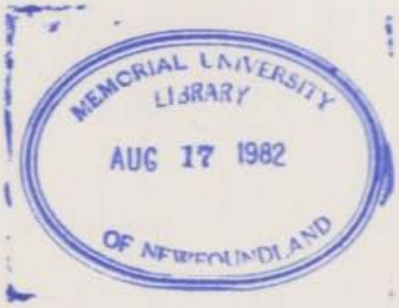
THE EFFECT OF TEACHER CONTROL UPON STUDENT PERCEPTION IN ELEMENTARY SCIENCE CLASSES

GARY LOUIS RUMBOLT



NOTICE

The quality of this microfiche is heavily dependent upon the quality of the original thesis submitted for microfilming. Every effort has been made to ensure the highest quality of reproduction possible.

If pages are missing, contact the university which granted the degree.

Some pages may have indistinct print especially if the original pages were typed with a poor typewriter ribbon or if the university sent us a poor photocopy.

Previously copyrighted materials (journal articles, published tests, etc.) are not filmed.

Reproduction in full or in part of this film is governed by the Canadian Copyright Act, R.S.C. 1970, c. C-30. Please read the authorization forms which accompany this thesis.

THIS DISSERTATION
HAS BEEN MICROFILMED
EXACTLY AS RECEIVED

AVIS

La qualité de cette microfiche dépend grandement de la qualité de la thèse soumise au microfilmage. Nous avons tout fait pour assurer une qualité supérieure de reproduction.

S'il manque des pages, veuillez communiquer avec l'université qui a conféré le grade.

La qualité d'impression de certaines pages peut laisser à désirer, surtout si les pages originales ont été dactylographiées à l'aide d'un ruban usé ou si l'université nous a fait parvenir une photocopie de mauvaise qualité.

Les documents qui font déjà l'objet d'un droit d'auteur (articles de revue, examens publiés, etc.) ne sont pas microfilmés.

La reproduction, même partielle, de ce microfilm est soumise à la Loi canadienne sur le droit d'auteur, SRC 1970, c. C-30. Veuillez prendre connaissance des formules d'autorisation qui accompagnent cette thèse.

LA THÈSE A ÉTÉ
MICROFILMÉE TELLE QUE
NOUS L'AVONS REÇUE

THE EFFECT OF TEACHER CONTROL UPON STUDENT PERCEPTION IN ELEMENTARY SCIENCE CLASSES

by

Gary Louis Rumbolt, B.Sc., B.Ed.,

A Thesis submitted in partial fulfillment of the requirements for the degree of Master of Education.

Faculty of Education
Department of Curriculum and Instruction
Memorial University of Newfoundland

1980

St. John's Newfoundland

ABSTRACT

This study, which was a part of a larger research project, attempted to ascertain whether variables such as classroom control and teacher or pupil characteristics had any affect upon student perceptions in grade six science classes.

Classroom control was divided into two categories: high teacher control and low teacher control. Six substitute teachers underwent a training program on lesson materials and treatment differences for a period of one week. After completion of training these teachers replaced regular classroom teachers during science classes for a period of eighteen weeks. The teachers adherence to treatment was monitored using video tape recorders and a modified version of the Bellack system (Bellack et al., 1975).

The sample consisted of eleven grade six classes chosen from both urban and rural areas within the Avalon School District in St. John's, Newfoundland. All classes were exposed to both the high and low control treatments.

Students' perceptions were measured using a pupil interview form consisting of twenty-five questions devised for this study. Eight students from each class were chosen at random, without replacement, and interviewed at four different times.

Information on pupil characteristics such as IQ, extraversion, dominance, and self-concept was obtained throughout the course of the study.

Results showed that teachers adhered to the treatments, although not to the extent that had been planned. A chi-square analysis of results yielded no significant interactions between student perceptions and variables such as self-concept, extraversion, dominance and IQ. Scattered incidents of significance indicated that there was some general interaction between teachers, treatments and student perceptions. However, it was impossible to distinguish any particular pattern.

Generally, student perceptions were similar to those expected of students in a high teacher controlled classroom environment, although there was a slight indication that this was beginning to change by the end of the study.

Acknowledgements

This study was carried out as part of a project of The Institute for Educational Research and Development, Memorial University of Newfoundland. Funding for the project was received from Canada Council. This author wished to acknowledge with grateful thanks the patience and continual guidance of Dr. R.K. Crocker, the director of the project, and Dr. R.P. Amaria, his associate.

Thanks are also extended to Dr. Glen Clarke, thesis supervisor, for his help and moral support throughout the study.

The author wishes to thank his parents for their faith in him throughout the years. May they be rewarded here and in heaven.

I dedicate this thesis to my fiancée, Maureen Hickey, who has been the inspiration I have needed to complete this study.

Finally, the author wishes to thank the staff of Probe Publishers Inc. for their competent typing of the manuscript.

TABLE OF CONTENTS

LIST OF TABLES

Chapter 1

THE PROBLEM

Introduction

There has been a marked fervor in recent years to emphasize the importance of teaching the "Processes" of science in elementary schools. These processes are outlined by the Commission on Science Education of the American Association for the Advancement of Science (1965) as two groups of skills. The basic skills stated are: (1)observing (2)communicating (3)predicting (4)measuring (5)inferring (6)using space-time relationships (7)using mathematical relations (8)classifying. The integrated skills stated are: (1)controlling variables (2)experimenting (3)formulating hypotheses (4)interpreting data (5)formulating models (6)defining operationally. The subdivision of these skills is based on supposed levels of complexity. It is felt that the integrated skills require: (1)the students' ability to manipulate several of the basic skills at one time, and (2)the use of abstract thinking. Perhaps students at the lower levels in our educational system need more opportunities to develop their cognitive structures to the point where they can satisfactorily integrate theories, concepts and other abstract scientific content into their structure of thinking. Developers conjecture that students might utilize a process oriented science curriculum to develop and apprec-

iate scientific skills and at the same time obtain sufficient concrete experiences through the manipulation of materials used in pursuit of the aforementioned skills. It is hoped that with such a strong scientific foundation in the basics a student can objectively and critically approach and assimilate more sensory stimuli from his environment.

Previous to the advent of process oriented curriculum such as, "AAAS – Science: A Process Approach", many people argued for an inquiry oriented science program. This was probably an offshoot of the hysteria arising out of Sputnik. Schwab (1969) voiced the sentiments of some when he pointed out the great loss of creativity in science. Schwab noted the abundance of stable science (research related to theories and ideas already available) in North America and the apparent lack of fluid science (dealing with the development of new ideas). He attributed this to the lack of inquiry oriented science programs. Schwab singled out the need to spend more time deciding how facts were arrived at, thus setting the ground work for fluid inquiry.

At first the impetus was to remove rote memorization of facts and get students involved in finding things out for themselves. The student was thought of as an apprentice scientist. However, it was soon realized that many students didn't have the basic skills elucidated by "Science – A Process Approach" which are necessary for an open-ended inquiry program. This led to process oriented curricula such as "AAAS - Science: AProcess Approach".

Curricula such as "Science – A Process Approach"

allowed the student to develop, in a stepwise fashion, each of the skills basic to an inquiring scientist. Inquiry focused on technique rather than content. A Process oriented curriculum has the intent of teaching the student how to inquire. This was done in "Science – A Process Approach" by asking students to carry out an activity in a prescribed fashion. Each activity has as its aim the development of a specified skill or skills. At the end of the course, the student should have all the skills necessary to indulge in the fluid inquiry which J.J. Schwab elucidated upon.

Classroom control and process learning

Assuming that a process oriented curriculum has been instituted, there is now the question of how the science activities contained within the curriculum should be structured in order to best facilitate learning. For example, should students be told step by step what to do in an activity (i.e. High Control) or should they be given the materials, a problem to solve and then allowed to figure the rest out for themselves (i.e. Low Control)?

Hunt (1971) argued that it is important to match teaching style to pupil characteristics. Hunt said that a student's conceptual level has to match the teacher's style. Most students are at the lower conceptual levels and require a structured teaching style. Students at the higher conceptual levels would supposedly do better in an environment with less teacher control. Using Hunt's argument it

might be concluded that process learning in the elementary grades would proceed better with a high teacher controlled class since most students are not at the higher conceptual levels.

Furthering the argument that there is an important relationship between student learning and teaching mode, Crumb (1966) did a study observing teaching methods, materials used and other factors tending to differentiate classes. Crumb stated that gain in understanding science depended upon the teacher regardless of materials used. In reference to the teacher, Morrison (1974) argued that there were three important dimensions of teacher leadership behavior: control, teacher warmth, and teacher enthusiasm or activity level. Of these, Morrison emphasized the control factor and tried to extend Flander's (1960) concept of control. Morrison also pointed out that further investigation into teacher control was necessary.

Teacher control and student perception

There has been very little study done concerning the way students perceive themselves and others in the classroom. Perhaps the student was thought to be too fickle in his attitude or perhaps his views were of little consequence as long as the behavioral objectives of the curriculum were met. In either case, there is a need to look at student perceptions and to ascertain whether or not they can be altered by the extent of teacher classroom control.

Lawrenz (1977) carried out a study involving 54 high

school classes. All students in the classes were administered the "Learning Environment Inventory" (LEI) at different times throughout a school year. From the study Lawrenz found that student perceptions of the social environment of the classroom might be an important variable contributing to educational outcomes and that attainment of a specific type of environment might itself become a primary educational goal.

Further research by people such as Shymansky and Penick, Krockover, and Malcolm, seem to show a connection between classroom environment, students' perceptions of themselves and others and the performance level of the students.

Shymansky and Penick (1977) suggested in their study that certain self-perceptions may not facilitate maximum learning from science activities which capitalize on problem-solving situations. They concluded that it would be quite advantageous to observe student perceptions.

Krockover and Malcolm (1977) observed that the "Science Curriculum Improvement Study" was conducive to self-concept development. The study they carried out involved 189 subjects in eight classes ranging from grades 3 - 6. The subjects had no previous instruction in any of the modern elementary science programs. Over a period of four and one-half months the experimental groups were taught a science using SCIS while the control groups used their same science textbook program. Self-concept development was measured before and after the treatment by admin-

istering the Piers-Harris Scale (PHS). Results obtained indicated that the SCIS program helped to create a classroom environment which improved the self-concept of students. They recommended that additional studies be conducted at all grade levels to further ascertain the role of modern science programs in the child's self-concept development.

In conclusion, Wylie (1961), in a review of literature related to self-concept, found studies tending to show increased levels of performance and achievement arising out of the improved self-image of the student. If the degree of classroom control affects student perceptions and if perceptions such as self-image affect the student's performance level, then an important relationship does exist between the classroom environment and the student's perceptions within the confines of that environment. It is to this relationship that the following thesis is oriented.

Statement of the problem

For the purpose of this study, teacher classroom control has been divided into two subdivisions, high control (HC) and low control (LC). In a highly teacher controlled class, a large degree of structuring goes on. Students are given the assignment, the materials, the exact procedure to follow, guidance along the way and constant reinforcement from the teacher. On the other hand, a low teacher controlled class (LC) would also obtain the assignment and the materials. However, this is all the two teaching styles

have in common. In the (LC) environment the student must seek his own procedure and decide for himself whether or not the findings are correct. Each of these subdivisions (LC & HC) are outlined in full detail in Chapter 3.

There have been a number of studies done on classroom control. This study, although hoping to expand somewhat on the idea of classroom control, does not have this as its major emphasis. The researcher is more interested in what effect HC and LC classroom environments would have upon student perceptions. Thus arises the question of what is meant by student perception.

Data on the overall area of student perception is scanty. It is therefore difficult to give a concise description of the term. For this reason, the following discussion is rather generalized. To begin with, a student's interest in a science activity is of prime importance. As a researcher, therefore, it would be beneficial to ascertain whether or not students perceived their science activities as being interesting.

An educator has a certain intent in teaching a lesson. For example, "Science – A Process Approach" emphasizes the development of the processes of science. The question is: do students perceive the intent of the activity in the same light as the teacher and curriculum designer?

Another area of student perception is self-concept. How does the student perceive himself in connection with: the teacher, other students, his own ideals, ambitions and ability to do the work assigned? Does the child see himself

as more, less or equal in importance to the teacher and fellow students during science activities? Does he think of his existence as having any relevance to what is going on around him?

A major area of concern is the student's perception of the atmosphere of the science activities. Does the student see the teacher as being authoritarian? Does he feel pressure from the teacher and/or his peers to perform? What does he expect of others and what does he perceive as being their expectations of him? What is the mood of the class? Does the student find it easy to relate to what he is doing? Does he feel that there is sufficient opportunity to utilize his curiosity? How does he perceive the research personnel, the teacher and the other students?

The area of student perception in the classroom is very wide. In fact, it is too wide to encompass as a whole in this study. The researcher thus found it necessary to limit himself to several aspects of the student perception question. In chapter 2 there will be further discussion as to the specific perceptions chosen and an in-depth look at each of them.

Measurement of student perceptions

The question that arises at this point is: how do you measure something as intangible as a perception? To answer the question, the researcher looked at the four types of measuring instruments that might be utilized.

First of all, there is the general questionnaire,

rating scale or checklist. Here the researcher administers a questionnaire to a class after completion of a number of science activities. The students write down answers to the questions based upon their interpretation of the questions asked by the researcher(s). Also, this is a rapid way to obtain feedback on the class. A disadvantage of this instrument is that children reading the questions are apt to perceive them differently and answer according to their own interpretation. Also, the way the student answers the question (even if two students think the same thing) will have an effect upon the researcher's interpretation. In short, neither the student nor the researcher can be sure of what the other is saying.

Another measuring instrument worth looking at involves a coding system. Following this scheme, the researcher would use a preconceived coding system to classify the audio and visual actions of the student. The researcher could either observe the students in person or monitor them with audio-visual equipment. An asset of this method is the reliability of a coding system. A disadvantage of this technique is that two children may react similarly to a stimulus for quite different reasons. Another disadvantage is the difficulty in setting up a coding scheme to measure such an intangible thing as student percepetion.

From the discussion of the previous two measuring instruments, it is evident that research into student perception needs some means of ensuring students understand questions put to them. Also, it is important that the re-

searcher be able to properly interpret student responses. Both of these problems can be reduced through confrontation with the student. Thus the argument arrives at a third measuring instrument, verbal discussion with students.

Through verbal discussion the researcher knows if the child understands the questions and can thereby make clarifications where necessary. In discussing the question the researcher can also obtain a better idea of the child's actual perceptions. A problem does arise if the researcher is trying to maintain the consistency of the questions posed and the interpretation of the answers obtained across several interviewers. Other disadvantages of this method are the large amounts of time required for personal interviews, and the possible influence which the researcher's presence might have upon the student's responses.

Some of the problems presented by the aforementioned method can be alleviated by the formation of a protocol which would make up a pupil interview form. Use of such an interview form whereby a researcher talks with a student on a one-to-one basis would assure consistency in questioning, the student's understanding of the questions and the researcher's knowledge of the student's perceptions. Also, it would allow for open-ended responses and permit probing of the reasons for pupil responses. However, still persisting are the disadvantages of the quantity of time required to interview students on an individual basis and the possible influence which the researcher's presence might have upon the student's responses. If used, a pupil interview form

would need some measurement of the validity of the questions, reliability of the student's answers (would the student answer the same way tomorrow as he did today), and inter-rater reliability for classifying responses.

The researcher developed an instrument to measure student perceptions in the classroom setting. With this instrument, the relationship between high and low teacher controlled classes and students' perceptions were investigated.

A substantial body of research (Anderson, 1960; Brown, 1967; Getzels and Jackson, 1962; Gibbony, 1959; Rushton, 1966; Tuckman, 1969) suggested an interaction between teacher control and pupil characteristics such as sex, academic ability, personality, creativity and socioeconomic status. Therefore, as part of this study, the researcher looked at the possibility of any interaction effect of these variables and high and low teacher control on the perceptions of the students.

Definitions

(1)Teacher classroom control

- high control (HC)
- low control (LC)

This study, which is part of a larger research project, has aided in the development and utilization of a category system for defining degree of teacher control. The system is outlined in its entirety in chapter 3.

(2)Scientific processes

The processes of science are outlined in "Science A

Process Approach" (1965).

Significance of the study)

There has been a need for research into the various interactions going on within a classroom. This was especially evident in the continued controversy over whether content or process was the essential ingredient of the ideal elementary science course. Proponents of neither recipe had sufficient data to back up their argument, let alone suggest the best environment in which to foster scientific learning.

This study departs from other related studies in a number of ways. The high and low contol treatments are monitored very closely, thus enabling the investigator to ascertain the degree to which the treatments are carried out. This is unlike many other studies in which there was no real knowledge of the differentiation between treatments.

Another distinction of this study is that the treatments were carried out in the classrooms for five months, with specially chosen teachers who were given prior training in teaching by treatment. Most other studies reviewed (see chapter 2) lasted only a couple of weeks and it was therefore questionable whether their treatments had an opportunity to take effect.

Unlike many other studies, the students in this study are subjected to both treatments at one time or another. This, along with the standardized subject matter across all classes, counterbalancing of teachers, counter-

balancing of time, and the wealth of background data collected on each individual student, made this study rather unique.

Also worth noting is the pupil interview form developed for the study. It is rather distinctive in the questions to which it seeks answers. If a relationship between treatment and student perception is shown, it could have a number of possible ramifications for the classroom.

Finally, the overall study sets out a very clear operational definition of teacher classroom control. Hopefully, this will be adopted by other researchers for use in their work.

Chapter 2

Related Literature

In reviewing the literature the investigator found little research concerning student perceptions within the classroom setting. However, the literature showed findings revealing a great deal of ambiguity involved with the classroom control question. Most of this ambiguity was probably due to inadequate research designs and distinctive differences between operational definitions of teacher control.

Teacher classroom control

There were a number of different classroom control scales in use throughout previous studies. Rosenshine (1971) noted that in eight studies of indirect/direct teaching methods which he reviewed, there were three different i/d ratios to describe teaching. Rosenshine argued that this made comparisons between studies questionable. On the same note, Hermann (1969) argued that lack of agreement upon operational definitions further complicated the possibility of reaching any agreement on the teacher control question. It is hoped that the operational definitions of classroom control devised for this project will aid in obtaining some consensus in this regard.

There have been a number of studies done on teacher control, each with its own label for the type of control

technique used. Penick et al. (1976) referred to teacher-structured and student-structured, Spears (1977) used structured and unstructured, Christensen (1960) referred to degrees of permissiveness, Soar (1973) ascribed to high and low teacher control, Lewin (1939) referred to authoritarian, laissez-faire and democratic modes of teacher control, Flanders (1960) used direct and indirect teaching, Herman (1969) utilized teacher-centered and pupil-centered, Myers (1968) referred to inductive and deductive teaching modes, and Olander (1973) addressed control in terms of discovery and expository methods. For the purpose of this discussion, and in keeping with the overall study, the following three groupings were used to avoid confusion: (1)high control; (2)low control; (3)flexible behavior.

Several studies concerning classroom control found high teacher control superior to low control. A study done by the Stanford Center for Research and Development in Teaching (1975) found that students in sixth grade classes achieved better in a high controlled environment. The study involved training four teachers for two weeks in order that they be able to utilize eight variations of combinations of high or low structuring, soliciting and reacting in teaching a two week course in Ecology. Each class was randomly split into two groups which each received a different treatment by separate teachers. At the end of nine days of instruction, students were given multiple choice and essay tests of their knowledge and understanding of ecology and filled out a questionnaire about their attitude toward

ecology. The multiple choice test was composed of two types of items - items that required recall of information and items that required integrating and applying information. The latter asked the students to combine facts to form principles, compare or contrast, and interpret. Results showed that classes that were asked more recall questions during the lesson (low soliciting) performed better on the achievement posttest than did classes that were asked more thought questions (high soliciting). Classes taught with a high level of structuring did slightly better than classes given little structuring. Classes that received praise for correct answers and reasons for the wrongness of an answer (high reacting) did slightly better than those classes given neutral feedback and no reason for an answer being considered wrong (low reacting).

Babikian (1971) compared the expository, laboratory and discovery methods of teaching science. For discussion purposes expository and discovery would be similar to high and low classroom control respectively. Two hundred and fifty grade eight students were broken up into groups, each of which was taught six science concepts over a period of one week using one of the teaching styles. Babikian concluded that students found all three methodsequally interesting but that most of them considered the expository (HC) method the easiest, clearest, and best method of science teaching. However, the groups never had another method to use as a point of reference in their comparisons. Also, it is questionable whether one week is sufficient time to

produce any treatment effect.

Spears and Zollman (1977) did a comparison of structured and unstructured labs. In a structured lab students were given a problem, the equipment necessary and the procedure to follow, whereas unstructured labs left the procedure for the students to devise. Four classes of first year university physics students were subjects. Two classes were given structured labs and two classes were given unstructured labs. The Science Process Inventory (SPI) was administered to the students before and after the course. Results showed no differences except in the activities of science. It appeared that the setting up of activities required formal operations. Most of the students were at the concrete level and therefore required directions and examples. If this was true at the university level, would it not also be true for grade six science students? Indeed, results such as these produce a strong argument for a high teacher controlled environment which offers more direction and examples. However, when the findings in favor of low control are taken into consideration, the issue becomes clouded.

Shymansky and Matthews (1974) looked at directive and nondirective patterns of teaching science using a sample of 52 grade five science students in two classes. The study took place over a five week period. According to their findings, students under the nondirective pattern of teaching showed a greater tendency toward self-actualization in the science classroom, while the dependency of the teacher

structured students appeared to increase. Also shown was a significant difference in student investigative skills in favor of the student structured students (nondirective) with the most dramatic difference appearing in the performance of the low ranking students.

Wolfson (1973) did a one year study looking at the indirect/direct ratio in the teaching style of teachers of 160 students in eight classes of grade eleven chemistry and 160 students in six classes of grade eight and nine science. Wolfson used Flanders (1960) I/D ratio and videotapes as his observation instruments. His results showed that students taught by teachers with a higher I/D ratio achieved higher scores on a standardized achievement test in either chemistry or general science and achieved higher scores on a retention test given four months later, than did students of teachers of lower I/D ratios.

Eggleston (1973) did a study comparing inductive and traditional methods of teaching high school biology. Her sample was comprised of ten teachers divided between the experimental group of eighty-six students and the control group of ninety students. Each group was taught the same ten labs using the appointed method. All labs were monitored using the Egelston coding system and the Learning Environment Inventory (LEI) was administered to all students at the end of the treatment. Egelston found that inductive (LC) classes showed greater academic achievement and more independent behavior.

Penick et al. (1976) compared the instructional strat-

agies of student-structured learning (LC) and teacher-structured learning (HC). The sample was comprised of eight teachers and 250 students from grades one through five. Their results showed that the students were more task oriented in low control classes than in high control classes. Other interesting findings were that teacher behavior definitely affected student behavior and that teachers were able to control their classroom behavior. The latter information is important in setting up high and low control treatments.

Research findings such as those just reported give strong evidence in favor of HC on the one hand and LC on the other. To make matters even more complicated, there has been an abundance of research which advocated flexible classroom behavior on the part of the teacher.

Soar (1971) did a study involving seventy classes over a three year period. From the seven programs looked at, he observed that abstract growth was related to teaching that was less controlled and less focused but had some structure (LC), while skill growth was related to more focus and structure (HC) with concrete growth (derived from actual experiences) positively related to still more highly focused teacher behaviour and negatively related to extreme pupil freedom. On the same note, Amidon and Flanders (1967) found that no one pattern of teacher behavior was superior to another under all conditions.

Christensen (1960) used a pupil-response questionnaire he developed to measure teacher warmth and permissiveness.

Degree of permissiveness in this case was very similar to classroom control. Using a sample of eight fourth grade teachers, Christensen found no effect for permissiveness on scores from five of the Iowa Tests of Basic Skills.

Hermann et al. (1969) looked at the relationship of teacher-centered activities (HC) and pupil-centered activities on pupil achievement and interest. Eighteen teachers were matched in nine pairs and then each set of teachers taught either teacher-centered activities or pupil-centered activities for six weeks to classes of grade five social studies students. When the six weeks were up, another teacher taught the students the other treatment. Results obtained indicated that the method of classroom control made no significant difference upon achievement of grade five students tested.

Weisner (1971) did a comparison of the effectiveness of discovery versus didactic methods and teacher-guided versus independent procedures in principle learning. A six week experimental program was written to teach six basic spelling principles to sixteen sixth-grade classes. The classes were randonly assigned to four experimental treatment groups each of which used a different combination of method and procedure. One immediate and one delayed post-test were given to determine spelling achievement in terms of retention, transfer, and problem-solving abilities. Analysis of variance procedures were used to analyze the data obtained. The results showed no significant differences for method, procedure, or interaction on retention,

transfer and problem-solving abilities of the grade six students.

Wallen and Wodtke (1963) found that a relationship existed between grade level and the method of control. In a four year study involving 65 teachers and their students, grades one through five, pupil data were correlated with teacher characteristics, one of which was the teacher's tendency toward high or low classroom control. Analysis of the data consisted of correlational and factorial analysis. Results obtained clearly indicated that relationships did not take the same form across the five grade levels of the study. The general impression resulting was that the typical first grader, being somewhat unsure of himself and new to the situation, is both more comfortable and achieves better given a situation which is quite structured and controlled by the teacher. At the same time the teacher should be rather supportive and encouraging but should deemphasize overt affection. By about the second grade this pattern tends to change and by the upper grades the general desirability of encouragement still exists but the effect of control shifts such that a greater degree of permissiveness has the more desirable effect in terms of both liking for school and achievement gain.

In conclusion, Myers (1968) looked at teacher characteristics and treatment effect (inductive and deductive styles), and their possible relationship with pupil achievement. Myers used a sample of 30 first and fourth grade teachers and their students. Four instruments measured

pupil achievement and one measure (The Runner Studies of Attitude Patterns, Interview form III) was used to determine the personal orientations of the teachers. Results of the study indicated that there were no significant differences in achievement between the pupils of teachers who taught deductively and those who tatught inductively, but that several teacher attitude patterns seemed to be related to pupil achievement.

It is obvious from the studies discussed thus far that there is no consensus on the effect of high and low controlled teaching styles upon students. Hopefully, this study will, through concise operational definition, stringent observational techniques and analysis coupled with an extended experimental period, alleviate at least some of the ambiguity in this area.

Student perception

In Chapter 1 the investigator alluded to the connection between the degree of classroom control and student perception within the classroom environment. At the same time, it was noted that there was a large and diffuse assortment of student perceptions worth consideration. However, it was impractical to look at all of them in this study. Therefore, the researcher was forced to choose several perceptions which he considered to be more interesting and in keeping with the overall study of which this is a part.

Once the researcher had chosen the perceptions to be studied the next step was the formulation of a student

interview protocol which would gain insight into them.

After consideration of the pros and cons of the measuring instrument which might be used, it was decided that a pupil interview form (protocol) was the most suitable for the purposes of this project. As was mentioned in Chapter 1, this kind of an instrument would allow the researcher to interact with the students on a one-to-one basis. Indeed, this method is quite time consuming. However, counterbalancing this were the advantages obtained by being able to discuss pertinent questions with the students. Such a protocol, as was previously mentioned, allowed consistency in questioning, students' understanding of the questions, the researcher's knowledge of the students' perceptions, open-ended responses and probing of the reasons for pupil responses.

The researcher was unable to find any literature in which an instrument of this kind was used to study student perceptions. Therefore, validation of such a technique created problems. This will be discussed further in Chapter 3.

At this point, it would perhaps be best to outline the perceptions chosen for investigation and the questions developed in order to operationalize these perceptions on the student interview form.

Interest

A prime concern of the researcher was the students' interest in the science program. If students found the

curriculum interesting, then it would be expected that they would become more involved. Perhaps the degree of interest varies with the amount of classroom control by the teacher.

Babikian (1971) found no significant differences in interest shown by grade eight students. However, in the study, students were only shown one of three possible treatments (expository, laboratory and discovery). Therefore, students had no real point of reference for the purpose of comparison. As is shown in Chapter 3 or this experiment, that problem can be alleviated.

In order to look at student interest the investigator asked the following question as part of the student interview form:

(1) Did you enjoy doing today's experiment?

Self-concept, self-esteem and student interaction

Coopersmith (1967) defines self-esteem as the amount of worthiness an individual perceives in himself. This perception is obtained in two ways. The first of these is external. A person observes himself in the eyes of others. The second means is internal. Here the person develops self-esteem through personal experiences, accomplishments and abilities (Coopersmith and Feldman, 1974).

Due to basic treatment differences it was expected that the teacher and fellow students would vary in amounts of time interacting with a student and also, the kind of interaction was expected to vary considerably. Aronson et al. (1978) pointed out that in the traditional classroom

(high control) there is a very competitive spirit with the development of winners and losers. On the other hand, a cooperative environment (such as low control) reduces competition and increases cooperation thereby eliminating losers and increasing the general level of self-esteem. The researcher was therefore interested in finding out if indeed there were distinct differences between high control and low control as to how the students perceived themselves.

On the same note, Aronson et al. (1978) pointed out that one of the major factors underlying cooperative behaviour on liking, positive attributions, self-esteem and performance was role taking ability. Aronson used the phrase "cooperative behavior on liking" in describing a less competitive atmosphere where students cooperate with each other in their efforts. This supposedly improved the student's self-image and enhanced his social development. Aronson pointed out that "when children engage in a coopereative rather than a competitive process, the nature of their interaction should increase their abilities to take one anothers' perspective (p.23)." This would obviously require a reduction in a student's egocentrism. This is very interesting because low teacher controlled science activities require a great deal of cooperative effort on the part of the students. Going by what Aronson has said, it might then be anticipated that low control students would be more socially concious, less egocentric, better able to perceive their lab partners thinking and therefore better able to get along with their partners in a lab setting.

Aronson was not alone in his assumptions. Staines (1956) pointed out that results from his research showed that teacher comments and interactions with students had a marked effect on student self-concept. On the other hand, research done by Klass and Hodge (1978) and Shymansky et al. (1974) showed no difference in self-concept between students in high and low control treatments. However, Klass pointed out that his results also showed no clear distinction between his treatments. This obviously nullified any conclusion he drew concerning self-concept and treatment effect.

Wylie (1961) stated the importance of enhancing the student's self-image in the classroom. In a survey which he did, Wylie pointed out that studies showed improved self-image of students led to increased levels of performance and achievement.

All this led the researcher to include the following set of questions in the student interview form:

(13)Who do you think did the better job on the activity, you or your partner?

(14)Why do you say that? (pert. to 13)

(15)Think about how your partner might feel about the activity. Who does your partner think did the better job?

(16)Why do you say that? (pert. to 15)

(17)Were you and your partner able to work well together?

(18)Could you explain your answer a little more? (pert. to 17)

(19)Do you think you did the activity the right way?

(20)Why do you say that? (pert. to 19)

(23)Do you think you got the right results?

(24)Why do you say that (pert. to 23)

The researcher asked students to justify their responses to questions such as numbers 13, 15, 17, 19, and 23 for several reasons. First of all, it was intended that this would aid the interviewer in finding out if the student understood the previous question. Secondly, requiring a rationale for a response would cause students to consider the questions and give more valid responses initially. Finally, it was hoped that the researcher might gain some insight as to why students responded to questions as they did.

Shymansky (1974) stated in his study that students tend to adapt their own investigative or problem solving behaviors to the role of the teacher. Due to the proposed

distinction between the HC and LC treatments in the study, it was anticipated that there might be a marked dissimilarity between treatments in the students' perception of the teacher's role in a science activity. The researcher wanted to find out whether the students felt they had played an essential role in the organization of the activity, collection of data and analysis of activity results. In essence, did the treatments affect the students' perception of who, either students or teachers, played the most important part in doing the activity? What rationale would students offer for their perceptions of who played the most important role?

In order to obtain answers to these questions the researcher asked the following questions as part of the student interview form:

(11)Who do you think played the most important part in doing the experiment today, students or the teacher?

(12)Why do you say that? (pert. to 11)

Dependency

Research findings by Shymansky and Matthews (1974), Egleston (1973), Penick et al. (1976), Spears and Zollman (1977), Good and Matthews (1976), and Shymansky et al. (1977) all point out that a teacher centered class tends to make students more dependent upon the teacher for direction and reinforcement. Indeed, Spears and Zollman (1977) found that most students actually got along better in a teacher centered (high teacher controlled) classroom. They argued

that the setting up of many process activities required formal operations, and that most students were at the concrete level and therefore required direction and examples.

The researcher, realizing that there is a difference in the amount of teacher based direction given with treatment, wished to find out if students in HC and LC felt they received sufficient teacher direction to carry out their science activities. Also, do students feel they exceed the level of direction needed to perform the activities in one treatment moreso than in the other? In order to obtain answers to these questions, the researcher asked the following questions as part of the student interview form:

(5) Did you get enough information from the teacher in order to get started on today's assignment?

(6) Suppose you had been given fewer directions. Would you have been able to do the experiment as well?

Often a student will carry out an activity in a specific manner, such as making a measurement or controlling certain variables, not because he realizes the necessity of doing so in order to obtain reliable and valid results, but simply because the student was directed to do so by the teacher. The question arises as to whether or not students, if now given the option to do the activity any way they wished, would pursue an activity in the same manner? Would

students in the LC treatment tend to follow a different procedure than dictated by the teacher to students in the HC treatment? What are the students' rationales for their choice of option? Is there a distinction between treatments as to whether or not students think it is essential to do an activity the way the teacher wanted it done?

In order to obtain answers to these questions, the researcher asked the following questions as part of the student interview form:

(9) If you had a choice, would you have done the activity the same way your teacher asked you to do it, or would you like to have done the activity another way?

(10) Could you explain your answer? (pert. to 9)

(21) Do you think you did the activity the way the teacher wanted it done?

(22) Do you think it was very important that you do the activity the way the teacher wanted?

Curiosity

It is widely held that children have a built-in curiosity; that they want to manipulate things, see how they work and what can be done with them. Peterson (1975) states that the results of her study indicate,

> "the need for a wider variety of conditions under which pupils are permitted to explore in order to accommodate what appear to be differentiated

preferences or modes of expressing curiosity among children of elementary school age (p. 207)".

In connection with HC and LC classes, it is endeavored to ascertain whether students have sufficient opportunity (ie. time, lack of outside interference) to manipulate the apparatus and carry out things they wish to try in the activity. In other words, do the students think they have sufficient opportunity to utilize their curiosity in both treatments and (or) to a greater extent in one treatment than in the other? Also, what are the students' rationales for their sufficiency or insufficiency of opportunity to utilize their curiosity?

In order to look at these perception questions the following questions were asked as part of the student interview form:

(7)Did you have the time to do all the things you would like to have done with the materials in the activity?

(8)Why do you say that? (pert. to 7)

Process orientation

Shymansky and Matthews (1974) noted in their research that low teacher controlled students tended to improve their investigative skills more than did high teacher controlled students. In looking at such occurrences, Barker (1968) developed the notion that an individual's perception

of the goals of a setting and of his role in the setting may influence his behavior. Thus, high and low teacher control may lead to different pupil expectations of goals and to different pupil role perceptions. For example, it might be hypothesized that in a high control setting the pupil may be more likely to perceive the goal in terms of meeting immediate teacher requirements, thus reducing the emphasis by the pupil on the cognitive demands of the problem at hand. Following from Barker, this study attempted to ascertain how the students perceived the intended goals of the science activities in which they were involved. It was conceived that significant differences existed between HC and LC classes on the process orientation of the students involved in a process oriented science curriculum. The question asked was, does a dissimilarity exist between HC and LC as to whether students perceive science activities in terms of: the process skills being developed, content, or procedure?

In order to answer these questions, the researcher asked the following questions as part of the student interview form:

(2) If you went outside after class and someone asked you what you did in science class today, what would you say?

(3) What do you think was the purpose or reason for doing this activity?

(4)What do you think you learned from the activity?

(25)What do you think the results you got show?

Treatment, perception and pupil characteristics

Barker's (1968) 'behavior-setting' construct admitted the possibility that an individuals' behavior is a function of that individual's characteristics as well as the nature of the setting. A more formal expression of this concept was given by Hunt (1971), and Hunt and Sullivan, (1974) in the context of the question of matching teaching styles to pupil characteristics.

Brookover et al. (1965) gave research findings which show that self-concept of Junior High School students is very heavily affected by parents' expectations. Amidon and Flanders (1961), investigating the relationship between dependence-proneness and teaching style with eighth-grade geometry students, showed that dependence-prone students are more successful with higher teacher indirectness. Crocker, Bartlett and Elliott (1976) found a significant interaction between treatment and neuroticism in their study with sixth grade science pupils, although insignificant interactions were found in the case of extraversion and dependence-proneness. This study therefore, saw the need to look at possible interactions between perception and pupil characteristics.

Hypotheses

The major thrust of this study concerned the development and use of an interview schedule to look at student perception. Of prime importance was the effect treatment (HC and LC) had on student perceptions. Therefore, the primary hypotheses were as follows:

Hypothesis 1: There are significant differences on variables a - j, as measured by the pupil interview form between grade six science students exposed to a high teacher controlled class environment and a low teacher controlled class environment:

(a) Process orientation of the students.

(b) Students' perception of sufficiency of teacher based directions for students to carry out the activity.

(c) Students' perception of their ability to work with less directions than they had been given.

(d) Students' perception of the sufficiency of opportunity for students to utilize their curiosity in an activity.

(e) Students' perception of whether they or their partners did the better job on the activity.

(f)Students' perception of the importance of doing the activity the way the teacher wanted it done.

(g)Students' perception of their partners' opinion of which of the two did the better job on the activity.

(h)Students' perception of their ability to work with their partners during the science activity.

(i)Students' perception of whether or not they carried out the activity in the right way.

(j)Students' perception of whether or not they got the right results.

As it has been noted, literature suggests that variables other than treatment may influence variables a -j above. It is possible that other independent variables will interact with the treatments. Out of this developed the following secondary hypothesis:

Hypothesis 2: When variables A - J from Hypothesis 1 are each used as the criterion, there is significant interaction between treatment and each of the following variables:

(a)Self-concept of ability, as measured by a modified version of the questionnaire developed by Brookover

(1962);

(b)Extraversion/Introversion, as measured by the Junior Eysenck Personality Inventory (JEIP), (Eysenck, S.B., 1963);

(c)Dominance/Submissiveness, As measured by The Children's Personality Questionnaire (Porter and Cattel, 1968);

(d)IQ, as measured by Raven's (1960) Standard Progressive Matrices;

(e)Teacher.

Chapter 3

METHODOLOGY

Experimental treatments

This study involved two experimental treatments, high teacher control (HC) and low teacher control (LC). Both of these treatments were operationally defined using a number of teacher behaviors derived from a modified version of the Bellack system (Bellack et al. 1966).

The modified version of the Bellack system came about from the efforts of Crocker et al., (1975). According to the system devised, the treatments are distinguished by different values of the variables listed in Table 1. Teachers were trained to behave in a manner in keeping with the high or low values of each variable as it affected them in the assigned treatment.

In order to ascertain whether or not the assigned treatment behaviors were adhered too, each teacher was videotaped during class on eight different occasions throughout the eighteen week experiment. The exact procedure followed in videotaping was as follows. Two video tape recorders were set up in the classroom prior to the class, preferably when students were gone on a break. The teacher had a microphone attached and five pupil pairs had a microphone placed on their desk. Each VTR unit recorded three groups (three pupil pairs or two pupil pairs plus the

Table 1

Summary of Variables Used in Differentiating Experimental Treatments

Variables	Relative Value	
	High Control	Low Control
Teacher-Class Interaction	High	Low
Teacher-Group Interaction	Low	High
Proportion of Pupil Talk During Teacher-Class Interaction	Low	High
Proportion of Pupil Talk During Teacher-Group Interaction	Low	High
Teacher Structuring	High	Low
Teacher Soliciting	Low	High
Teacher Responding	Low	High
Teacher Reacting	High	Low
Ratio of Commands to Total Teacher Solicits	High	Low
Ratio of Requests to Total Teacher Solicits	Low	High
Pupils Reporting Individual Results	Low	High
Teacher Substantive-Logical Discourse	Low	High
Pupil Substantive-Logical Discourse	Low	High
Average Wait Time (Sec)	Short	Long

teacher) by taking successive three-minute samples from each group throughout the lesson. A single thirty-minute tape was used for each class session, which permitted three to four three-minute observations for each group. Gaps of appropriate length were left between the three-minute recordings if the lesson was longer than thirty minutes in order to ensure that behaviors throughout the lesson were sampled (that is to ensure that the tape did not run out before the end of the lesson, resulting in a lack of data on behaviors during the lesson summary phase).

The information received from the videotaping was later coded using the detailed coding system devised by Crocker et al., (1975). Although teachers were given some feedback, the coding was not completed soon enough to be of as much significance in teacher reinforcement as was planned. However, the coding of the videotapes did enable the researcher to obtain valuable information concerning the degree to which the treatments were distinguishable.

It was anticipated that differences in teaching style would occur and thereby reduce uniformity of the treatments. However, it was this variance that would increase the generalizability of the experimental findings. On the other hand, it was also anticipated that these differences would not be so large as to nullify the treatment effect. Data on the treatment differences are presented in Chapter 4.

Four experienced teachers were chosen and provided with a one week training program on lesson material and

treatment differences. Three of the teachers chosen were employed on a part-time basis and the fourth, full-time. The full-time teacher acted as coordinator for lesson preparation, distribution of materials, sequencing, and related tasks. These teachers replaced the regular classroom teachers during science periods for the duration of the eighteen week experiment. In this manner, it was possible to assign teachers to classes in accordance with experimental requirements. Although replacing the teacher did mean some loss in generalizability this was more than offset by the gain in experimental control from being able to assign teachers to classes in a balanced fashion, thereby avoiding the teacher-class effects common to studies using intact classes.

Subjects

The sample consisted of eleven sixth grade classes in six schools within the Avalon Consolidated School District in St. John's, Newfoundland. One of the classes was later dropped from the main analysis when it was found that the students had already completed some of the course content covered in the experimental program. However, this class was used for reliability studies on several of the instruments used.

The samples were chosen from a region having a population of about 250,000. Half of these lived in the Metropolitan area of St. John's and the rest came from surrounding communities with populations ranging between one

and five thousand inhabitants. A wide range of occupations existed within the sample. St. John's is a University and government centre, while the rural areas are a mixture of primary industry (fishing and farming) blended with workers commuting to and from St. John's. Thus, a wide range of social and occupational classes exist throughout the region.

The schools chosen were part of a denominational school system found on the island of Newfoundland. The tendency of the schools in the area has been towards regionalism, thus the development of larger and more elaborate schools with students bussed in from outlying areas. Classes in the suburban areas were generally large as opposed to smaller classes in the urban areas, the latter undergoing declining enrollments as people move to the suburbs.

The schools were using the standard curriculum laid down by the provincial Department of Education. Little science had been taught prior to the introduction of the experimental program, with the exception of the class which was subsequently dropped from analysis.

Curriculum

The science program was a modified version of Science-A Process Approach (AAAS, 1968). The students used three processes; interpreting data, controlling variables and measurement, the latter process being added in order that students obtain prerequisite skills lacking due to little previous science experience.

The program consisted of a series of activities occupying one or two class sessions. Sets of apparatus were provided so that students were able to work in pairs. Each activity began with an introduction by the teacher, a period of data collection during which students set up apparatus and made measurements, followed by a class discussion based on the data gathered.

The activities were grouped into three content units: Batteries and Bulbs, Human Reactions and Mechanics. A summary of their connection with the use of the three science processes previously mentioned is given in Tables 2, 3 and 4. These tables were developed by Helen Banfield (1978).

Instrument development

As was pointed out earlier, the student interview form was designed to provide a standard format whereby interviewers could ask questions about: (1)whether the pupils perceived the activities in process, content, procedural or other terms; (2)how the pupils perceived frequency, clarity and sufficiency of teacher directions for the conduct of the activities; (3)pupil perceptions of the amount of freedom available in carrying out the activities; and (4)the pupil's relationship with his partner. In order to expedite matters as quickly and efficiently as possible, a list of possible student responses to each of the twenty-five questions outlined in chapter 2 was placed on the interview form. Also, space was provided under each question for answers which didn't conform to the set of predefined

Table 2

Summary of Objectives and Activities

for the Process of Measurement

	Objective	Batteries/Bulb	Mechanics	Human Reactions
1.	Problems of Estimation	Bulb brightness	----	----
2.	Use of arbitrary units	Strength of an electromagnet	weighing objects using a balance	----
3.	Metric units	----	----	Length of optical lines
4.	Subunits	----	weighing objects using a balance	----
5.	Conversion	----	----	----
6.	Instruments	Brightness meter	Balances	----
7.	Averaging errors	Strength of an electromagnet	----	Individual differences in learning and forgetting
8.	Judgements on precision	Effect of battery condition on brightness	Stretching rubber bands	Change of pulse rates during counting

Note. Transfer items are based on the same process objectives

Table 3

Summary of Objectives and Activities

for the Process of Controlling Variables

	Objective	Batteries/Bulb	Mechanics	Human Reactions
1.	Identifying relevant variables	Variables infl. bulb brightness, Variables infl. strength of e/magnet	Rolling cylinders	Variables infl. pulse rate; Variable infl. rate of learning and forgetting
2.	Identifying constant and manipulated variables	Manipulating number of batteries and number of turns of e/magnet	Selection of cylinders to attain a single manipulated variable	Manipulate learning time, hold length of list constant
3.	Identifying responding variables	Bulb brightness, e/magnet strength	Relative time of rolling	Interval of recall
4.	Identifying variable that affect respond. variable	time of day, temp. number of batteriess	Preliminary check of rolling cylinder	Variables in learning
5.	Identifying uncontrolled variables which exert syst. effects on responding variable	Classroom temp. turn spacing number of batteries	Individual variations in rubber bands	Individual differences external history classroom conditions
6.	Conduct of Invest. with one manipulated & one respond. variable with other variables constant	Brightnesss of bulb as a function of number of batteries or number of bulbs	----	Pulse rate as a a function of exercise

Table 4

Summary of Objectives

for the Processs of Interpreting Data

Objectiyes	Batteries/Bulbs	Mechanics	Human Relations
1. Calculation of means Calculation of range	strength of e/magnet	strength of rubber bands	Optical illusionss, pulse ratess
3. Contruction of data tables	strength of e/magnet brightness of bulbs	----	Pulse rate as function of exercise
4. Constructing graphs, (histograms)	Brightness of bulbs, strength of e/magnet	Pendulum, length/ weight of balance	----
5. Interpolation of graphs, (prediction)	----	Stretch of rubber bands	----
6. Averaging errors	----	Balance, pendulum	----
7. Extrapolation prediction	----	----	----
8. Limits	Limit of strength limit of brightness	Non lin-earity of length-time relationship	Limits of pulse rates
9. Law-like relationships	----	Law of lever	----

categories. A final version of the student interview form is found in the appendix.

Experimental design

The sample used in this project was comprised of a small number of classes. A repeated treatments design in which all classes were exposed to both treatments was used. At the beginning of the experimental period, five classes were assigned to low control and six to high control. After nine weeks, the treatments were reversed and the teachers reassigned to new classes. The assignment of teachers was random, with the restriction that each teacher have at least one class in each treatment. Scheduling difficulties imposed some constraints on teacher assignments. These constraints were not considered related to any of the experimental variables and were therefore not considered departures from randomness.

These design considerations are summarized in Table 5. The occurrence of six classes in one treatment and four in the other resulted from the loss of the eleventh class as mentioned above. On the whole, the design permitted the analysis of data free from compounding due to teacher and class effects. Some compounding does remain in assessing treatment-teacher interactions within a round. However, this compounding can be removed to some degree by treating the two rounds as replications, with teachers being assigned to different classes in the two rounds.

On four occasions throughout the experimental

Table 5

Experimental Design

	Interview Schedule		Treatment: High Control		Treatment: Low Control	
	Round	Time	Teacher	Class	Teacher	Class
Session 1 Weeks 1-9	1	Week 1	D	1	D	2
			D	4	B	3
			A	8	B	5
			B	10	A	6
					A	7
					C	9
	2	Week 9				
Session 2 Weeks 10-18	3	Week 10	B	2	B	1
			D	3	C	4
			C	5	A	8
			A	6	D	10
			D	7		
			A	9		
	4	Week 18				

sequence, four pairs of students from each class were selected as interview subjects. The student pairs were picked at random without replacement so that by the end of the experiment every student in the class would have been interviewed at least once. Each time the students were placed in a one-on-one situation with the interviewer. The interviews took place immediately following a science activity, and questions were framed in the text of the activity. Due to the large number of students being interviewed immediately after the science activity, it was necessary to use five interviewers. This made inter-rater reliability checks a necessity. During the first round, interviews were recorded on audio tape for discussion among interviewers and to permit reliability checks.

Data sources

Throughout the duration of the experimental treatment, information on students was continually collected for the overall study of which this study is a segment. The collection of the information was spread out in order that students wouldn't be bombarded with questions all at once and to cause as little disruption of the school's functions as possible. The information obtained enabled this researcher to ascertain whether or not there were any interactions between treatment, student perceptions and pupil characteristics. A catalogue of the instruments used to collect the pertinent information utilized in this study follows. A bridf description of each instrument was

obtained from the report on the overall study done by Crocker et al. (1977).

Self-concept of ability

The Brookover (1962) questionnaire formed the basis for this scale. This scale consisted of six, five-choice items on the aspect of general self- concept of ability. A test-retest reliability coefficient of 0.72 has been established.

"Junior Eysenck Personality Inventory

The two traits measured by this instrument extraversion and neuroticism, were judged relevant to the study because each has a bearing on how a person behaves in his relationships with others. There is also evidence that anxiety or neuroticism exhibits interactions with teaching styles.

Construct validity of the instrument is based on the nature of the intercorrelations between various personality traits. Split-half and test-retest reliabilities for the scales are in the 0,7 to 0.8 range. The inventory contains a Lie scale designed to detect the faking of responses.

Children's Personality Questionnaire.

This instrument is a derivative of Cattell's 16PF (Porter and Cattell, 1968) designed for use with young children. For purposes of this study, only the submissive-dominant subscale was used. This scale was selected because it was judged relevant to the issue of the observed imbalance in student behavior in some student groups, with one student tending to dominate the activity. The question of interest was whether dominance of activity was related to the broader personality characteristic measured by the submissive-dominant scale and whether this characteristic was ultimately related to performance.

Test-retest and parallel forms reliability coefficients for Factor E of the CPQ (of which submissive-dominant is one of four subscales) are in the range 0.74 - 0.82.

Raven Progressive Matrices

The Raven Progressive Matrices (Raven, 1960) yields a measure of non-verbal intelligence. The scale has a test-retest reliability of from 0.83 to 0.93, depending on age of subjects. It was decided to use this test rather than a more comprehensive intelligence test because other measures were available which were considered to be sufficiently well correlated with verbal intelligence measurement. Non-verbal intelligence was also considered to be important to the study because of the nature of the science activities used (p. 46 - 47)."

Data analysis.

Due to the nature of the interview form used in the study, it was decided to use cross-tabulations of the item responses by treatment and pupil characteristics. Generally, a two way cross-tabulation was considered more than acceptable. However, a three way cross-tabulation was carried out in order to clarify any ambiguities. The chi-square statistic was used in tests of significance.

Reliability & validity of interview form.

The student interview protocol was used by five interviewers during the course of the experiment. It was therefore necessary to do inter-rater and intra-rater reliability checks along with a test-retest reliability check on the students. The inter-rater reliability was obtained in the following manner. Each interviewer made an audio tape of all interviews made during round one. Interviewer number one then listened to two tapes from each interviewer including himself and filled out an interview sheet based on what he heard. The two interview sheets belonging to the interviewers were then compared to the new ones which

interviewer number one obtained from the tapes and the percentage of agreement was obtained. On the average the percentage of agreement between interviewer number one and the other interviewers was 91%. This was considered to be quite reliable. The individual percentages of agreement were as follows:

Interrater reliability

Between Interviewers	% of Agreement
1 and 1	0.96
2 and 1	0.85
3 and 1	0.94
4 and 1	0.94
5 and 1	0.88

From the oral clues given, it appeared that differences in interviewer responses should not have occurred. Apart from the human error factor, the researcher is lead to believe that visual stimuli have some effect on the interviewers catagorization of responses to interview questions.

Test-retest reliability

In order to do this reliability check, one group of eight students was asked the same interview questions one day later and another group was interviewed seven days later. The responses of each student were compared with those given on the previous interview and the percentage of agreement was obtained. The level

of agreement was 0.55%.

From the information received and observations made, it appeared that students forgot about the particulars of the previous lab very quickly and therefore made the results of such a reliability check rather insignificant.

Validity

The validity of the interview form was based on the aforementioned reliability checks and the face validity obtained by having several authorities in the area look at the preliminary version of the interview form and suggesting alterations. Due to time limitations in setting up the study, there wasn't time to do a pilot of the interview form, although this would be a suggestion for any future studies.

Chapter 4

EXPERIMENTAL RESULTS

The purpose of this study was to look at student perceptions in the classroom setting. The researcher hoped to gain some insight as to how the students viewed the science activities in which they participated. It was conceived that differences in student perceptions would be due mainly to treatment effect and to a lesser extent to variables such as the teacher and student characteristics such as IQ, self-concept, extraversion and dominance. The intent of this chapter is to present the findings obtained from the study.

Implementation of the treatments

As was mentioned earlier, there were two treatments involved in this study. They were high teacher controlled classes and low teacher controlled classes. Specially trained teachers were placed in science classes and directed to maintain either a HC or LC setting. The degree to which teachers adhered to the treatments assigned was monitored with audio-visual taping equipment and later coded. The results of the coding are listed in Table 6.

In general, results obtained were in the desired direction. It could therefore be assumed that the two treatments were maintained as planned. There was more teacher-group interaction in LC as opposed to more teacher--class interaction in HC. Teacher structuring was more pro-

Table 6

Comparison of Behaviors in High and Low Control Treatments

Variable	High Control	Low Control
Teacher–Class Interaction	876	419
Teacher–Group Interaction	671	1,095
Proportion of Pupil Talk During Teacher–Class Interaction	.06	.10
Proportion of Pupil Talk During Teacher–Group Intereaction	.24	.29
Teacher Structuring	453	369
Teacher Soliciting	539	650
Teacher Responding	89	84
Teacher Reacting	229	227
Ratio of Commands to Total Solicits	.69	.79
Pupils Responding Individual Results	76	46
Teacher Substantive-Logical Discourse	187	230
Pupil Substantive-Logical Discourse	34	55
Average Wait Time (sec)	1.5	1.9

Note: Units are total sentences uttered in a sample of approximately 130 minutes lesson time for each treatment. Sample includes 13 lessons with all teachers included at least once in each treatment. Ratios and wait time computed for same sample data.

nounced in HC whereas teacher soliciting was predominant in LC. Also, the amount of time teachers waited for a response from students (wait-time) was longer in LC than in HC. There were a few deviations from expected outcomes however. Exceptions occurred for teacher responding and reacting, which showed essentially no differences, and pupils reporting individual results which showed a difference in the opposite direction from that predicted. In the latter case, however, the large interlesson variance within a treatment rendered the result unreliable. In any case this form of pupil behavior was perhaps not under teacher control to a sufficient degree to show predictable effects.

Analysis

As was mentioned in the methodology, the technique utilized was crosstabulation with chi-square test analysis. This technique resulted in a very large number of contingency tables. It therefore became necessary to cluster items under common themes as pointed out in chapter 2 and to list only the chi-square tests on the individual items.

Interest

During the first round of interviews it was found that nearly all students responded positively when asked if they enjoyed doing the activity. The decision was made to drop this question due to its lack of discriminating ability. Its use in any further analysis was therefore discontinued.

Summary of Chi-Square tests for pupil responses to interview questions for rounds One to Four.

Question 2
If you went outside after class and someone asked you what you did in science class today, what would you say? (0)don't know or off task (1)procedure (2)content (3)process.

Table 7

Variable		Round 1		Round 2		Round 3		Round 4	
	Df	x^2	P	x^2	P	x^2	P	x^2	P
Treatment	3	1.22	N.S.	0.98	N.S.	7.91	.05	7.98	0.05
Teacher	9	15.03	N.S.	17.61	.05	15.60	N.S.	8.93	N.S.
IQ	9	12.15	N.S.	7.43	N.S.	3.60	N.S.	3.93	N.S.
Extraversion	9	10.63	N.S.	6.24	N.S.	8.66	N.S.	7.73	N.S.
Dominance	6	5.09	N.S.	13.11	.05	17.11	.01	6.70	N.S.
Self-Concept	9	5.81	N.S.	9.53	N.S.	11.27	N.S.	7.45	N.S.

Question 3

What do you think was the purpose or reason for doing this activity? (0)don't know or off task (1)procedure (2)content (3)process

Table 8

Variable		Round 1		Round 2		Round 3		Round 4	
	Df	x^2	P	x^2	P	x^2	P	x^2	P
Treatment	3	2.17	N.S.	3.71	N.S.	7.19	N.S.	2.99	N.S.
Teacher	9	14.46	N.S.	19.02	.05	17.20	.05	16.16	N.S.
IQ	9	9.79	N.S.	4.18	N.S.	3.21	N.S.	8.50	N.S.
Extraversion	9	7.86	N.S.	13.97	N.S.	3.27	N.S.	13.16	N.S.
Dominance	6	5.44	N.S.	13.80	.05	2.17	N.S.	2.66	N.S.
Self-Concept	9	5.52	N.S.	6.59	N.S.	14.73	N.S.	7.94	N.S.

Question 4

What do you think you learned from the activity? (0)don't know or off task (1)procedure (2)content (3)process

Table 9

Variable		Round 1		Round 2		Round 3		Round 4	
	Df	x^2	P	x^2	P	x^2	P	x^2	P
Treatment	3	7.27	N.S.	10.26	.05	7.87	.05	4.12	N.S.
Teacher	9	20.52	.05	8.49	N.S.	10.40	N.S.	12.84	N.S.
IQ	9	8.83	N.S.	20.31	.05	4.67	N.S.	5.09	N.S.
Extraversion	9	4.32	N.S.	16.67	N.S.	3.15	N.S.	14.64	N.S.
Dominance	6	13.60	.05	7.21	N.S.	6.93	N.S.	13.43	N.S.
Self-Concept	9	5.19	N.S.	8.13	N.S.	5.40	N.S.	4.07	N.S.

Question 5

Did you get enough information from the teacher in order to get started on today's experiment
(0)don't know or off task (1)yes (2)no

Table 10

Variable		Round 1		Round 2		Round 3		Round 4	
	Df	x^2	P	x^2	P	x^2	P	x^2	P
Treatment	2	1.43	N.S.	0.87	N.S.	0.18	N.S.	3.25	N.S.
Teacher	6	21.91	.01	2.86	N.S.	3.33	N.S.	5.25	N.S.
IQ	6	5.90	N.S.	0.39	N.S.	0.96	N.S.	4.63	N.S.
Extraversion	6	2.86	N.S.	0.84	N.S.	5.11	N.S.	4.42	N.S.
Dominance	4	2.44	N.S.	1.67	N.S.	0.30	N.S.	11.43	.01
Self-Concept	6	2.75	N.S.	4.85	N.S.	1.57	N.S.	1.05	N.S.

Question 6

Suppose you had been given fewer directions. Would you have been able to do the experiment as well?
(0)don't know or off task (1)yes (2) almost as well (3)no (4)better

Table 11

Variable		Round 1		Round 2		Round 3		Round 4	
	Df	x^2	P	x^2	P	x^2	P	x^2	P
Treatment	4	3.23	N.S.	4.19	N.S.	3.91	N.S.	0.54	N.S.
Teacher	12	24.00	.05	12.22	N.S.	8.81	N.S.	7.67	N.S.
IQ	12	24.22	.05	7.54	N.S.	8.52	N.S.	6.46	N.S.
Extraversion	12	10.31	N.S.	11.10	N.S.	12.30	N.S.	3.47	N.S.
Dominance	8	7.88	N.S.	5.64	N.S.	15.93	.05	8.31	N.S.
Self-Concept	12	11.78	N.S.	5.29	N.S.	12.39	N.S.	2.82	N.S.

Question 7

Did you have the time to do all the things you would like to have done with the materials in the activity?
(0)don't know or off task (1)yes (2)no (3)yes and no

Table 12

Variable		Round 1		Round 2		Round 3		Round 4	
	Df	x^2	P	x^2	P	x^2	P	x^2	P
Treatment	3	2.81	N.S.	0.84	N.S.	1.08	N.S.	1.62	N.S.
Teacher	9	16.08	N.S.	11.29	N.S.	5.57	N.S.	10.49	N.S.
IQ	9	5.88	N.S.	5.38	N.S.	8.20	N.S.	4.71	N.S.
Extraversion	9	3.22	N.S.	8.93	N.S.	6.30	N.S.	12.54	N.S.
Dominance	6	4.87	N.S.	5.40	N.S.	2.22	N.S.	3.97	N.S.
Self-Concept	9	8.08	N.S.	3.19	N.S.	14.25	.05	3.70	N.S.

Question 8

Why do you say that (pertaining to question 7)?
(0)don't know or off task (1)did all we wanted to do (2)did what teacher wanted (3)wanted more trial & error (4)didn't finish teacher assigned work (5)ran out of time (6)procedure (7)content

Table 13

Variable		Round 1		Round 2		Round 3		Round 4	
	Df	x^2	P	x^2	P	x^2	P	x^2	P
Treatment	7	16.24	.05	7.52	N.S.	8.04	N.S.	11.06	N.S.
Teacher	21	37.19	.05	18.77	N.S.	23.15	N.S.	36.65	.05
IQ	21	18.14	N.S.	15.56	N.S.	19.33	.05	19.34	N.S.
Extraversion	21	20.54	N.S.	15.42	N.S.	11.73	N.S.	32.62	N.S.
Dominance	14	8.74	N.S.	13.05	N.S.	18.97	.05	16.46	N.S.
Self-Concept	21	20.46	N.S.	19.67	N.S.	18.25	N.S.	22.77	N.S.

Question 9

If you had a choice, would you have done the activity the same way your teacher asked you to do it, or would you like to have done the activity another way?
(0)don't know or off task (1)same way (2)another way (3)both

Table 14

Variable		Round 1		Round 2		Round 3		Round 4	
	Df	x^2	P	x^2	P	x^2	P	x^2	P
Treatment	3	4.09	N.S.	3.15	N.S.	0.62	N.S.	10.39	.05
Teacher	9	15.94	N.S.	5.96	N.S.	7.49	N.S.	6.61	N.S.
IQ	9	5.16	N.S.	5.56	N.S.	1.18	N.S.	6.93	N.S.
Extraversion	9	6.86	N.S.	4.91	N.S.	1.46	N.S.	9.02	N.S.
Dominance	6	9.27	N.S.	5.39	N.S.	1.59	N.S.	7.32	N.S.
Self-Concept	9	10.10	N.S.	6.53	N.S.	1.16	N.S.	4.25	N.S.

Question 10

Could you explain your answer (pertaining to question 9)?
(0)don't know or off task (1)liked the way the teacher did it (2)couldn't see any other way (3)easier (4)good to try different methods (5)didn't like the teacher's way (6)teacher's way plus it's good to experiment (7) should follow teachers directions (8)easier to understand (9)get it wrong otherwise.

Table 15

Variable		Round 1		Round 2		Round 3		Round 4	
	Df	x^2	P	x^2	P	x^2	P	x^2	P
Treatment	9	10.94	N.S.	15.82	.05	11.31	N.S.	13.79	N.S.
Teacher	27	40.99	.05	21.48	N.S.	42.74	.05	45.92	.05
IQ	27	30.11	N.S.	14.82	N.S.	8.35	N.S.	16.02	N.S.
Extraversion	27	32.75	N.S.	20.92	N.S.	26.11	N.S.	35.44	N.S.
Dominance	18	16.90	N.S.	11.17	N.S.	18.64	N.S.	21.61	N.S.
Self-Concept	27	21.69	N.S.	23.65	N.S.	15.84	N.S.	18.90	N.S.

Question 11

Who do you think played the most important part in doing the experiment today, students of teacher?
(0)don't know or off task (1)teacher (2)students (3)both

Table 16

Variable		Round 1		Round 2		Round 3		Round 4	
	Df	x^2	P	x^2	P	x^2	P	x^2	P
Treatment	3	4.25	N.S.	0.95	N.S.	0.99	N.S.	13.25	.01
Teacher	9	17.75	.05	11.38	N.S.	6.85	N.S.	10.87	N.S.
IQ	9	8.04	N.S.	9.20	N.S.	3.36	N.S.	6.70	N.S.
Extraversion	9	19.41	.05	11.12	N.S.	10.96	N.S.	11.61	N.S.
Dominance	6	3.13	N.S.	4.04	N.S.	4.66	N.S.	6.11	N.S.
Self-Concept	9	10.45	N.S.	9.86	N.S.	3.45	N.S.	10.78	N.S.

Question 12

Why do you say that (pertaining to question 11)?
(0)don't know or off task (1)teacher told us what to do (2)students didn't do much (3)students did activity (4)both did important parts.

Table 17

Variable		Round 1		Round 2		Round 3		Round 4	
	Df	x^2	P	x^2	P	x^2	P	x^2	P
Treatment	4	3.99	N.S.	5.05	N.S.	7.95	N.S.	15.08	.01
Teacher	12	15.25	N.S.	12.92	N.S.	13.73	N.S.	20.21	N.S.
IQ	12	18.86	N.S.	19.77	N.S.	6.91	N.S.	10.39	N.S.
Extraversion	12	18.90	N.S.	18.05	N.S.	14.30	N.S.	22.86	N.S.
Dominance	8	6.18	N.S.	13.56	N.S.	12.04	N.S.	9.05	N.S.
Self-Concept	12	11.74	N.S.	19.14	N.S.	15.13	N.S.	16.61	N.S.

Question 13

Who do you think did the better job on the activity you or your partner?
(0)don't know or off task (1)student interviewed (2)partner (3)same

Table 18

Variable		Round 1		Round 2		Round 3		Round 4	
	Df	x^2	P	x^2	P	x^2	P	x^2	P
Treatment	3	5.74	N.S.	10.18	.05	6.63	N.S.	3.51	N.S.
Teacher	9	11.20	N.S.	14.80	N.S.	13.26	N.S.	6.32	N.S.
IQ	9	11.12	N.S.	13.37	N.S.	8.39	N.S.	15.31	N.S.
Extraversion	9	12.70	N.S.	12.46	N.S.	12.01	N.S.	12.90	N.S.
Dominance	6	2.08	N.S.	4.11	N.S.	6.33	N.S.	13.99	N.S.
Self-Concept	9	5.31	N.S.	8.74	N.S.	7.55	N.S.	5.41	N.S.

Question 14

Why do you say that (pertaining to question 13)?
(0)don't know or off task (1)shared work (2)I did most and knew more (3) partner did most and knew more (4)complemented each other (5) did same things (6)proper etiquett (7)partner neater (8)did own work (9)neither of us is any good (10)made mistakes

Table 19

Variable	Df	Round 1 χ^2	P	Round 2 χ^2	P	Round 3 χ^2	P	Round 4 χ^2	P
Treatment	10	18.42	.05	23.13	.01	4.46	N.S.	13.32	N.S.
Teacher	30	48.03	.05	44.43	.01	35.98	N.S.	29.11	N.S.
IQ	30	28.94	N.S.	27.68	N.S.	15.42	N.S.	37.93	.05
Extraversion	30	58.33	.01	21.01	N.S.	24.77	N.S.	38.28	.05
Dominance	20	13.01	N.S.	12.91	N.S.	12.44	N.S.	23.60	N.S.
Self-Concept	30	28.16	N.S.	29.98	N.S.	18.08	N.S.	17.84	N.S.

Question 15

Think about how your partner might feel about the activity. Who does your partner think did the better job?
(0)don't know or off task (1)pupil interviewed (2)partner (3)same

Table 20

Variable	Df	Round 1 χ^2	P	Round 2 χ^2	P	Round 3 χ^2	P	Round 4 χ^2	P
Treatment	3	1.98	N.S.	6.03	N.S.	1.9	N.S.	7.07	N.S.
Teacher	9	18.04	.05	8.71	N.S.	7.42	N.S.	11.69	N.S.
IQ	9	18.46	.05	6.67	N.S.	3.44	N.S.	9.41	N.S.
Extraversion	9	12.98	N.S.	21.92	.01	1.97	N.S.	9.06	N.S.
Dominance	6	3.12	N.S.	5.57	N.S.	3.85	N.S.	9.64	N.S.
Self-Concept	9	8.99	N.S.	15.98	N.S.	15.34	N.S.	7.92	N.S.

Question 16

Why do you say that (pertaining to question 15)?
(0)don't know or off task (1)shared work (2)I did most and knew more (3)he did most and knew more (4)complemented each other (5)did same things (6) proper etiquette (7)he thinks he did more (8)won't admit he did less (9) didn't tell me.

Table 21

Variable	Df	Round 1 χ^2	P	Round 2 χ^2	P	Round 3 χ^2	P	Round 4 χ^2	P
Treatment	9	8.28	N.S.	3.80	N.S.	18.06	.05	15.76	.05
Teacher	27	45.58	.05	24.31	N.S.	33.32	N.S.	26.76	N.S.
IQ	27	39.39	N.S.	14.38	N.S.	19.66	N.S.	15.10	N.S.
Extraversion	27	25.46	N.S.	28.24	N.S.	29.58	N.S.	23.08	N.S.
Dominance	18	10.46	N.S.	19.58	N.S.	18.00	N.S.	23.87	N.S.
Self-Concept	27	23.52	N.S.	30.93	N.S.	22.36	N.S.	23.38	N.S.

Question 17

Were you and your partner able to work well together?
(0)don't know or off task (1)yes (2)no (3)indifferent.

Table 22

Variable		Round 1		Round 2		Round 3		Round 4	
	Df	x^2	P	x^2	P	x^2	P	x^2	P
Treatment	2	1.16	N.S.	1.60	N.S.	1.43	N.S.	5.39	N.S.
Teacher	6	4.38	N.S.	3.79	N.S.	6.18	N.S.	8.34	N.S.
IQ	6	4.38	N.S.	6.79	N.S.	4.83	N.S.	8.29	N.S.
Extraversion	6	14.90	.05	6.29	N.S.	4.35	N.S.	5.99	N.S.
Dominance	4	3.41	N.S.	5.17	N.S.	4.11	N.S.	25.49	.001
Self-Concept	6	13.59	.05	4.28	N.S.	7.37	N.S.	7.09	N.S.

Question 18

Could you explain your answer a little more (pertaining to question 17)?
(0)don't know or off task (1)shared work (2)complemented each other (3) good friends (4)partner hogged all stuff (5)I hogged all stuff (6)don't get along (7)got along together (8)better to work with partner of own sex (9)better to work with partner of opposite sex.

Table 23

Variable		Round 1		Round 2		Round 3		Round 4	
	Df	x^2	P	x^2	P	x^2	P	x^2	P
Treatment	7	8.04	N.S.	6.65	N.S.	10.39	N.S.	3.17	N.S.
Teacher	21	22.48	N.S.	15.85	N.S.	24.52	N.S.	31.46	.05
IQ	21	22.21	N.S.	16.57	N.S.	8.13	N.S.	20.08	N.S.
Extraversion	21	28.99	N.S.	7.87	N.S.	10.41	N.S.	17.45	N.S.
Dominance	14	14.85	N.S.	22.28	.05	13.46	N.S.	27.04	N.S.
Self-Concept	21	21.74	N.S.	13.54	N.S.	16.40	N.S.	26.01	N.S.

Question 19

Do you think you did the activity the right way?
(0)don't know or off task (1)yes (2)no (3)yes and no.

Table 24

Variable		Round 1		Round 2		Round 3		Round 4	
	Df	x^2	P	x^2	P	x^2	P	x^2	P
Treatment	3	1.10	N.S.	2.22	N.S.	5.04	N.S.	5.39	N.S.
Teacher	9	7.82	N.S.	5.21	N.S.	16.58	N.S.	10.14	N.S.
IQ	9	6.55	N.S.	3.49	N.S.	9.37	N.S.	9.51	N.S.
Extraversion	9	6.99	N.S.	1.49	N.S.	14.49	N.S.	5.31	N.S.
Dominance	6	5.80	N.S.	2.80	N.S.	4.14	N.S.	7.06	N.S.
Self-Concept	9	4.64	N.S.	4.30	N.S.	6.58	N.S.	8.35	N.S.

Question 20

Why do you say that (pertaining to question 19)?
(0)don't know or off task (1)got right results (teacher told us (3)followed diretions (4)understood (5)same as others (6)didn't understand how to do it (7)weren't told which was the right way (8)not enough time to finish (9)didn't understand for awhile.

Table 25

Variable		Round 1		Round 2		Round 3		Round 4	
	Df	x^2	P	x^2	P	x^2	P	x^2	P
Treatment	9	9.17	N.S.	9.33	N.S.	8.26	N.S.	8.36	N.S.
Teacher	27	25.45	N.S.	30.25	.05	39.30	.01	24.98	N.S.
IQ	27	17.62	N.S.	21.12	N.S.	12.00	N.S.	26.63	N.S.
Extraversion	27	21.62	N.S.	14.08	N.S.	30.44	.05	17.97	N.S.
Dominance	18	17.38	N.S.	7.66	N.S.	18.98	N.S.	25.90	N.S.
Self-Concept	27	17.39	N.S.	17.95	N.S.	14.98	N.S.	24.52	N.S.

Question 21

Do you think you did the activity the way the teacher wanted it done?
(0)don't know or off task (1)yes (2)no

Table 26

Variable		Round 1		Round 2		Round 3		Round 4	
	Df	x^2	P	x^2	P	x^2	P	x^2	P
Treatment	2	0.75	N.S.	1.21	N.S.	2.83	N.S.	0.04	N.S.
Teacher	6	6.19	N.S.	2.04	N.S.	8.78	N.S.	2.61	N.S.
IQ	6	2.26	N.S.	2.15	N.S.	7.94	N.S.	5.54	N.S.
Extraversion	6	5.69	N.S.	5.06	N.S.	5.76	N.S.	1.77	N.S.
Dominance	4	6.31	N.S.	4.19	N.S.	2.91	N.S.	2.90	N.S.
Self-Concept	6	2.78	N.S.	9.13	N.S.	5.28	N.S.	0.59	N.S.

Question 22

Do you think it was very important that you do the activity the way the teacher wanted?
(0)don't know or off task (1)yes (2)no (3)yes and no

Table 27

Variable		Round 1		Round 2		Round 3		Round 4	
	Df	x^2	P	x^2	P	x^2	P	x^2	P
Treatment	3	3.49	N.S.	0.12	N.S.	2.28	N.S.	2.42	N.S.
Teacher	9	14.40	N.S.	2.54	N.S.	13.36	N.S.	13.62	N.S.
IQ	9	6.22	N.S.	1.04	N.S.	4.53	N.S.	13.07	N.S.
Extraversion	9	15.12	N.S.	2.66	N.S.	4.64	N.S.	15.51	N.S.
Dominance	6	3.55	N.S.	0.17	N.S.	8.92	N.S.	6.65	N.S.
Self-Concept	9	5.83	N.S.	2.44	N.S.	7.16	N.S.	10.33	N.S.

Question 23

Do you think you got the right results?
(0)don't know or off task (1)yes (2)no (3)yes and no

Table 28

Variable		Round 1		Round 2		Round 3		Round 4	
	Df	x^2	P	x^2	P	x^2	P	x^2	P
Treatment	3	2.91	N.S.	1.15	N.S.	1.12	N.S.	5.82	N.S.
Teacher	9	4.38	N.S.	2.30	N.S.	7.95	N.S.	9.24	N.S.
IQ	9	6.75	N.S.	14.51	.05	9.47	N.S.	6.50	N.S.
Extraversion	9	7.16	N.S.	2.51	N.S.	13.09	N.S.	16.21	N.S.
Dominance	6	6.36	N.S.	5.32	N.S.	6.96	N.S.	14.31	N.S.
Self-Concept	9	6.46	N.S.	7.16	N.S.	8.92	N.S.	8.93	N.S.

Question 24

Why do you say that (pertaining to question 23)?
(0)don't know or off task (1)same as others (2)teacher told us (3)good experimenting (4)followed correct procedure (5)got expected results (6) insufficient time to finish (7)didn't get expected results (8)different from others (9)followed wrong procedure.

Table 29

Variable		Round 1		Round 2		Round 3		Round 4	
	Df	x^2	P	x^2	P	x^2	P	x^2	P
Treatment	9	14.49	N.S.	3.68	N.S.	5.54	N.S.	10.80	N.S.
Teacher	27	46.35	.05	19.17	N.S.	33.98	.05	43.26	.01
IQ	27	29.61	N.S.	39.80	.05	10.30	N.S.	18.72	N.S.
Extraversion	27	21.67	N.S.	33.79	N.S.	22.86	N.S.	24.19	N.S.
Dominance	18	17.78	N.S.	18.23	N.S.	15.70	N.S.	31.75	N.S.
Self-Concept	27	19.35	N.S.	29.03	N.S.	18.44	N.S.	29.06	N.S.

Question 25

What do you think the results you got show?
(0)don't know or off task (1)procedure (2)content (3)process

Table 30

Variable		Round 1		Round 2		Round 3		Round 4	
	Df	x^2	P	x^2	P	x^2	P	x^2	P
Treatment	3	11.76	.01	0.98	N.S.	8.66	.05	1.59	N.S.
Teacher	9	20.12	.05	15.28	N.S.	16.85	N.S.	13.73	N.S.
IQ	9	16.69	N.S.	10.89	N.S.	18.26	.01	8.97	N.S.
Extraversion	9	7.80	N.S.	14.53	N.S.	6.39	N.S.	12.11	N.S.
Dominance	6	6.56	N.S.	13.98	.05	6.37	N.S.	11.83	N.S.
Self-Concept	9	4.82	N.S.	18.21	.05	16.33	N.S.	8.27	N.S.

Time

Over the four rounds about 60% of the students found that they had sufficient time to do the things they wanted to do in the activity. Reasons for the response were usually either (1)We did what we wanted to do, or (2) We did what the teacher wanted done.

There were no significant differences between treatments, teachers or student characteristics concerning responses to these questions.

Dependency

Responses to the questions showed that over 90% of students found they were given enough information by the teacher. About 45% of students thought they wouldn't do as well if given fewer directions whereas 35% thought they could do as well.

When given a choice as to which way to carry out the activity, the majority of students chose to do the experiment the way the teacher told them. The number of students responding in this manner progressively increased from 67% in round 1 to 85% in round 4. Reasons for this response varied considerably although 25% of students admitted that they couldn't see any other way of doing the activity.

When asked if they thought they had done the activity the way the teacher wanted it done, over 90% of students said yes. At the same time over 90% of students thought it was very important to do the activity the way the teacher

wanted it done.

There were no significant differences between treatments or student characteristics concerning responses to these questions. There was a significant difference between teachers on question 10 in rounds 1, 3 and 4. However, due to the large variety of responses on that question in contrast to a relatively small sample of students, this was of little or no value in denoting any trend.

Self-concept, self-esteem and student interaction

Most students in round 1 thought the teacher played the most important role in doing the activity. However, their numbers declined so that round 4 had the majority of students in low control favoring the student as playing the dominant role whereas high control students favored the teacher. Responses in favor of the teacher were based on the feeling that the teacher had told the students just what to do whereas those in favor of the student held that the students did all the work.

Results showed that about 50% of students thought both they and their partners had done about the same job on the activity whereas about 33% thought their partner had done a better job. Very few students put themselves ahead of their partner. Although reasons for their responses varied, 30% of those avowing equality gave sharing the workload as their rationale whereas those in favor of their partner said their partner had done more in 20% of cases. When asked what their partner thought, an interesting picture

developed from responses over the four rounds. In round one 39% of students thought the partner would pick himself whereas 28% figured the partner would say they were both equal. These figures altered consistently so that by round 4 the students thought their partner would say they were equal in 50% of the cases and pick himself in only 25% of cases. Reasons for responses varied greatly with 20% saying that the partner did most and knew more.

Almost all students (97%) thought that they and their partners worked well together. Students figured this was due mostly to sharing the work and being good friends. The latter reason took precedence as the experiment progressed.

About 92% of students thought they had done the activities the right way. Of these, 30% said the teacher told them whereas about 40% said they followed directions.

Process orientation

Very few students showed themselves to be process oriented during round 1. However, the number of process oriented students increased to about 20% by round 2 and held there for the duration of the study. Most students gave responses which categorized them as content oriented.

There were no significant differences between treatment, teacher or student characteristics concerning responses to these questions.

A number of the items comprising the interview form had a common theme (process orientation), and a similar selection of possible responses. In order to look at the

possibility that the relatively small sample size of 72 students per round may have failed to show any significant trends on individual items, it was decided to group the scores on the responses concerning process orientation thereby increasing sample size by a multiple of four. The items comprising this cluster were question numbers 2, 3, 4 and 25. A summary of the chi-square tests for the cluster is found in Table 31. The contingency tables from which these chi- square tests were computed consisted of item responses classed as content, process, procedure, don't know or off task crossed with the independent variable listed, in dichotomous form.

As indicated by Table 31, results show that there is a strong relationship between the students' process orientation and variables such as treatment, teacher, dominance and extraversion. The teacher showed a significant difference in all four rounds whereas treatment, dominance and extraversion showed significant differences in at least three rounds.

Data on treatment effect showed students in HC perceiving the curriculum more in procedural and less in content terms as opposed to the reverse for LC during round 1. This trend reversed itself in round 2. In rounds 3 and 4 most students in both treatments were content oriented. During all four rounds, more students in HC perceived the curriculum in process terms than in the LC treatment.

Although the teacher showed the strongest effect

Table 31

Summary of Chi-Square Tests for Pupil Responses to the Interview Item Cluster Concerning Process Orientation for Rounds One to Four

		Round 1		Round 2		Round 3		Round 4	
Variable	Df	x^2	P	x^2	P	x^2	P	x^2	P
Treatment	3	24.24	.001	5.02	N.S.	8.65	.05	9.93	.05
Teacher	9	36.74	.001	39.29	.001	28.16	.001	23.81	.01
IQ	6	16.81	.001	10.61	N.S.	13.11	.05	4.76	N.S.
Extraversion	6	13.55	.05	22.79	.001	5.29	N.S.	15.45	.05
Dominance	6	17.14	.01	28.72	.001	12.58	.05	10.02	N.S.
Self-Concept	6	3.74	N.S.	13.90	.05	10.39	N.S.	6.37	N.S.

upon student perception, there seemed to be no consistency across rounds. Where one teacher might have more content and less process oriented students in one round, the next round found the same teacher with fewer content and more process oriented students. The same inconsistency across rounds arose for extraversion and dominance. However, it was observed that the number of process oriented students did increase slightly as the level of dominance increased in all four rounds.

Overall results

The 600 contingency tables which comprise the findings of this study indicated 63 scattered incidences of significant differences. Generally speaking, most of these might have occurred by chance. For this reason, differences were considered significant for each question only if they showed up in at least three rounds of interviews. However, when these isolated incidents of significance were broken down by variable, a different picture developed. The breakdown was as follows: teachers, 19; treatment, 16; dominance, 10; IQ, 8; extraversion, 6; and self-concept, 3. It is highly unlikely that significant differences would have occurred for the variables teacher and treatment by chance alone. Combined with the fact that these significant differences occurred throughout the interview schedule, it is fair to assume that the treatments and the teachers had a generalized affect upon student perception.

It had been hoped that increasing sample size by clustering items would give some new insight. A higher number of incidents of significant differences did occur on those items clustered. More students in HC tended to perceive the curriculum in process terms than in the LC treatment. Also, the number of process oriented students tended to increase as the level of dominance increased. Generally speaking however, the same inconsistency across rounds occurred for the clustered items as did for the individual items.

Chapter 5

SUMMARY AND CONCLUSION

This study attempted to ascertain whether or not variables such as treatment, teacher or pupil characteristics had any affect upon student perception in grade six science classes. From the results obtained a large number of contingency tables were produced. Examination of the contingency tables yielded no specific pattern of response replicated over the four rounds. Crocker et al. (1977) pointed out that there were too many significant effects reported in the contingency tables to have occurred by chance alone. Responses must have been dependent upon some unmeasured variable or variables. Two possible explanations were: (1) that responses were a function of the content of specific lessons; (2) that responses were due to a complex set of interactions which couldn't be detected by the contingency tables.

Summary of findings

1. Generally speaking the treatment differences were implemented as defined. However, differences were not as distinct as had been intended.

2. The majority of students found they had sufficient time to complete activities irrespective of treatment.

3. Most students were either content or procedure

oriented. Very few students were process oriented, although the slight but distinct increase in their numbers from rounds 1 through 4 gave some indication that this might have changed given more time.

4. Students showed a strong dependence upon the teacher. Although most students thought the teacher had given them enough direction, the majority didn't think they could do as well with less teacher direction. Along the same lines, most students wouldn't have wanted to do the experiment any other way but the teacher's. Students also perceived that it was important to do the activity the way the teacher wanted it done, and in actuality most students thought they had. There was a majority of students who thought they did the activity the right way and got the right results. In confirmation of their dependency they had based their reasoning upon the teacher's judgment and direction. All of this was in keeping with a high teacher controlled setting.

The only evidence that student dependence upon the teacher might be on the decline came from the fact that the majority of students in round 4 thought the students had played the most important role in doing the activity. Most of these students belonged to the low control treatment. Perhaps this is an indication that the treatments were beginning to take effect.

Closer examination of question 9 of the interview form indicated that the question was suited only to the high control treatment. Students in low control had not

been given specific directions on how to carry out the procedure. It is therefore illogical to ask them if they would do the activity the way the teacher asked. However, it is interesting to note that 90% of students did answer the question in the affirmative.

5. Generally, students thought that they and their partners worked well together. Most students thought that both they and their partners did equivalent work. As the friendship between partners developed over the course of the experiment more and more students began to think they did equivalent work. Very seldom did students put themselves ahead of their partner.

6. Generally, there were no significant differences between treatments, teachers or pupil characteristics on the individual interview items concerning student perceptions in the classroom. In most cases students perceived their classroom environment in a manner consistent with that of a high teacher controlled class. However, as has been pointed out, there is indication of an overall interaction between variables such as treatment, teacher and student perception. The exact way this relationship manifests itself is difficult to ascertain. This is probably due to the size of the sample used in each round. With approximately forty interviews done for each treatment and up to nine possible responses on some questions, there were only a few students giving any one particular response on some questions. Added to this was the fact that the same students were not interviewed again in any other

round. This made it even more difficult to distinguish shifts in perceptions from round to round. It would be advisable that any further investigations in this area use a sample at least double the size used in this study.

7. The item cluster on process orientation indicated HC students were more process oriented than LC students and that students high on the dominance scale were also more process oriented.

8. Some ATI effects on perceptions were indicated but the nature of the interview data precluded a fully systematic investigation of these effects.

Conclusion

The results of this study did not support the hypotheses that there were significant interactions between student perceptions in the classroom and variables such as treatment, teacher, self-concept, extraversion, dominance and IQ.

Although the researchers found the student interview protocol a suitable method for research into student perception, there was always the feeling that students were trying to give answers which they thought the researcher wanted to hear. For example, almost all students said they enjoyed doing the activities. Most classroom teachers would agree that this was highly unlikely in light of their own classroom experience. On the same note, etiquette again seemed to play its part in questions concerning pupil-partner relationships. Students were un-

willing to say they did a better job on an activity than their partner. A suggestion for further research in this area would be avoidance of these extraneous variables.

Results of coding done on the teachers' videotapes showed that the treatments were not as distinct as had been planned. It is recommended that future studies give teachers more than a week's training in treatment assimilation and that the teachers be given more feedback on their behavior throughout the experiment.

Generally, student perceptions were in keeping with a high teacher controlled classroom environment, although there was a slight indication that this was beginning to change by the end of the study. This was quite understandable considering that the experimental teachers were only present during science classes over a five month period. Quite possibly the regular classroom teacher's influence carried over into the science classes thereby influencing the students' perceptions. Therefore, where it had been anticipated that a more independent outlook would have been expressed by low control students, there was a strong dependence upon the teacher.

REFERENCES

American Association for the Advancement of Science. Commission on Science Education. The Psychological Basis of Science - A Process Approach. AAAS Miscellaneous Publication, 1963.

Amidon, E.J. and Flanders, N.A. The Role of the Teacher In the Classroom: A Manual for Understanding and Improving Teacher Classroom Behavior. Minneapolis: Association for Productive Teaching, Incorporated, 1967.

Anderson, J.E. The Nature of Ability. In E.P. Torrance (Ed.) Talent and Education. Minneapolis: University of Minnesota Press, 1960.

Aronson, E., Bridgeman, D.L. and Geffner R. Interdependent Interaction and Prosocial Behavior. Journal of Research and Development in Education, 12:1, 1978.

Babikian, Y. The Reactions of Students to Three Methods of Teaching Science. School Science and Mathematics, 71, 681-688, 1971.

Banfield, H.G. The Influence of Teacher Control and Pupil Characteristics on Process Achievement in Elementary Science Classes. Unpublished Master's Thesis, Memorial University, St. John's, Newfoundland 1978.

Barker, R.G. and Wright, H.F. Midwest and Its Children. Evantson, Illinois: Row, Peterson, 1955.

Barker, R.G. Ecological Psychology. Stanford, California, Stanford University Press, 1968.

Bellack, A.A., et. al. The Language of the Classroom. New York: Teachers College Press, 1966.

Bernstein, B. Class, Codes, and Control. London: Routledge and Kegan Paul, 1971.

Brookover, W.B., Peterson, A. and Thomas, S. SelfConcept of Ability and School Achievement, Office of Research and Publications, College of Education, Michigan State University, Michigan, 1962.

Brookover, W.B., et. al. Self-Concept of Ability and School Achievement, II: Improving Academic Achievement Through Student Self-Concept Enhancement. U.S. Office of Education, Cooperative Research Project No. 1636, 1965.

Brown, C.K. Pupil Personality, Teaching Style and Achievement. Unpublished Doctoral Dissertation, University of Alberta, Edmonton, Canada, 1967.

Christensen, C.M. Relationships Between Pupil Achievement, Affect-Need, Teacher Warmth, and Teacher Permissiveness. In Journal of Educational Psychology, 51; 169 - 174, 1960.

Coppersmith, S. and Feldman, R. Fostering a Positive Self-Concept and High SelfEsteem in the Classroom. In R.H. Coop and K. white (eds.), Psychological Concepts in the Classroom. New York: Harper and Row, 1974.

Coopersmith, S. The Antecedents of Self-Esteem. San Francisco: Freeman, 1967.

Crocker, R.K. et. al. A Category System for the Analysis of Interact-Patterns in Elementary Science Classes. Unpublished Paper, 1975.

Crocker, R.K., Bartlett, K.R. and Elliott, H.G., A Comparison of Structured and Unstructured Modes of Teaching Elementary Science Process Activities. Journal of Research in Science Teaching, 13, 267-274, 1976.

Crocker, R.K., et. al. An Experimental Study of Teacher Control in Sixth Grade Science Classes. Paper Set Presented at the Annual Meeting of the National Association for Research in Science Teaching, Cincinnati, Ohio, March, 1977.

Crocker, R.K. et. al. Teacher Control, Classroom Behaviors and Pupil Performance in Elementary Science Classes. Memorial University, Institute for Education Research and Development, St. John's, 1977.

Crumb, G.H. and Abegg, G.L. Influences on Students' Understanding of Science. U.S. Department of Health, Education and Welfare Cooperative Research Project No. S - 399-65, 1966.

Egelston, J. Inductive vs. Traditional Methods of Teaching High School Biology Laboratory Experiments. Science Education, 57, 467-677, 1973.

Eysenck, B.G. Junior Eysenck Personality Inventory, Education and Industrial Testing Service, California, 1963.

Flanders, N.A. Teacher Influence, Pupil Attitudes, and Achievement. United States Department of Health, Education and Welfare, Office of Education, Cooperative Research Project No. 397, 1960.

Flanders, N.A. Analyzing Teacher Behavior. In Education Leadership, 19, 173 - 180, 1961.

Flanders, N.A. et. al. Measuring Depeendence Proneness in the Classroom. In Educational and Psychological Measurement, 23:3, 1961.

Flanders, N.A. Teacher Influence, Pupil Attitudes, and Achievement. United States Office of Education Cooperative Research Monograph No. 12, 1965.

Getzels, J.W., and Jackson, P.W. Creativity and Intelligence. New York: Wiley, 1962.

Gibbony, R.A. Socioeconomic Status and Achievement in Social Studies. Elementary School Journal, 59, 340 - 346, 1959.

Good, R. et. Al. Relationship Between Classroom Behavior and Cognitive Development Characteristics in Elementary School Children. In Journal of Research in Science Teaching, 13, 533 - 538, 1976.

Hermann, G. Learning By Discovery: A Critical Review of Studies. In Journal of Experimental Education, 38:1, 58 - 72, 1969.

Hermann, W.L., et. al. The Relationship of Teacher-Centered Activities and Pupil-Centered Activities to Pupil-Centered Activities to Pupil Achievement and Interest in Eighteen Fifth Grade Social Studies Classes. In American Educational Research Journal. Washington, D.C.: American Educational Research Association, 6:2, 1969.

Hunt, D.E. Matching Models in Education. Toronto, Ontario Institute for Studies in Education, Monograph Series No. 10, 1971.

Hunt, D.E. and Sullivan, E.V. Between Psychology and Education. Hinsdall, Illinois: Dryden Press, 1974.

Krockover, G.H. and Malcolm, M.D.. The Effects of the Science Curriculum Improvement Study on a Child's Self-Concept. In Journal of Research in Science Teaching, 14, 295 - 299, 1977.

Klass, W.H. and Hodge, S.E. Self-Esteem in Open and Traditional Classrooms. In Journal of Educational Psychology, 70, 701 - 705, 1978.

Lawrenz, F. The Stability of Student Perception of the Classroom Learning Environment. In Journal of Research in Science Teaching, 14, 77 - 78, 1977.

Lewin, K., Lippitt, R., and White, R.K. Patterns of Aggressive Behavior in Experimentally Created Social Climates. In Journal of Social Psychology, 10, 271 - 299, 1939.

Miller, E.J., and Rice, A.K. Systems of Organization. London: Tavistock Publications, 1967.

Morrison, T.L. Control as an Aspect of Group Leadership in Classrooms: A Review of Research. In Journal of Education (Boston), 156:4, 39 - 64, 1974.

Myers, R.E. Relationships of Teacher Orientation and Effectiveness Under Inductive and Deductive Teaching Methods. U.S. Department of Health, Education, and Welfare, National Institute of Education, 1968.

Olander, H.T. and Robertson, H.C. The Effectiveness of Discovery and Expository Methods in the Teaching of Fourth-Grade Mathematics. In Journal for Research in Mathematics Education, 4:1, 1973.

Penick, J.E., et.al. Studying the Effects of Two Quantitatively Defined Teaching Strategies on Student Behavior in Elementary School Science Using Macroanalytic Techniques. In Journal of Research in Science Teaching, 13:4, 289 - 296, 1976.

Peterson, R.W. The Differential Effects of an Adult's Presence on the Curiosity Behavior of Children. In Journal of Research in Science Teaching, 12:3, 199 - 208, 1975.

Porter, R.B., and Cattell, R.B. Handbook for the Children's Personality Questionnaire. Institue for Personality and Ability Testing, Illinois, 1968.

Raven, J.C. Guide to the Standard Progressive Matrices Sets A, B, C, D and E. London: H.K. Lewis and Company Limited, 1960.

Rice, A.K. Learning for Leadership: Interpersonal and Intergroup Relation. London: Tavistock Publications, 1965.

Rosenshine, B. Teaching Behaviors Related to Pupil Achievement: A Review of Research. In Research Into Classroom Processes. New York: Teachers College Press, 1971.

Rushton, J. The Relationship Between Personality Characteristics and School Success in Eleven-Year-Old Children. In British Journal of Educational Psychology 36, 178 - 184, 1966.

Samph, T. Observer Effects on Teacher Behavior. Unpublished Doctoral Dissertation, University of Michigan, 1968.

Schwab, J.J. Enquiry, the Science Teacher and the Educator. In Hans Q. Andersen (Ed.), Readings in Science Education for the Secondary School. New York: The Macmillan Company, 1969.

Shymansky, J.G., and Matthews, C.C. A Comparative Laboratory Study of the Effects of Two Teaching Patterns on the Behavior of Students in Fifth Grade Science. In Journal of Research in Science Teaching, 11, 157 - 168, 1974.

Shymansky, J.A., et.al. A Study of Self-Perception Among Elementary School Students Exposed to Contrasting Teaching Strategies in Science. In Science Education, 58:3, 331 - 341, 1974.

Shymansky, J.A. and Penick, J.E. A Study of Classroom Behavior and Self-Perception as it Relates to Problem Solving. In Journal of Research in Science Teaching, 14, 191 - 198, 1977.

Soar, R.S. Follow Through Classroom Process Measurement. Institute for Development of Human Resources, College of Education, University of Florida, 1971.

Soar, R.S., et.al. Change in Classroom Behavior From Fall to Winter for High and Low Control Teachers. Paper presented at the Annual Meeting of the American Educational Research Association, New Orleans, Lousiana, February, 1973.

Spears, J. and Zollman, D. The Influence of Structured Versus Unstructured Laboratory on Students Understanding the Process of Science. In Journal of Research in Science Teaching, 14:1, 33 - 38, 1977.

Staines, J.W. Self-Picture as a Factor in the Classroom. In British Journal of Educational Psychology, 28, 97 - 111, 1956.

Stanford Center for Research and Development in Teaching. Preliminary Report of a Factorially Designed Experiment on Teacher Structuring, Soliciting and Reacting. Occasional paper No. 7. California: Stanford University, 1975.

Tuckman, B.W. Study of the Interactive Effects of Teaching Style and Pupil Personality. Paper presented at the 77th Annual Meeting of the American Psychological Association, 1969.

Wallen, N.E. and Wodtke, K.H. Relationships Between Teacher Characteristics and Student Behavior. U.S. Department of Health, Education, and Welfare, Office of Education Contract No. 2-10-013, 1963.

Weisner, C. A Comparison of the Effectiveness of Discovery Versus Didactic Methods and Teacher - Guided Versus Independent Procedures in Principle Learning. In The Journal of Educational Research. Madison, Wisconsin: Dembar Educational Research Services, Vol. 64, No. 5, 1971.

Wodtke, K.H. and Wallen, N.E. Teacher Classroom Control, Pupil Creativity and Pupil Classroom Behavior. In Journal of Experimental Education, Vol. 34, No. 1, 1965.

Wolfson, M.L. A Consideration of Direct and Indirect Teaching Styles With Respect to Achievement and Retention of Learning in Science Classes. In Journal of Research in Science Teaching. New York: John Wiley and Sons, Vol. 10, No. 4, 1973.

Wylie, R.C. The Self-Concept: A Critical Survey of Pertinent Research Literature. Lincoln, Nebraska: University of Nebraska Press, 1961.

APPENDIX A

INSTRUMENT

Pupil Interview Form

Name _____ School and Class _____
Teacher _____ Interviewer _____
Round _____ Activity _____
Partner _____ Treatment _____

1. Did you enjoy doing today's experiment? (1) enthusiastic (2) positive (3) indifferent (4) negative (5) highly negative. _____

2. If you went outside after class and someone asked you what you did in science class today what would you say?
(0) don't know or off task (1) procedure (2) content (3) process. _____

3. What do you think was the purpose or reason for doing this activity?
(0) don't know or off task (1) procedure (2) content (3) process. _____

4. What do you think you learned from the activity?
(0) don't know or off task (1) procedure (2) content (3) process. _____

5. Did you get enough information from the teacher in order to get started on today's experiment?
(0) don't know or off task (1) Yes (2) No. _____

6. Suppose you had been given fewer directions. Would you have been able to do the experiment as well?
(0) don't know or off task (1) Yes (2) almost as well (3) No (4) Better. _____

7. Did you have the time to do all the things you would like to have done with the materials in the activity?
(0) don't know or off task (1) Yes (2) No (3) Yes and No. _____

8. Why do you say that?
(0) don't know or off task (1) did all we wanted to do (2) did what teacher wanted (3) wanted more trial and error (4) didn't finish teacher assigned work (5) ran out of time. _____

9. If you had a choice, would you have done the activity the same way your teacher asked you to do it, or would you like to have done the activity another way?
(0) don't know or off task (1) same way (2) another way (3) both. _____

10. Could you explain your answer?
(0) don't know or off task (1) liked the way the teacher did it (2) couldn't see any other way (3) easier (4) good to try different methods (5) didn't like the teacher's way (6) teacher's way plus good to experiment (7) should follow teacher's directions (8) easier to understand (9) get it wrong otherwise. _____

11. Who do you think played the most important part in doing the experiment today, students or the teacher?
(0) don't know or off task (1) teacher (2) students (3) both. _____

12. Why do you say that?
(0) don't know or off task (1) teacher told us what to do (2) students didn't do much (3) students did activity (4) teacher didn't do much (5) both did important parts. _____

13. Who do you think did the better job on the activity, you or your partner?
(0) don't know or off task (1) pupil interviewer (2) partner (3) same. _____

14. Why do you say that?
(0) don't know or off task (1) shared work (2) I did most and knew more (3) she did most and knew more (4) complemented each other (5) did same things (6) proper etiquette (7) partner neater (8) did own work (9) neither of us is any good (10) made mistakes. _____

15. Think about how your partner might feel about the activity. Who does your partner think did the better job?
(0) don't know or off task (1) pupil interviewed (2) partner (3) same. _____

16. Why do you say that?
(0) don't know or off task (1) shared work (2) I did most and knew more (3) he did most and knew more (4) complemented each other (5) did same things (6) proper etiquette (7) he thinks he did more (8) won't admit he did less (9) didn't tell me. _____

17. Were you and your partner able to work well together?
(0) don't know or off task (1) yes (2) no (3) indifferent. _____

18. Could you explain your answer a little more?
(0) don't know or off task (1) shared work (2) complemented each other (3) good friends (4) partner hoarded apparatus (5) I hoarded apparatus (6) don't get along (7) got along together (8) better to work with partner of own sex (9) better to work with partner of opposite sex. _____

19. Do you think you did the activity the right way?
(0) don't know or off task (1) yes (2) no (3) yes and no. _____

20. Why do you say that?
(0) don't know or off task (1) got right results (2) teacher told us (3) followed directions (4) understood (5) same as others (6) didn't understand how to do it (7) weren't told which was right way (8) not enough time to finish (9) didn't understand for awhile. _____

21. Do you think you did the activity the way the teacher wanted it done?
(0) don't know or off task (1) yes (2) no. _____

22. Do you think it was very important that you do the activity the way the teacher wanted?
(0) don't know or off task (1) yes (2) no (3) yes and no. _____

23. Do you think you got the right results? (0) don't know or off task (1) yes (2) no (3) yes and no. _____

24. Why do you say that? (ie. How can you tell?) (0) don't know or off task (1) same as others (2) teacher told us (3) good experimenting (4) followed correct procedure (5) got expected results (6) insufficient time to finish (7) didn't get expected results (8) different from others (9) followed wrong procedure. _____

25. What do you think the results you got show? (0) don't know or off task (1) procedure (2) content (3) process. _____