the SCIS program is satisfactory for the Corvallis Public Schools, SCIS materials will be placed in more classrooms within the district.

Statement of the Problem

The purpose of this study was to investigate one of the effects of the SCIS program on primary age students in the Corvallis, Oregon Public Schools. The investigation was based on a comparison of students ability in SCIS and non-SCIS classes to construct a logical theoretical model when presented with a discrepant event.

Justification of the Problem

The SCIS program is currently in the final experimental stages with the first through third grade units available and in use. The fourth through sixth grade units are scheduled for completion by September, 1971. While SCIS has devised and used special measures for every trial unit, Hutchins (1970) has reported that SCIS does not plan norms based on the trial assessment program and it has not made available the results of those tests.

Conard (1969) stated that the SCIS teachers two functions are to be an observer that listens to children and notices how well they have progressed in their
investigations and to be a guide that leads children to see a relationship in their findings and the key concepts of the program. The SCIS teacher is not the pivot about which the class revolves and is not expected to summarize every lesson and tie up loose ends.

Haney (1964, p. 34) noted that:

The willingness to consider novel hypotheses and explanations and to attempt unorthodox procedures in a form of open-mindedness toward creative ideas... amounts to the "no holds barred" attitude of the scientist.

Haney's explanation of the attitude of the scientist would concur with the SCIS philosophy for student interaction.

In light of the newness of the SCIS program, the lack of research results on testing, and the uniqueness of SCIS; further research into the effects of SCIS is indicated. Special measures are required for the measurement of the effects of inquiry and open-mindedness.

Significance of the Study

The Corvallis Public Schools is in its initial year of a pilot program with SCIS. The district is interested in evaluating the success of the program. The present study will help to fill that need.

Definition of Terms

SCIS (Science Curriculum Improvement Study)

An elementary science curriculum being developed by
Robert Karplus and others at the University of California at Berkley under a grant of the National Science Foundation.

**Model**

The term model refers not to a physical model but to a set of mental constructs that explain a phenomenon.

**Hypotheses**

The hypotheses to be tested in this study have the following forms:

H11. **First and First-Second Split Grade**

Students in first and first-second split grade SCIS classes can demonstrate a greater ability to construct a logical theoretical model from a discrepant event than those students in Non SCIS classes.

H12. **Second Grade**

Students in second grade SCIS classes can demonstrate a greater ability to construct a logical theoretical model from a discrepant event than those students in Non SCIS classes.

H13. **Third Grade**

Students in third grade SCIS classes can demonstrate a greater ability to construct a logical theoretical
model from a discrepant event than those students in Non SCIS classes.

H14. Total Sample First Through Third Grade

Students in grades one through three SCIS classes can demonstrate a greater ability to construct a logical theoretical model from a discrepant event than those students in Non SCIS classes.

Basic Assumptions

The assumptions underlying this study were:

1. That the SCIS and non SCIS teachers originally represented the same population - i.e., the population of Corvallis teachers in district 509J.

2. That the SCIS and non SCIS students originally represented the same population - i.e., the population of students in Corvallis district 509J.

3. That theoretical model construction can be measured.

4. That the researcher designed measurements are valid.

Limitations

This study was limited as follows:

1. It was limited to a sample of SCIS students and a sample of non SCIS students in Corvallis Public School
District 509J during winter semester, 1971. Each sample was random from the named group, and stratified by grade. Grades one to three were represented.

2. The experimental sample had one semester of SCIS prior to the study.

3. It was limited by use of the specified presentation and measuring instruments.
II. REVIEW OF LITERATURE

In the area of previous research dealing with SCIS, it was found that most of the studies were confined to two main areas. The studies of Wilson (1967), Kondo (1968) and Renner and Wilson (1969) were typical of the studies dealing with types of teacher verbal behavior and the level of teacher questions according to Bloom's Taxonomy. It was generally found that SCIS teachers asked more and higher ordered questions than non SCIS teachers. The second main area of research dealt with the students ability to perform the Piaget conservation tasks. The studies of Allen (1967), Stafford (1969), and McClure (1971) typify the research with the conservation tasks.

One study was in the affective domain and compared SCIS to non SCIS students with a favorite subjects instrument. Tanner (1971) found that SCIS students named science three times as much as non SCIS students as their favorite subject.

The present study dealt with the ability of SCIS and non SCIS students to construct a logical theoretical model from a discrepant event. With previous research supporting the higher ordered questions asked by SCIS teachers and the SCIS students working with inquiry based materials in more open classroom settings, the researcher felt that a greater amount of SCIS students could think of a logical possibility to explain a discrepant event than non SCIS students.
Literature was therefore reviewed in the area of inquiry, the type of classroom situation conducive for inquiry, and the relationship of SCIS to inquiry and discrepant events.

Under the general heading of inquiry, Thelen (1960) related that while facts and knowledge are the short range benefits of science; the long range value of science was inquiry. With the premise that inquiry is the long range value of science, Fish and Goldmark (1966) stated that through the use of inquiry, a student could obtain the capability of evaluating the theories of others and can become more adept at generating his own theories.

Several authors have commented about the inappropriateness and fallaciousness of the sometimes held concept that knowledge is absolute. Suchman's (1965, p. 290) statement that "detrimental to inquiry is the belief that knowledge is absolute, that it must be passed down from authorities and that the student must accept it as truth" is in agreement with the writings of Ivany (1964) and Fischler (1968) about the fallacy that knowledge is absolute and must be accepted as truth. Nice (1971, p. 1) further stated that:

Science does not lend itself to the exact answers in the way that many textbook writers have presumed. The weight of the Hydrogen Atom is not exactly 1.008 A.U., but rather 1.008 A.U. represents an average weight of all Hydrogen Atoms, an average weight which most scientists have agreed to accept when in fact it is probable that no where in the universe does there exist a Hydrogen Atom which weighs exactly 1.008 A.U.
If you accept that facts and theories are relative and subject to change as is essential for inquiry, then the role of the teacher must change from being a dispenser of all knowledge and wisdom with the students passively absorbing what the teacher has to say, to more active involvement of the students with the teacher becoming a guide and diagnostician of learning problems. This requires a profound faith in the child for as Rogers (1963, p. 29) chided: "If we distrust the human being, then we must cram him with information of our own choosing lest he go his own mistaken way." With the changing role of the teacher, Barth (1970, p. 197), in discussing open concept schools in Britain, further indicated that:

Teachers who become aware of temptations to step in and show the right way, give the right answers and prevent mistakes soon recognize that these kinds of interventions often serve their own needs more than those of the child.

Smith (1963) argued for more open forms of teaching. The works of Gallagher, based on the Guilford model of the intellect in the field of divergent questions (Gallagher and Jenne, 1963) would correlate with the writings of Smith. Suchman (1965, p. 291) related the open form of teaching to the use of discrepant events when he stated that:

If the teacher has an open-ended point of view about knowledge and allows the children to have this point of view too, there is no end to the creative thinking that a discrepant event will produce in the classroom.

Discrepant events are the observation of an event that
does not fit our conceptual model. Such events are discrepant because they are different than that which we had expected. Fischler (1968, p. 278) offered the hypothesis that the "job we have in science is nothing more than carefully sequencing these discrepant events."

Inquiry and associated discrepant events blend into the writings of the Swiss psychologist, Jean Piaget. Discrepant events themselves would be another name for equilibration and therefore the equilibration theory associated with Piaget would be pertinent for this study. Thier (1970, p. 100) related that:

Equilibration, or self-regulation, is the factor and the process which is the foundation of and basic to an understanding of Piaget's whole approach to intellectual development. As described by Piaget, the child in order to come to know something must be active. He is faced with an external disturbance and reacts to compensate for the disturbance. This reaction tends to bring him towards equilibration with the disturbance.

Piaget has heavily influenced the Science Curriculum Improvement Study program. Karplus (1971, p. 2) applied the "learning by equilibration" theory attributed with Piaget to the three types of instructional units used in the SCIS program and described the units as:

exploration, referring to self-directed, unstructured investigation; invention, referring to the introduction of a new integrating concept by teacher or by learner; and discovery, referring to applications of the same new concept in a variety of situations, partly self-directed, partly guided.
Exploration is in accord with "learning-by-discovery" and "learning-by-equilibration." It allows the learner to impose his ideas and preconceptions on the subject matter to be investigated. If he comes up with a successful new idea, more power to him. If, as often is the case, his preconceptions lead to confusion, the teacher learns about these difficulties. At the same time, the exploration should create some disequilibrium, since not all students can cope with the materials with equal success.

Invention is in accord with the "learning-by-equilibration" theory, as the new idea introduced at the time suggests a way for the learner to resolve his disequilibrium.

Discovery, finally, is in accord with "learning-by-equilibration," and also with the "learning-by-conditioning" view that repetition and practice are necessary for learning. It is essential, however, that the repetition and practice occur largely through self-directed activities by the learner, so that he will actually resolve his dis-equilibrium by interacting with the experimental materials and by establishing a new feedback pattern for his action and observations.

The SCIS program is structured around the fundamental concepts of both the physical and biological sciences and organized on an ascending level of abstraction. The first unit in the physical sciences (of one half year duration) deals with material objects. With material objects, the students develop the concept of order in nature. The second and third units develop the concept of systems with related subsystems and variables. Fischler (1968, p. 281) has stated that:

The notion of system is crucial and fundamental in science. No scientist looks at the total world. Scientists look at systems, definable systems. The child does not discover this, by the way, a system has to be invented. We, the teachers, have to
invent the notion of systems and then we have to give the pupil the opportunity to assimilate and accommodate the notion and feel very comfortable using it, so that when we are no longer with him he is constantly utilizing the concept of a system.

SCIS stresses the concept of system in the physical as well as the biological units.

Based on the philosophy of Piaget, SCIS provides the students with activities on an ascending of abstraction that deal with the basic concepts of science. The SCIS teachers generally asked higher ordered questions than non-SCIS teachers, and the role of the SCIS teacher is to act as a guide and diagnostician as the student progresses through the open-ended inquiry approach of SCIS.

**Summary**

From the review of related literature, it has been found that research into SCIS has dealt mainly in the areas of types of teacher verbal behavior and ability of students to perform the Piaget conservation tasks. It was found that SCIS was based upon the philosophy of Piaget and that Piaget's theory of equilibration was used in the design of the three types of instructional units (exploration, invention, and discovery) used in SCIS. The equilibration theory was analogous to discrepant events and associated inquiry. The SCIS program has provided the students with a more open classroom setting, has provided for the active
participation of students in working with materials and developing concepts of order and systems through a combined program in the biological and physical sciences. The review of literature into SCIS and related inquiry supported the researchers general hypothesis that SCIS students would have a greater ability to construct a logical theoretical model from a discrepant event than non SCIS students.
III. DESIGN OF THE STUDY

This study was designed to determine one of the effects of the SCIS pilot program with primary students of Corvallis Public School District 509J. It was designed to investigate the student's ability to construct a theoretical model from a discrepant event.

Description of the Setting

District 509J is located in Corvallis, Oregon which is the site of Oregon State University. The total school district enrollment is 7,992 with 4,420 students in the grade schools. (Figures as of March, 1970)

Sample of the Study

The sample consisted of the students of twelve teachers in a stratified random sample by grade level. The SCIS classes were divided into one first grade, one first-second grade, two second grades, and two third grades. The SCIS sample consisted of 136 students. The non SCIS classes were also divided into one first grade, one first-second grade, two second grades, and two third grades. The non SCIS sample consisted of 153 students. The sample was obtained in conjunction with the research department of the Corvallis Public Schools by use of a table of random numbers and district teacher lists. Alternate classes were
selected but were not used in this study.

Description of Apparatus

Inference Box

The inference box consisted of a shoe box with a six ounce empty metal juice can inside. The shoe box was taped shut.

Theory Box

The theory box was a modification of the theory box as described by Shoresman (1965). In constructing the theory box, the researcher felt that the box must be constructed out of materials that the students had prior interaction with. The chance that the theory box would be considered "magic" by the primary students was therefore decreased.

The theory box consisted of a modified shoe box with a funnel made from a paper dixie cup that was visible to the students. (Appendix A) The interior of the theory box consisted of three funnels and tubing to allow for liquid flow. Two of the funnels had paper filter cones inside that had food coloring applied prior to each data gathering session. The back of the box was removable so that the upper tubing could be moved from one funnel to another to change the color of the liquid. Included with the theory box was two seven ounce clear plastic beakers, one one ounce
clear plastic beaker, and one clear plastic quart container filled with water.

Description of Data Gathering Instrument

Student Response Sheet

The response sheet consisted of a ditto process outline of the theory box with the top funnel, bottom hose that would be visible to the students, and a beaker. The dimensions of the outline were five inches by eight inches. (Appendix B)

There was no writing or directions on the response sheet except for the word "name." The response sheet was so designed that reading and writing skills were not necessary for its completion.

Procedures for Obtaining Data

Permission and approval of the study was obtained from the Corvallis Public Schools along with participating principals and teachers. The study was conducted during winter semester, 1971 when the SCIS classes had completed one semester of the SCIS program.

The data gathering lessons and student response sheets were administered by the researcher. The steps for the data gathering lessons and student responses were:

1. At the start of the lesson, the classroom teacher
introduced the researcher and stated that the class would be having a science lesson with the researcher.

2. As an introduction to the theory box, the researcher held up an inference box (a shoe box with a metal can inside) and asked the students what they thought was in the shoe box. After a variety of responses - most of which could be correct, the students were asked if they knew for sure what was in the box. The box was then shaken and the students heard the sound of the contents. Based upon the new evidence of hearing the sound of the contents of the box, the students were asked what they thought was in the box.

The researcher told the students that by using the clues they got as a careful observer by listening or looking and then thinking, they were able to come up with some very good ideas. For example: (1) Several of your ideas were very good as you used the evidence you had. (2) Many of the answers could be true - based upon what you observed. and (3) Many of you changed your ideas about the contents of the box when you saw the box shaken.

3. The students were told that they were now given the opportunity to observe carefully the theory box as used by the researcher and discover or invent what they thought was contained within or what the theory box looked like inside.

4. The theory box was placed on a table along with
two clear plastic seven ounce beakers, a one ounce clear plastic beaker, and a clear plastic quart capped bottle nearly filled with a clear liquid.

5. The students were asked to observe what they saw on the table. They were asked what they thought was inside the box and what the liquid was. They were asked if they knew for sure and if there could be anything else inside of the box or bottle.

6. The students were asked to predict what would happen when the researcher poured some liquid into the funnel.

7. The researcher placed one of the plastic beakers underneath the exposed hose in the bottom of the theory box and slowly poured one ounce of the clear liquid into the funnel on top of the theory box. The liquid poured through the theory box system and came out of the bottom hose and into the beaker as a bright blue liquid.

8. While the researcher asked the students what they thought had happened and what they thought was inside of the theory box, he opened the back of the theory box and changed the position of hose A (Appendix A) from funnel B to funnel C. The researcher made every possible effort to distract the students so that they would not see him changing something in the theory box.

9. The researcher held up the beaker with the bright blue liquid and asked if anyone could explain what could
have happened to cause the change in color.

10. The students were asked to predict what would happen when the researcher poured some of the same clear liquid into the funnel for a second time.

11. The researcher placed the remaining seven ounce clear plastic beaker beneath the exposed hose in the bottom of the theory box and slowly poured one ounce of the clear liquid into the top funnel. The liquid poured through the theory box system and came out the bottom hose as a bright yellow liquid.

12. The researcher told the students to think about what they had observed about the theory box. He passed out the student response sheets (Appendix B) and asked the students to draw what they thought was inside of the theory box or what the inside of the theory box looked like. They were told that their answers could be just as good as anyone else's as their answers were based upon what they had observed.

13. After the students had ten minutes to work on their responses, the classroom teacher made sure that the response sheets were collected from everyone and placed the sheets in an envelope without letting the researcher observe them. The purpose of the teacher collection of the students' response sheets was to avoid researcher instrumentation bias of the SCIS/non SCIS sample.

14. The students were asked if they wanted to try to
explain what they thought might have been in the theory box and following the discussion were thanked for their efforts.

**Classification of Theory Box Data**

**Coding the Data**

The collected response sheets were turned over to the research department of the Corvallis Public Schools in sealed envelopes. The response sheets were numbered 1 to 289 and two code sheets were made showing the classes and numbers assigned to those classes. The response sheets were coded to avoid instrumentation bias by the researcher. The response sheets were returned to the researcher along with a sealed envelope containing one code sheet. The second code sheet was kept in the research department in case of need. The envelope was not to be opened until after the data was classified.

**Classification of Data**

A panel of three persons consisting of one science education professor and two university seniors who had just completed an elementary science education methods course classified the theory box data. The procedure used to classify the data was:

1. The researcher demonstrated the data gathering lesson for the panel as had been done with the elementary
students.

2. The researcher gave each panel member a list (Appendix C) of the criteria for classification of the data into Logical, Probably Logical, and Non Logical. The researcher had consulted with members of the Science Education staff at Oregon State University for approval of the criteria for classification.

To qualify for a Logical rating, the response sheet would need a complete internal system and a means of adding color to the system. To qualify for a Probably Logical rating, the response sheet would need a system but would not need a means of adding color or the system would have two or more colors in the same tube. With Probably Logical, the student could formulate a mental construct about a system inside the theory box. Responses that were blank, had no system inside, or contained some color, spots, or random coloring were classified as Non Logical. The Non Logical rating indicated the lack of a theoretical construct by the student to explain the operation of the theory box.

3. The researcher provided the panel with samples of Logical, Probably Logical, and Non Logical response sheets gathered from classes outside of the random sample. The samples were discussed and agreement reached as to the categories that the samples were placed in.

4. Working independently, the panel members scored each coded response sheet as to Logical, Probably Logical,
or Non Logical on tally sheets. (Appendix D)

5. The response sheets were divided into two categories with the first category being all three tallies by the panel in agreement as to the response sheet classification. If one or more panel members disagreed as to the classification, the response sheet was placed in the second category.

6. The panel reclassified the response sheets that they did not reach agreement on independently. As a group, they discussed each sheet and came up with a consensus opinion which was recorded on new tally sheets.

7. The researcher opened the code envelope and tabulated the results of the classified data for analysis.

Statistical Analysis

Chi-square analysis of variance, after Siegel (1956), was used to find the relationships between SCIS and non SCIS classes on ability to construct a logical theoretical model from a discrepant event. A three by two factorial design was used with the data from the response sheets of SCIS classed and non SCIS (control) classes being compared as to Logical, Probably Logical, and Non Logical. The chi-square analysis of variance was approved through the research department of the Corvallis Public Schools for this study as the test appeared sensitive enough for the type of data analyzed and critical enough to detect differences if
any occurred.

For the analysis of all hypotheses, a .05 level of significance was used. In other words, one could be 95 per cent confident that the results of these tests would be correct. Whereas, about 5 per cent of the time it could be expected that chance or random variability of the sample would lead to a significant result, when in reality there was no difference between the two groups, at least with respect to the measured variables.
IV. FINDINGS OF THE STUDY

Inter-Rater Reliability of Classification of Student Response Sheets

The three member panel, after an introductory session with the researcher, independently classified the 289 coded student response sheets into Logical, Probably Logical and Non Logical from the criteria as shown in Appendix C.

The panel members used tally sheets (Appendix D) to record the classifications. The tally sheets were then compared to find those response sheet numbers that met with complete agreement by each panel member into a particular category. One hundred seventy one response sheets out of 289 response sheets had complete agreement by the panel members independently as to a particular category. The panel members therefore, had 59.2 per cent initial agreement as to the category that each response sheet should be placed. The remaining 118 student response sheets were reclassified by consensus opinion with group panel discussion.

Test of Hypotheses

$H_{11}$ First and First-Second Split Grade

Students in first and first-second split grade SCIS classes can demonstrate a greater ability to construct a logical theoretical model from a discrepant event than
those students in Non SCIS classes.

The statistical techniques used for the analysis of hypothesis 1 was the chi-square ($X^2$) test of independence. A significant computed chi-square value at the .05 level of significance from the table of chi-square values (Siegel, 1956 p. 249) must be larger or equal to 4.60, one tailed, with two degrees of freedom. The computed chi-square for hypothesis 1 was 7.08. The directional hypothesis was rejected. From table 4-3, it was shown that the students in first and first-second split grade non SCIS classes had more ability to construct a logical theoretical model from a discrepant event than first and first-second split grade SCIS classes.

$H_{12}$—Second Grade

Students in second grade SCIS classes can demonstrate a greater ability to construct a logical theoretical model from a discrepant event than those students in Non SCIS classes.

Chi-square analysis was used to test any differences between SCIS and Non SCIS classes on the second grade level. A significant computed chi-square value at the .05 level of significance must be greater or equal to 4.60, one tailed, with two degrees of freedom. From Table 4-4, it is shown that the computed chi-square value for hypothesis 2 is 2.44. The hypothesis was therefore rejected with any differences
between SCIS and Non SCIS second grade classes on ability to construct a logical theoretical model from a discrepant event being attributed to chance.

**H₁₃—Third Grade**

Students in third grade SCIS classes can demonstrate a greater ability to construct a logical theoretical model from a discrepant event than those students in Non SCIS classes.

From Table 4-5, it is noted that the expected frequency for the SCIS - Non Logical cell is 2.9 and the expected frequency for the Non SCIS - Non Logical cell is 3.0. Siegel (1956 p. 110) stated the recommendation of Cochran (1954) that when df > 1, "the X² test may be used if fewer than 20 per cent of the cells have an expected frequency of less than 5." If greater than 20 per cent of the cells had an expected frequency of less than 5 then Siegel suggested combining cells to make the frequency ≥ 5. While it would be possible to combine the Logical and Probably Logical cells, in view of the stated hypothesis it would be impossible to combine the Non Logical cells with any other cells. It was therefore not possible to use chi-square analysis of variance with hypothesis 3. With no supporting statistical evidence, the SCIS factor involving third grade students ability to construct a logical theoretical model from a discrepant event was rejected.
$H_{14}$ Total Sample First Through Third Grade

Students in grades one through three SCIS classes can demonstrate a greater ability to construct a logical theoretical model from a discrepant event than those students in Non SCIS classes.

Once again, chi-square analysis was used to test for any differences in the total sample of the first through third grade SCIS ($N = 136$) and Non SCIS ($N = 153$) classes on ability to construct a logical theoretical model from a discrepant event. From Table 4-6, it is shown that the computed chi-square value for hypothesis 4 is .05. To be significant at the .05 level, one tailed, with two degrees of freedom, the computed chi-square value must be greater or equal to 4.60. Hypothesis 4 was rejected; there was no evidence to show that SCIS was a factor in the ability of first through third grade students to construct a logical theoretical model from a discrepant event.

Findings Not Related to Original Hypotheses

Comparison of Combined Second and Third Grade SCIS Classes with Similar Non SCIS Classes on Ability to Construct a Logical Theoretical Model from a Discrepant Event

The combined second and third grade SCIS sample was compared with a similar Non SCIS sample to check for differences in ability to construct a logical theoretical
model from a discrepant event. This was done as it was impossible to use the third grade sample due to the lack of a high enough expected frequency for valid use of chi-square. Using the combined sample, a statistical test was made using chi-square with a computed value of 4.08 being obtained (Table 4-7). To be significant at the .10 level, a chi-square value of 3.22 one tailed must be met. There was therefore a possibility that SCIS was a factor in the ability of the combined second and third grade classes to construct a logical theoretical model from a discrepant event.

Grade Level as a Factor in the Ability of a Student to Construct a Logical Theoretical Model from a Discrepant Event

The data from Tables 4-1, 4-2, 4-3, 4-4, and 4-5 suggests a possible relationship between age level and ability to construct a logical theoretical model. Chi-square analysis was used to find any differences between age level and the ability to construct a logical theoretical model from a discrepant event. Comparisons were made on the first and first-second split grade level to the second grade level, on the second grade level to the third grade level, and finally on the first and first-second split grade level to the third grade level.
First and First-Second Split Grade Level to Second Grade Level

A computed chi-square value of 4.82 was obtained for the comparison of the total first and first-second split grade level to the total second grade level (Table 4-8). To be significant at the .10 level, two tailed, with two degrees of freedom, chi-square must be greater or equal to 4.60. There was weak statistical evidence to support that grade level was a factor on the ability of a student to construct a logical theoretical model from a discrepant event as the analysis indicated significance beyond the .10 level.

Second Grade Level to Third Grade Level

Chi-square analysis achieved significance beyond the .05 level with a computed value of 7.6 (Table 4-9). It was therefore a possibility that the difference in grade level from second to third grade was a factor in the ability of a student to construct a logical theoretical model from a discrepant event.

First and First-Second Split Grade Level to Third Grade Level

A computed chi-square value of 13.82, two tailed, with two degrees of freedom must be obtained to reach significance at the .001 level. The computed chi-square
value for comparison of the total first and first-second split grade level to the total third grade level was 19.12. The statistical significance way beyond the .001 level strongly indicates that grade level was a factor in comparison of the first and first-second split grade level to the third grade level.

Summary

$H_{11}$, $H_{12}$, and $H_{14}$ were rejected due to lack of chi-square values that approached significance. There was no evidence to support the hypotheses that student use of Science Curriculum Improvement Study Materials (SCIS) was a factor when compared on the first, second, and total first through third grade samples with ability to construct a logical theoretical model from a discrepant event.

$H_{13}$ was rejected due to the lack of large enough expected frequencies to validate use of chi-square analysis.

Comparison of the combined second and third grade SCIS samples to the second and third grade non SCIS sample was significant beyond the .10 level one tailed. The data indicates a weak possibility that SCIS could be a factor when compared on the combined second and third grade levels with respect to ability to construct a logical theoretical model from a discrepant event.

Comparison of grade level as a factor obtained significance beyond the .10 level, two tailed, for the
first and first-second split grade sample to the second grade sample; .05 level, two tailed, for the second grade sample to the third grade sample; and way beyond the .001 level, two tailed, for the first and first-second split grade sample to the third grade sample. There was strong statistical evidence to show that grade level was a factor in the ability of young children to construct a logical theoretical model from a discrepant event.
TABLE 4-1

TABULATION OF RESULTS OF CLASSIFICATION OF SCIS STUDENT RESPONSE SHEETS INTO LOGICAL, PROBABLY LOGICAL, AND NON LOGICAL, BY CLASS AND GRADE LEVEL
### SCIS Sample

<table>
<thead>
<tr>
<th>Class</th>
<th>Grade</th>
<th>L</th>
<th>L'</th>
<th>PL</th>
<th>PL'</th>
<th>NL</th>
<th>NL'</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>10</td>
<td>1</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>B</td>
<td>1-2</td>
<td>1</td>
<td>4</td>
<td>9</td>
<td>1</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>C</td>
<td>2</td>
<td>6</td>
<td>9</td>
<td>8</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>D</td>
<td>2</td>
<td>3</td>
<td>8</td>
<td>3</td>
<td>6</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>E</td>
<td>3</td>
<td>4</td>
<td>9</td>
<td>8</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>F</td>
<td>3</td>
<td>7</td>
<td>11</td>
<td>6</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>23</th>
<th>42</th>
<th>44</th>
<th>10</th>
<th>14</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>65</td>
<td>54</td>
<td></td>
<td>14</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>119</td>
<td></td>
<td></td>
<td></td>
<td>17</td>
<td></td>
</tr>
</tbody>
</table>

136

L = Logical - complete independent agreement by panel
L' = Logical - consensus panel agreement
PL = Probably Logical - complete independent agreement by panel
PL' = Probably Logical - consensus panel agreement
NL = Non Logical - complete independent agreement by panel
NL' = Non Logical - consensus panel agreement
TABLE 4-2

TABULATION OF RESULTS OF CLASSIFICATION OF NON SCIS
STUDENT RESPONSE SHEETS INTO LOGICAL, PROBABLY
LOGICAL, AND NON LOGICAL, BY CLASS AND GRADE LEVEL
## Non SCIS Sample

<table>
<thead>
<tr>
<th>Class</th>
<th>Grade</th>
<th>L</th>
<th>L'</th>
<th>PL</th>
<th>PL'</th>
<th>NL</th>
<th>NL'</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>-</td>
</tr>
<tr>
<td>B</td>
<td>1-2</td>
<td>4</td>
<td>7</td>
<td>5</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C</td>
<td>2</td>
<td>6</td>
<td>7</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>D</td>
<td>2</td>
<td>6</td>
<td>8</td>
<td>16</td>
<td>9</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>E</td>
<td>3</td>
<td>12</td>
<td>8</td>
<td>5</td>
<td>-</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>F</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>3</td>
<td>-</td>
</tr>
</tbody>
</table>

34 40 41 19 15 4

74 60 19

134 19

153
TABLE 4-3

ANALYSIS OF VARIANCE FOR COMPARISON OF FIRST AND FIRST-SECOND SPLIT GRADE SCIS CLASSES TO FIRST AND FIRST-SECOND GRADE NON SCIS CLASSES ON ABILITY TO CONSTRUCT A LOGICAL THEORETICAL MODEL FROM A DISCREPANT EVENT
<table>
<thead>
<tr>
<th>Factor</th>
<th>Logical</th>
<th>Probably Logical</th>
<th>Non Logical</th>
<th>Total</th>
<th>d.f.</th>
<th>$X^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCIS</td>
<td>(13.1)</td>
<td>(18.9)</td>
<td>(8.7)</td>
<td>41</td>
<td>2</td>
<td>7.08</td>
</tr>
<tr>
<td>Non SCIS (Control)</td>
<td>(11.8)</td>
<td>(17.1)</td>
<td>(8.5)</td>
<td>37</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>36</td>
<td>17</td>
<td>78</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1/ 0.05 level of significance with two degrees of freedom requires that $X^2 \geq 4.60$ one tailed
TABLE 4-4

ANALYSIS OF VARIANCE FOR COMPARISON OF SECOND GRADE SCIS CLASSES TO SECOND GRADE NON SCIS CLASSES ON ABILITY TO CONSTRUCT A LOGICAL THEORETICAL MODEL FROM A DISCREPANT EVENT
<table>
<thead>
<tr>
<th>Factor</th>
<th>Logical</th>
<th>Probably Logical</th>
<th>Non Logical</th>
<th>Total</th>
<th>d.f.</th>
<th>$x^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCIS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(21.9)</td>
<td>26</td>
<td>18</td>
<td>4</td>
<td>48</td>
<td>2</td>
<td>2.44</td>
</tr>
<tr>
<td>Non SCIS (Control)</td>
<td>27</td>
<td>32</td>
<td>9</td>
<td>68</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>53</td>
<td>50</td>
<td>13</td>
<td>116</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1/ 0.05 level of significance with two degrees of freedom requires that $x^2 \geq 4.60$ one tailed
TABLE 4-5

ANALYSIS OF VARIANCE FOR COMPARISON OF THIRD GRADE SCIS CLASSES TO THIRD GRADE NON SCIS CLASSES ON ABILITY TO CONSTRUCT A LOGICAL THEORETICAL MODEL FROM A DISCREPANT EVENT
<table>
<thead>
<tr>
<th>Factor</th>
<th>Logical</th>
<th>Probably Logical</th>
<th>Non Logical</th>
<th>Total</th>
<th>d.f.</th>
<th>$X^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCIS</td>
<td>(30.2)</td>
<td>(13.8)</td>
<td>(2.9)</td>
<td>47</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>31</td>
<td>15</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non SCIS</td>
<td>(30.8)</td>
<td>(14.1)</td>
<td>(3.0)</td>
<td>48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Control)</td>
<td>30</td>
<td>13</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>61</td>
<td>28</td>
<td>6</td>
<td>95</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1/ 0.05 level of significance with two degrees of freedom requires that $X^2 \geq 4.60$ one tailed
TABLE 4-6

ANALYSIS OF VARIANCE FOR COMPARISON OF FIRST THROUGH THIRD GRADE SCIS CLASSES TO FIRST THROUGH THIRD GRADE NON SCIS CLASSES ON ABILITY TO CONSTRUCT A LOGICAL THEORETICAL MODEL FROM A DISCREPANT EVENT
<table>
<thead>
<tr>
<th>Factor</th>
<th>Logical</th>
<th>Probably Logical</th>
<th>Non Logical</th>
<th>Total</th>
<th>d.f.</th>
<th>$X^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCIS</td>
<td>(65.3)</td>
<td>(53.6)</td>
<td>(16.9)</td>
<td>136</td>
<td>2</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>65</td>
<td>54</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non SCIS (Control)</td>
<td>(73.4)</td>
<td>(60.3)</td>
<td>(19.1)</td>
<td>153</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>74</td>
<td>60</td>
<td>19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>139</td>
<td>114</td>
<td>36</td>
<td>289</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1/ 0.05 level of significance with two degrees of freedom requires that $X^2 \geq 4.60$ one tailed
TABLE 4-7

ANALYSIS OF VARIANCE FOR COMPARISON OF SECOND AND THIRD GRADE SCIS CLASSES TO SECOND AND THIRD GRADE NON SCIS CLASSES ON ABILITY TO CONSTRUCT A LOGICAL THEORETICAL MODEL FROM A DISCREPANT EVENT
<table>
<thead>
<tr>
<th>Factor</th>
<th>Logical</th>
<th>Probably Logical</th>
<th>Non Logical</th>
<th>Total</th>
<th>d.f.</th>
<th>$X^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCIS</td>
<td>(51.3)</td>
<td>(30.4)</td>
<td>(8.5)</td>
<td>95</td>
<td>2</td>
<td>4.08</td>
</tr>
<tr>
<td>Non SCIS (Control)</td>
<td>57</td>
<td>33</td>
<td>5</td>
<td>116</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>114</td>
<td>78</td>
<td>19</td>
<td>211</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1/ 0.05 level of significance with two degrees of freedom requires that $X^2 \geq 4.60$ one tailed
TABLE 4-8

ANALYSIS OF VARIANCE FOR COMPARISON OF THE FIRST AND FIRST-SECOND SPLIT GRADE LEVEL TO THE SECOND GRADE LEVEL ON ABILITY TO CONSTRUCT A LOGICAL THEORETICAL MODEL FROM A DISCREPANT EVENT
<table>
<thead>
<tr>
<th>Factor</th>
<th>Logical</th>
<th>Probably Logical</th>
<th>Non Logical</th>
<th>Total</th>
<th>d.f.</th>
<th>$X^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>First and First-Second Grade</td>
<td>(31.4)</td>
<td>(34.5)</td>
<td>(12.4)</td>
<td>78</td>
<td>2</td>
<td>4.82</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>36</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Second Grade</td>
<td>(46.6)</td>
<td>(50.9)</td>
<td>(17.9)</td>
<td>116</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>53</td>
<td>50</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>78</td>
<td>86</td>
<td>30</td>
<td>194</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1/ 0.10 level of significance with two degrees of freedom requires that $X^2 \geq 4.60$ two tailed
TABLE 4-9

ANALYSIS OF VARIANCE FOR COMPARISON OF THE SECOND GRADE LEVEL TO THE THIRD GRADE LEVEL ON ABILITY TO CONSTRUCT A LOGICAL THEORETICAL MODEL FROM A DISCREPANT EVENT
<table>
<thead>
<tr>
<th>Factor</th>
<th>Logical</th>
<th>Probably Logical</th>
<th>Non Logical</th>
<th>Total</th>
<th>d.f.</th>
<th>$X^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second Grade</td>
<td>(62.7)</td>
<td>(42.8)</td>
<td>(10.4)</td>
<td>116</td>
<td>2</td>
<td>7.6</td>
</tr>
<tr>
<td>Third Grade</td>
<td>(51.3)</td>
<td>(35.1)</td>
<td>(8.5)</td>
<td>95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>114</td>
<td>78</td>
<td>19</td>
<td>211</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1/ 0.05 level of significance with two degrees of freedom requires that $X^2 \geq 5.99$ two tailed
TABLE 4-10

ANALYSIS OF VARIANCE FOR COMPARISON OF THE FIRST AND FIRST-SECOND SPLIT GRADE LEVEL TO THE THIRD GRADE LEVEL ON ABILITY TO CONSTRUCT A LOGICAL THEORETICAL MODEL FROM A DISCREPANT EVENT
<table>
<thead>
<tr>
<th>Factor</th>
<th>Logical</th>
<th>Probably Logical</th>
<th>Non Logical</th>
<th>Total</th>
<th>d.f.</th>
<th>$X^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(38.8)</td>
<td>(28.8)</td>
<td>(10.4)</td>
<td>78</td>
<td>2</td>
<td>19.12</td>
</tr>
<tr>
<td>First and</td>
<td>25</td>
<td>36</td>
<td>17</td>
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<td></td>
</tr>
<tr>
<td>First-Second</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade</td>
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<td></td>
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\[0.001\] level of significance with two degrees of freedom requires that $X^2 \geq 13.82$ two tailed
V. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The purpose of this study was to investigate one of the effects of the SCIS program on primary students in the Corvallis, Oregon Public Schools. The investigation was based on a comparison of students' ability in SCIS and non-SCIS classes to construct a logical theoretical model when presented with a discrepant event.

The sample of the study was obtained with no known systematic bias by use of a table of random numbers and district teacher lists. The total sample consisted of 289 students with the SCIS sample consisting of 136 students that were stratified by grade level with one first grade, one first-second split grade, two second grades, and two third grades represented. The non SCIS sample consisted of 153 students that were stratified along similar grade level lines. The experimental group had only one semester of SCIS prior to the study and only grades one to three were represented as the Corvallis Public Schools SCIS pilot project for the 1970-71 school year was for the primary grades.

The data gathering session was conducted by the researcher and consisted of presenting the students with a discrepant event in the form of a "theory box" (Appendix A). The students observed the researcher pouring a clear liquid
into a funnel on top of the theory box and the liquid came out of the bottom blue. After some unobtrusive manipulation by the researcher with the theory box, a clear liquid (from the same original container) was again poured into the funnel on top of the theory box. This time the liquid came out yellow. Using student response sheets (Appendix B), the students were asked to draw in what they thought could be inside of the theory box.

After ten minutes, the student response sheets were collected by the classroom teacher and sealed for coding by the Corvallis Public Schools research department. The coded response sheets were classified by a three member panel into Logical, Probably Logical, and Non Logical based upon criteria developed by the researcher in conjunction with members of the Science Education staff at Oregon State University.

Conclusions

Using chi-square analysis of variance, after Siegel, three directional hypotheses were rejected due to lack of chi-square values that approached significance at the .05 level. In other words, there was no statistical evidence to support that SCIS was a factor on the first, second, and total first through third grade sample in the ability of students to construct a logical theoretical model when presented with a discrepant event.
The three rejected directional hypotheses were:

**H₁₁ First and First-Second Split Grade**

Students in first and first-second split grade SCIS classes can demonstrate a greater ability to construct a logical theoretical model from a discrepant event than those students in Non SCIS classes.

**H₁₂ Second Grade**

Students in second grade SCIS classes can demonstrate a greater ability to construct a logical theoretical model from a discrepant event than those students in Non SCIS classes.

**H₁₄ Total Sample First Through Third Grade**

Students in grades one through three SCIS classes can demonstrate a greater ability to construct a logical theoretical model from a discrepant event than those students in Non SCIS classes.

While hypothesis one, hypothesis two and hypothesis four were rejected due to the lack of statistical significance, hypothesis three was rejected due to an insufficient expected frequency in the non-logical cells for valid use of chi-square analysis. Hypothesis three was
H13 Third Grade

Students in third grade SCIS classes can demonstrate a greater ability to construct a logical theoretical model from a discrepant event than those students in Non SCIS classes.

To utilize the third grade data, the second and third grade samples were combined with significance beyond the .10 level, one tailed, achieved for the SCIS to non SCIS sample. The .10 level of significance might weakly support the idea that SCIS could be a factor in the ability of students to construct a logical theoretical model when presented with a discrepant event on the second and third grade levels.

Comparison of grade level as a factor obtained significance beyond the .10 level, two tailed, for the first and first-second split grade sample to the second grade sample; beyond the .05 level for the second to the third grade sample; and way beyond the .001 level of significance for the first and first-second split grade sample to the third grade sample. Significant results from chi-square analysis indicated a strong possibility that the grade level of a child was a factor in the ability of young children to construct a logical theoretical model from a discrepant event.
Recommendations

Based upon the data gathered in this study, the researcher recommends that a similar study be conducted using a larger sample and covering more grade levels. It also appears logical, to this researcher, to compare the SCIS to non SCIS students after more than just one semester experience with SCIS materials. To replicate such a study, further refinement of the researcher designed instruments is indicated.

Along the line of further research, the researcher recommends that the factors of Sex and I.Q. be explored with the ability of SCIS and non SCIS students to construct a logical theoretical model from a discrepant event. It also seems to this researcher that a significant follow-up study might be a comparison of student ability to construct a logical theoretical model from a discrepant event between students who were classified as pre-operational and concrete operational in terms of the Piaget conservation tasks.
BIBLIOGRAPHY


APPENDICES
APPENDIX A

DIAGRAM OF CONSTRUCTION OF THEORY BOX APPARATUS
APPENDIX B

STUDENT RESPONSE SHEET
APPENDIX C

CRITERIA FOR CLASSIFICATION OF STUDENT RESPONSE SHEETS
INTO LOGICAL, PROBABLY LOGICAL, AND NON LOGICAL
LOGICAL

Has system for flow of liquid
Has internal or funnel method of adding color
Has two or more colors or mechanism where the color would be
Liquid flows in a horizontal or downward direction

PROBABLY LOGICAL

May have a single system for flow of liquid
May have both a system for flow of liquid and color but no
means of adding color
System may have one, two, or more colors in the same tube

NON LOGICAL

Has no system inside
May be blank
May have some color, spots, or color without order
APPENDIX D

TALLY SHEET FOR RECORDING CLASSIFICATION
OF CODED STUDENT RESPONSE SHEETS
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