A DESCRIPTIVE STUDY OF TEACHER INTERVENTIONS IN LABORATORY GROUPS OF ELEMENTARY SCIENCE STUDENTS

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JUN 2 1979
MEMORIAL UNIVERSITY
OF NEWFOUNDLAND

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A DESCRIPTIVE STUDY OF TEACHER INTERVENTIONS IN LABORATORY GROUPS OF ELEMENTARY SCIENCE STUDENTS

A Thesis
Presented to the Faculty of Education
Department of Curriculum and Instruction
Memorial University of Newfoundland

In Partial Fulfillment
of the requirements for the degree
MASTER OF EDUCATION

by

WAYNE FREDERICK OAKLEY

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ABSTRACT

This study was designed to analyze teacher interventions in laboratory groups of elementary school students. It was designed as a descriptive study of interventions, with cross tabulations of certain variables. The study attempted to find information on the number and length of interventions, who initiated the interventions and for what reason, and to ascertain the outcome of the interventions. These variables were considered overall, and by group, class, and grade. The student variables of IQ, self-concept, extraversion and neuroticism were correlated with the student behavior variables of the proportion of sentences, solicits, responses, requests, and commands made during the intervention. The same student behavior variables during and outside the interventions were also studied.

The sample consisted of ten elementary classes, from grade 2, 4, and 6. Two pairs of students from each class were observed using videotape. The lessons chosen for taping were activity oriented, having the development of processes as one of their main objectives. After videotaping was completed, students were administered the Junior Eysenck Personality Inventory, a Self-Concept questionnaire, and the Raven Colored Progressive Matrices, Sets A, Ab, B, designed to measure IQ.

After all data were collected, typed transcripts were prepared from audio portions of the tapes. After the transcripts were edited, they were coded. Coded data was then keypunched with each unit of analysis on a separate card, and the punched data transferred to a

computer disk file. Teacher intervention data was then isolated and analyzed.

Considering intervention length and number, results indicated that overall the length of the interventions was relatively short, and the number of interventions was generally low.

T-tests results in no significant difference for intervention length between groups within a class. Analysis of variance resulted in no significant differences between classes and between grades with respect to intervention length.

A critical incidents technique showed that teachers intervened mainly to give procedure and to solicit progress reports. Students generally initiated interventions to report observations or to give a progress report. Teachers requested more often than did students. Both teachers and students did very little reacting.

Chi square tests showed that a significant relationship existed between the speaker and: (i) the type of pedagogical move, where teachers tended to solicit while students tended to respond; (ii) the use of gives, requests, and commands, where teachers tended to request more, and students tended to give more; (iii) the use of the Nature of Reference dimension, where both teachers and students tended to make reference to apparatus and individual results; and (iv) the use of the Rating dimension, where rating by both teachers and students was extremely low. Where rating did occur both teachers and students rated either positively or negatively.

A chi square test resulted in no significant difference between speaker and the Substantive Logical dimension.

Correlation analysis resulted in the student characteristic of extraversion being significantly positively correlated with the proportion of sentences made during the interventions. No other student characteristics were significantly correlated with student behavior variables under analysis.

A comparison of some of the student behavior variables outside the interventions with the same student behavior variables during the interventions indicated definite change in student behavior patterns. The presence of the teacher appeared to change student behavior patterns.

ACKNOWLEDGEMENTS

The writer wishes to express his appreciation to all individuals who made this project possible. Without continued support and cooperation of many individuals this work would not have been a reality.

The writer is particularly indebted to Dr. R. K. Crocker who supervised the researcher during the project. Thanks are also expressed to Dr. R. P. Amanda, Dr. G. W. Clark, and Dr. N. W. Garlie for their many helpful suggestions.

Finally, the writer wishes to acknowledge the understanding and moral support of his wife, Myrna.

CHAPTER I

INTRODUCTION

Background to the Study

Teaching has been defined in a number of ways depending on who one reads. Smith (1961) defines teaching as 'a system of actions intended to induce learning'. The American Educational Research Association Committee (1952) defines teaching as 'a form of interpersonal influence aimed at changing the behavior potential of another person', while Hughes (1959) defines teaching as 'an interaction in the teacher-learner situation of the classroom where the adult holds the position of teacher in relationship to the child'.

Few would argue that teaching involves an interaction between two or more individuals. In the traditional classroom, teacher-class interactions predominate. In science classrooms broader types of interaction are possible. These interactions can be of several types: teacher-student; teacher-students (whole class); teacher-students (small groups); and student-student. The study of such interaction patterns is one obvious method by which an understanding of the teaching process can be enhanced.

Rosenshine and Furst (1963) give a paradigm for studying teaching in natural settings or classrooms, which they refer to as the 'descriptive-correlational-experimental loop'. In the first stage the investigators develop ways to categorize classroom interaction and use these instruments to describe classroom behavior in a general sense. In the second stage correlational studies are conducted to determine which kinds of behaviors

are worth pursuing further and which behaviors are probably irrelevant for student growth. During the third stage the correlational results are tested in experimental studies.

This study falls into the 'descriptive' phase of the above paradigm. A great deal of research has been conducted on classroom interaction, using a variety of interaction analysis systems, some of which will be discussed later during the review of the literature section. However, relatively little research has been conducted using science classes as the basis of analysis. Although science classes can be considered similar to conventional classroom settings at times, these science classes obviously depart from the conventional classroom setting during activity sessions, particularly in the prominence of student-student interactions. Because of this unique classroom setting, no existing interaction analysis system could be used to analyze the behavior occurring in these classes. Consequently, the first task of the study was to develop an instrument suited to analyze behavior of science laboratory activities. This interaction analysis system will be discussed in detail in the section on instrumentation. It is anticipated that the results from this first phase of the above paradigm will generate research of a correlational and experimental nature.

Although many researchers would argue that true research begins during the 'correlational-experimental' phases of the paradigm, that at these phases the major contributions are made, it must be emphasized that studies of a descriptive nature are quite acceptable and useful during the initial phases of instrument development. This idea is supported by Rowe

(1974) who states that in contrast to the vigorous experimental control of sources of variances that is impressed on heuristic studies in their later stages, in the early stages there is license for messing about, for free-wheeling, imaginative juxtaposition of ideas. Rowe's own studies of wait-time and rewards offer an interesting example of how initial descriptive studies can lead to the identification of potentially important variables which can be explored in more detail in experimental studies.

The Problem

This study forms a segment of a larger one currently under development at Memorial University of Newfoundland, St. John's, Newfoundland by Dr. R. K. Crocker and associates. During the past year research has been carried out on the development of an interaction analysis system. This system was developed to study the substantive nature of classes involved in science activities. More specifically, the major study tried to ascertain whether or not processes were being dealt with in the science lessons. The amount of control that the teacher exerted over the learning situation was also studied in the larger study. Most science process based curricula have as their objective the teaching of science as a process, with activities and materials required to realize the objectives. However, these curricula differ widely on the degree to which the teacher exerts control. This control can result in interaction between teacher-class; student-student within a group; and teacher-small group. It was the latter interaction that was pursued in this study.

This study focused on the interaction of the teacher and a laboratory group, after the laboratory activity had been introduced by the teacher and the students had begun the activity. The study considered teacher intervention in laboratory groups where teacher intervention is defined as whenever a teacher enters the discourse of the group under analysis from several perspectives. First, an attempt was made to determine the circumstances that give rise to teacher intervention. More specifically, the study considered the importance of some of the following variables by analyzing the frequency of occurrence of these variables: (a) student solicited help, defined as a request by the student for the attention of the teacher, for such possible reasons as to seek clarification of instruction, to seek reassurance of progress, to solve group disagreements, for apparatus manipulation, to ensure a good grade, and possibly others; (b) teacher directed intervention, defined as occurring whenever the teacher enters the discourse of the group under analysis of his own volition, for such reasons as to determine laboratory progress, to give specific instructions, to give positive or negative reinforcement for student accomplishments, to reinforce any discovery made, to help solve stalemates, to put students 'on task', and many others; (c) other laboratory group intervention, where one group approaches the teacher to point out something that another group is doing or has done, and so on. Second, the study also attempted to determine if there was a relationship between grade levels and the nature of the teacher intervention. Third, student variables of IQ, extraversion, neuroticism, and self-concept were also considered to see if there was a relationship between these variables and the nature of the teacher intervention.

In summary, this study concerned itself with identifying some kinds of student behaviors that initiated teacher intervention in the group, the nature of the student and teacher behavior during the intervention, and the relation between student characteristics and student behavior.

Questions

As discussed earlier, this study attempted to identify the initial conditions giving rise to teacher intervention, possible effects of the teacher intervention on the lesson, and the possible effects of a number of student variables on these circumstances and effects.

These initial conditions and effects of teacher intervention in laboratory groups can be for many reasons. Some of these types such as student solicitation, teacher directed intervention, and other-group intervention have already been mentioned in the problem section.

Following is a list of questions that were studied. Most of these questions are given in terms of the frequency of occurrence of specific patterns of behavior.

1. (a) What is the distribution of length of the interventions?

(b) What is the mean length and number of interventions in a lesson for a particular group?

(c) How does the mean length and number vary from group to group, class to class, and grade to grade?

(d) What is the mean length of teacher versus student initiated interventions?

2. What is the ratio of teacher initiated interventions to student initiated interventions?
3. How are interventions initiated and what are the outcomes?
4. What types of interventions occur?
5. What patterns of teacher and student move, substantive-logical, controlling, reference, and rating behavior occur?
6. How do the student characteristics of IQ, extraversion, neuroticism, and self-concept affect the student behavior variables of proportion of sentences, the proportion of solicits, responses, requests, and commands made?

Theoretical Considerations

This study dealt with the interaction of the teacher and small groups. There are many variables which might affect these interventions. Some of these variables need to be controlled while exploring the effects of other variables. The interactive effects of these variables must be considered. Ordinarily a theoretical model would be useful in identifying potentially useful relationships. However, because of the exploratory nature of this study the use of a specific theoretical framework would perhaps be too restrictive. However, some direction can be given to the study by considering a possible model of the type of relationships that occur among components of the classroom setting.

Crocker (1975) has developed a model of the classroom setting (Figure 1). The model expresses the nature of the potential student and teacher behaviors and illustrates the assumption that behaviors are a function of teaching strategy which, in turn, is influenced by a set of prior constraints referred to as boundary conditions.

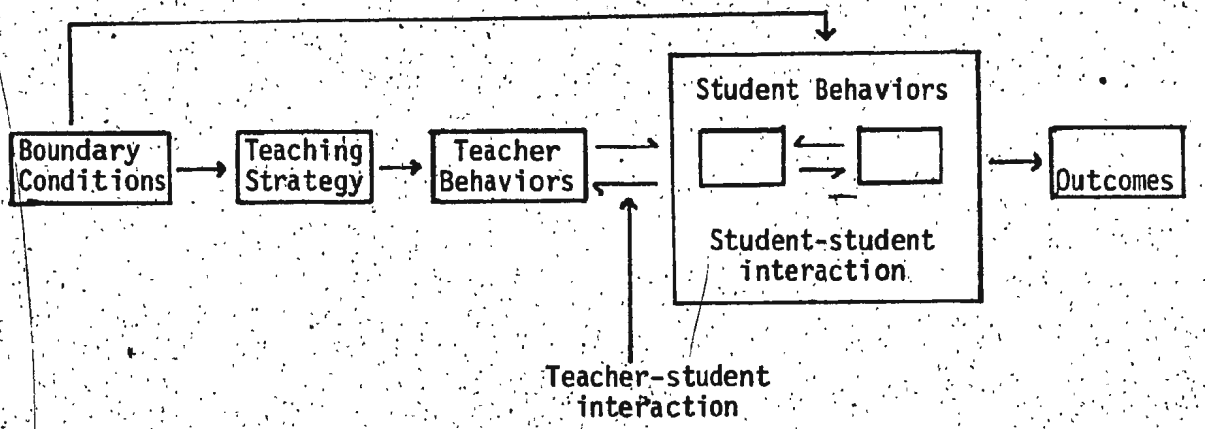

Figure 1

Crocker (1975) states that variables which constitute the boundary conditions are regarded as those that, for whatever reason, are fixed prior to the lesson and prior to the teacher formulating a strategy for the teaching of that lesson. Some of these possible boundary conditions include: the nature of the curriculum; the time available; the class size; the grouping arrangements within the class; the teacher expectations of student performance; the student perception of role vis à vis the teacher, of goals, and of teacher expectations; student characteristics; teacher characteristics; and the student's previous experience in the type of class activity being conducted. In general, boundary conditions are all those conditions which influence

classroom behavior but are not under teacher or student control.

The term teaching strategy as used in this model refers to an overall pattern of behavior which the teacher follows during the course of the lesson. Teaching strategies are seen as being limited by the boundary conditions, while, at the same time, limiting specific teacher and student behaviors. Thus, in the science classes used in this study, specific limitations on teaching strategies are imposed by the nature of the curriculum, which follows an activity mode, with several small groups of students working with separate sets of apparatus. However, within this constraint, the teacher can control the lesson by choosing, for example, whether to give specific directions on apparatus manipulations to the entire class or to give such directions to individual groups on request. Such a decision would have very pronounced effects on the amount of teacher intervention in the group, the nature of the intervention, and its outcome.

The degree of teacher control is one of the areas of interest in this study. The student in the science classroom can have one of two objectives, either to solve a scientific problem, or to adhere to the specific immediate demands placed by the teacher or possibly other students. In a situation of high teacher control, it is speculated that the student's primary concern may be to satisfy the immediate requirement of the teacher, even at the expense of exploring the scientific problem at hand.

A second reason for the concern with teacher control stems from the concept of a behavior setting (Barker, 1968) or, more specifically

from the notion that an individual's perception of the goals of the setting may influence his behavior in that setting. High teacher control might lead to a narrowing of the range of student behaviors so that more behaviors are related to the perceived goal of satisfying teacher requirements.

Teacher behaviors as viewed in the model are regarded as being directly influenced by teaching strategy. The model itself allows for the possibility of student behavior changing teacher behavior. However, this latter possibility is not directly under investigation in this study.

According to the model, student behaviors are seen as also being influenced by the boundary conditions either directly or through teacher behavior. It is possible that such boundary conditions as student perception of role and of teacher expectations can themselves be affected by teacher behaviors, particularly if a consistent pattern of teacher behaviors has been observed by the student over a period of time.

This model then, is one way of considering the potential relationships among various setting and behavior variables. The major study attempted to devise a system of mapping the possible range of teacher and student behaviors and interactions between these that occur in a specific type of classroom setting, and to devise a means of measuring outcomes directly from classroom behavior. This study was concerned with a specific form of teacher-student interaction, that

of teacher interventions in laboratory groups of elementary science classes.

Significance of the Study

Interaction analysis studies have typically been carried out in conventional classes. The major study broadens the range of class situations that have been studied. Once one decides to study non-conventional classes, a series of problems occur that are not typically investigated. The broad question of small group behavior is one such problem. The effect of the teacher on the small group is a sub-problem.

Because research on teacher intervention in small groups is very limited, an exploratory study such as this one is justified. Generally such information can help define the overall problem of teacher control of the learner situation. Relatively little is known about the manner in which children approach the type of problems with which they are typically confronted in science classes, about the teaching strategies which can best enhance the required thought processes, and about the variables that influence these teaching strategies. The information gathered in this type of study should, in the long term, be of value to science teachers in planning instructional strategies. For example, where results of the study indicated that teacher intervention proved useful under certain specific situations, a teacher might decide to intervene in a group whenever that occasion arose. On the other hand, where results showed that under other conditions teacher intervention was undesirable, he would probably decide not to intervene under these conditions.

CHAPTER 2

REVIEW OF THE LITERATURE

In this chapter the literature review is divided into two main sections: group dynamics and classroom observational systems. In the group dynamics section there are essentially two areas in the literature that are relevant: studies on group dynamics of a general nature, and studies which identify a number of variables dealing with teacher-group interaction that possibly influence what occurs in the classroom.

Section A: Group Dynamics

Literature related specifically to teacher intervention in small groups is very limited. However, since the small group situation under study can be considered a social setting consisting of groups of people interacting, literature related to group dynamics is relevant and abundant.

Much of the research on group dynamics is related to such groups as T-groups, encounter groups, sensitivity groups, interpersonal relations groups, and so on. However, many of the results can be applied to education, in particular the classroom.

A great deal has been written about what goes on in the classroom. Most of the functions associated with teaching are implemented by verbal communication. Flanders (1965) found that discourse occurs over 60% of the total class time, and that the teacher talks over 70% of that time in the conventional classroom. Bellack (1966), using the language game theory of Wittgenstein (1953), was led to an analysis of

the concept of "pedagogical moves" in classroom discourse. It was found that communication in the classroom could be described in terms of cycles, beginning typically with a solicit move and followed by the student with a response move.

It is obvious that communication plays a major role in most class settings. This communication can take the form of teacher-student, teacher-students, and student-student interactions. Whenever a group of people meet in a social setting, communication occurs. It is this fact that makes group dynamics literature generally applicable in this study. In the study, the major emphasis is placed on the teacher-small group interaction.

Group dynamics is a relatively new area of research, with a tremendous increase in research occurring after the importance of groups was illuminated by Kurt Lewin and associates in 1947. Gunderson (1950) states that despite the ambiguity of the term, most people adhere to the definition of group dynamics as being 'the theory held by a number of educationalists, social psychologists, sociologists, and welfare workers who claim they have discovered a method for the application of 'science' to the process of human relations.'

Rogers (1970) says that regardless of the group name, they all tend to have certain similar external characteristics which include the following: small numbers; relatively unstructured; require cognitive input; leader responsibility is primarily to facilitate the expression of both feelings and thoughts on the part of the group members; and a

focus by the leader and members on the process and dynamics of immediate personal interactions.

Lippitt[1] gives several principles of group behavior which include the following: successful group productivity depends on the ability of the members to exchange ideas freely and clearly and to feel involved in the decisions and the processes of the group; a collection of capable individuals does not always produce a capable group; groups may be helped to grow to maturity by using appropriate procedures; and the ability of a group to function properly is not necessarily dependent upon the leader, since no group can become fully productive until its members are willing to assume responsibility for the way the group acts.

Schmuck (1971) considers group dynamics theory to include the following attributes of groups: informal and formal aspects; emotional aspects; group effects on the self-concept; and group effects on intellectual performance.

Schmuck (1971) states that in theory the classroom with the greatest degree of groupness in its goals would have small groups of students working on subject matter projects (task-group); individuals working alone but in parallel on subject matter (task-individual); discussions in which group expectations and feelings were made public (social-emotional group); and informal relationships of warmth and security that would be satisfying to the individual student (social-emotional-individual).

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[1]Lippitt, G. L. Group Effectiveness. Xerox. Source unknown.

Many of the comments of the above authors about groups are applicable to the teacher-small groups which were analyzed in this study.

Group behavior can be analyzed in a number of ways. Hurd and Rowe (1966) classified the study of group behavior into three categories: by using the individual as the unit of analysis; by using the group as the unit of analysis; and by studying the effect of the individual on the group, and of the group on the individual. In this study, the individual was the unit of analysis but the effects of the group on the individual was of great importance.

Teaching has been defined by Hughes (1959) as an interaction between the teacher and student(s). Hopkins (1941) defines interaction as 'the action that occurs in the classroom environment between pupils and their teacher'. Zafforoni (1963) lists four factors that influence interaction: teacher role; student-teacher relationships; the use of materials; and problem solving situations.

Bills (1959) states that 'to teach a person we must understand him. This is most easily accomplished by trying to see him and his world as he sees them.' Stavsky (1957) states that 'one of the main functions of teaching is to reduce or control anxiety in order that the goal of the class -- learning and development -- may be reached.'

Many of the articles discussed above have stressed the communication and interaction involved in the process of learning. This interaction is probably more pronounced in this study than in many

conventional classroom studies since students are interacting among themselves to a greater extent than usual because of the activity nature of the lessons.

The behavior of a group, and what is achieved by the group is dependent on many variables. Few would disagree that the interpersonal relationships that occur in a classroom between teacher-student(s) and student-student can affect the classroom setting, and can also determine the classroom setting and climate. At the same time these variables can be influenced by the self-concept, personality, and intellectual performance of the student.

Teaching strategy variables can also play a very important role in determining what goes on in the classroom. Grannis (1973) has proposed that behavior (specifically on- and off-task behavior in his study) will be influenced by whether the setting is congruent or incongruent in terms of a number of variables related to teacher control or child control of various parameters of the setting. For example, a high degree of teacher pacing of the learning task is incongruent with a high degree of child-child interaction.

A study of research related to these variables is very important for the purposes of this study since one of the main objectives of the study was to determine who initiated a teacher intervention, and for what reason the intervention was initiated.

Literature related to the following areas now will be discussed: interpersonal relationships; classroom climate; self-concept, personality, and intellectual performance; and teaching strategies.

Interpersonal Relationships

Rogers (1969) considers the facilitation of significant learning to depend more upon certain attitudinal qualities which exist in the personal relationship between the teacher and the learner than upon other factors such as teaching skills, knowledge of the field, curricular planning, use of audiovisual aids and so on. He considers the attitudes of the teacher that facilitate learning to consist of the following: realness or genuineness; prizing, accepting, and trusting; and empathetic understanding, where the teacher sees a situation through the learner's eyes. This may be particularly applicable to the elementary school level, where teacher-student empathy may be more important than other variables. This may be achieved better by low teacher control than by high teacher control.

Zafforoni (1963) states that knowledge and understanding of how to work effectively in groups is one of the most important contributions a teacher can make to any group of children.

Bion (1948) and Thelen (1954) stress the importance of the affective nature on all interpersonal relationships, stating that the initial interpersonal relationships saturated with feeling begin in the family, and such feelings learned in the family are extended and used in all other groups.

Classroom Climate

MacDonald and Zaret (1966) found that when teacher behavior tended to be 'open' -- stimulating, accepting, facilitating -- the student responses tended to be 'productive' -- discovering, exploring, experimenting,

and synthesizing -- whereas when teacher behavior tended to be 'closed' -- judging, directing, reproving, ignoring -- the student responses tended to be 'reproductive' -- parroting, guessing, acquiescing, reproducing facts, and reasoning from given or remembered data.

Schmuck (1963) has shown that in classrooms where students perceive their teachers as understanding them, there is likely to be a more diffuse liking structure among the students. Aspy (1965) has found in a study of third graders that students in an understanding classroom climate where the teacher is emphatic and trusting showed a significantly greater gain in reading achievement than those students in classes with a lesser degree of these qualities.

Schmuck (1966) has shown that among students that are highly involved in their classroom peer group, 'significant relationships exist between actual liking status on the one hand and utilization of abilities, attitude towards self and attitude towards school on the other hand'. Schmuck also found that classroom groups with supportive friendship patterns enhance academic learning, while more hostile classroom environments reduce learning.

Lewin, Lippitt, and White (1939); Anderson (1939); and Withall (1951) found that the climate of the group was related to the leadership performance of the teacher.

In summary, the research indicates that in classrooms where the atmosphere is friendly and congenial, the students achieve better,

and such a setting generally provides a better learning environment for students.

Self-concept, Personality, and Intellectual Performance

Schmuck (1971) states that some social psychologists argue convincingly that a person's self-concept develops through relationships he has with other people. Schmuck also quotes Mead, Cooley, and Sullivan as saying that 'human' beings develop in a sequential and systematic manner, not because of the gradual unfolding of instinctual tendencies, but because they experience a regular sequence of interpersonal interactions in their lives. Mannheim (1957) concluded from her research that a student's self-image tended to be similar to the self-image reflected to him by members of his dominant reference group which, in most cases, was his living unit.

Lippitt and Gold (1959) found that positive self-esteem begets supportive responses which in turn support the self-esteem and that negative feelings about the self beget hostile reactions which lead to less esteem.

Wispe (1951) and Smith (1955) have shown that psychologically different types of students, identified by personality tests, have different reactions to the same teacher behavior patterns.

The Wispe and Smith studies point out the difficulty in controlling the many variables that must be considered when analyzing classroom interaction. The classroom setting is a very complex one, with each student being an individual, with a different personality,

having different needs and requirements, different self-concepts, viewing the teacher in different ways, and so on. Adding to this complexity is the different attributes of the teacher. This study considered, in a correlational manner, such variables as self-concept, personality, and IQ in an attempt to determine what effect these variables had on the incidence of and reasons for teacher intervention.

Teaching Strategies

Taba (1964) concluded from her studies on thinking in elementary school children that teaching strategies have strong effects on the scope and level of thinking in groups. Hughes (1959) writes of the importance of structure intervention, where the teacher intervenes to structure the student's attention during laboratory group work. This area will be explored in the present study in a descriptive manner.

Rowe (1974a), over a six-year period, studied the influence of a variable called teacher 'wait-time' on development of language and logic in children taking part in elementary science programs. Wait-time is defined as (1) the time allowed to a student to begin a reply to a question, and (2) the pause following a student statement, followed by the teacher's reaction. From analysis of more than 900 tapes she found that when mean wait-times of three to five seconds are achieved through training, there was a change of values on ten of the following variables: (1) the length of the response increases; (2) the number of unsolicited but appropriate responses increases; (3) failures to respond decrease; (4) confidence as reflected in decrease of inflected responses increases; (5) incidence of speculative responses increases;

(6) incidence of child-child comparisons of data increases; (7) incidence of evidence-inference statements increases; (8) the frequency of student questions increases; (9) incidence of responses from students rated by teachers as relatively slow increases; and (10) the variety in the type of moves made by students increases.

It was noted, in addition, that there is an interaction between wait-time and rewards and that students rated at the top or at the bottom of a class receive differential treatment with respect to these variables.

Shymansky (1974) studied the effects of two instructional strategies on the performance of students in fifth grade science. He used directive (teacher structured) and nondirective (student structured) patterns of teaching and found that students under the nondirective pattern of teaching showed a greater tendency towards self-actualization in the science classroom while the dependency of the teacher structured students appeared to increase. TAB test data further revealed a significant difference in the student investigative skills in favor of the student structured students with the most dramatic difference appearing in the performance of the low ranking students.

The importance of teaching strategies in this study should be obvious. Students accustomed to carrying out laboratory activities in a highly structured situation most likely would exhibit different behaviors than if they were in a less structured situation. One could hypothesize, for example, that a highly structured activity would create a greater dependence by the student on the teacher, resulting in a higher incidence of student initiated intervention than in a less structured

activity. Also, the teacher who employs a more highly structured teaching strategy would probably initiate interventions to a greater extent than the teacher who employs a less structured approach. This study attempted to identify such trends.

Summary of Group Dynamics Literature

From an analysis of the group dynamics literature, it can be seen that many studies related to groups in general can be related specifically to the classroom, since the classroom can be considered a social setting. There is a great deal of research which shows the positive relationship of an open and understanding classroom environment on such variables as student achievement, self-concept, and personality. These student variables appear to be very important in the learning situation.

The research indicates that more study is required to determine the influence of certain variables on the learning situation. Rogers (1969) reports that with respect to learning, attitudinal changes are far more important than other variables such as teaching strategy, whereas Taba (1964) reports that teaching strategies play a very important role in learning. Such conflicting research illuminates the need for further study. This study attempted to explore the relationship between some of these variables in the specific context of the teacher-small group relationships that characterize laboratory activities in science. The type of classroom situation in this study, then, involves many of the teacher-group relationships that characterize groups as discussed in the literature in this section.

Section B: Observational Systems

In order to avoid the complexities of taking a completely open-ended approach to the observation of behavior in the classroom, most researchers have developed or used some sort of category system. Interaction analysis literature contains a large number of category systems which have a variety of origins and have been developed for a number of purposes. Rosenshine and Furst (1973) have grouped seventy-three instruments according to their origin and purposes. They denote four main purposes of interaction systems as follows: to describe current classroom practice; to train teachers; to monitor instructional systems; and to investigate relationships between classroom activities and student growth.

Despite the multiplicity of purposes of interaction systems Flanders (1963) states that 'the ultimate aim of studying teacher influence in the classroom is to understand teacher-student interaction and, in particular, to specify conditions in which learning is maximized'.

Most existing observation systems have been designed to record only a single dimension of the ongoing discourse. Flanders (1960), Bales (1950) and their derivatives concentrate on a sort of general 'climate' of the classroom or other groups in the sense of identifying degrees of 'control' over the discourse. These systems have a small number of highly general categories and are thus incapable of detecting any 'fine structure' in the interactions. In contrast, systems such as those of Smith and Meux (1963) and Aschner and Gallagher (1963), while remaining unidimensional, contain much larger numbers of categories.

This leads to reduced reliability of coding. When the stability is increased by collapsing categories into broader units, the refinements that might be possible with many categories are lost.

Flanders (1961) concentrates on the dimension of teacher control. The Flanders system, which contains only ten categories, can be used 'live' by an observer coding while sitting in the classroom, and does not require tape recording the interaction for playback purposes for later coding. Despite the small number of categories, this system has proved useful in research and teacher training, in part because of the simple yet sophisticated matrix technique developed by Flanders. This allows a reader to tell from looking at a matrix what preceded and what followed every verbal behavior of both the teacher and the students. This linking of behavior into pairs increases the power of the data, and yet is simple enough to be learned by the classroom teacher.

This system has been used in both descriptive and experimental research, in which teachers were trained to role-play various teacher styles as determined by either 'heavy' or 'light' use of particular categories. The results are similar in both descriptive and experimental studies. Flanders defines indirect teaching as a strategy where the teacher accepts feeling, praises or encourages, accepts student ideas, and asks questions, behaviors which generally allow greater freedom of action for the student. Direct teaching is defined as a strategy where the teacher lectures, gives directions, criticizes or justifies authority, behaviors which generally tend to increase teacher participation

and to establish restraints on student behavior. Flanders (1965) found that indirect teaching is more effective than direct teaching with respect to positive student attitudes, and student cognitive growth as measured by achievement tests and IQ scores in primary grades.

Many of these systems are meant to be descriptive of classroom behavior. One major problem referred to by Rosenshine and Furst (1973) is that descriptive systems and data very soon become prescriptive, based on what the user thinks 'should happen'. The Flanders system, as used in teacher training, is perhaps the system which has been most widely used for prescriptive purposes, even though Flanders cautions against such use. The difficulty here is in training teachers to engage in specific behaviors even though there is no evidence that such behaviors lead to more desirable learning outcomes.

Smith and Meux (1963) concentrate on the dimension of the logical structure of the discourse. The development of this system represents a relatively long-term effort to determine a logical structure for teaching subject matter. Logical operations were derived from an analysis of logical thinking. The categories focus on the analysis of how teacher and students process content. The unit of code is (1) the episode, defined as one or more exchanges which comprise a completed verbal transaction between two or more speakers, and (2) the monologue, defined as solo performances of a speaker addressing a group.

This system was used to study 17 classrooms from five different high schools, using teachers from each of the major subject areas of English, mathematics, social studies, and science. The study was an analytic and descriptive one. From the study Smith and Meux concluded that logical operations could be applied to classroom discourse, and furthermore that some of these operations are more prevalent than others, notably describing, designating, and explaining, in that order. Also, it seems likely that differences may exist in the extent to which the logical operations are employed from teacher to teacher, and from area to area.

Of the systems mentioned above, the Smith and Meux (1963) and Aschner and Gallagher (1963) systems differ from the others in that the categories deal with the logical content of the discourse units rather than with the 'controlling' function of the discourse. A system which attempts to categorize both these dimensions is that of Taba (1964). Taba has coded each discourse unit in three dimensions; the source of the unit (teacher or child/giving or seeking), the function (analogous to the 'control' concept), and the level of thought (the logical quality of the unit). In the latter dimension, three task areas, grouping and labelling, interpreting information and making inferences, and predicting were identified. Each task area was considered to consist of three levels: an irrelevant or incorrect unit; a correct unit without elaboration; and a correct unit accompanied by qualification or explanation.

Using this instrument Taba studied the development of thought processes under optimum training conditions. Optimum was defined to

include: (1) a curriculum for the development of thought; (2) teaching strategies focused directly on mastery of necessary cognitive skills, and (3) a sufficient time span to permit a developmental training sequence. Children from 20 elementary school classes in grades 2 through 6 participated. Participating teachers received special training to facilitate learning of cognitive skills which consist of categorization, interpretation, and application of principles.

The results of this study include the following: (1) generally low positive correlations were obtained between the level of intelligence and the level of performance in both the Social Studies Inference Test and the classroom discussions; (2) in terms of growth, as measured by change scores on the Social Studies Inference Test, students with low IQ's gained as much in cognitive skills measured in this study over the year as did the students with high IQ's. There was no relationship in this gain to either social studies achievement or to reading comprehension; (3) the most significant factor influencing cognitive performance was the teaching strategy.

While the Taba system thus deals with both the controlling and the logical dimensions, the system has a number of limitations which make its wider use questionable. First, the system still uses 'child' collectively to refer to whichever child happens to be speaking at the time of coding. Second, the unit of analysis is not well defined operationally, lending to ambiguity in coding. Finally, the cognitive task categories are logically incomplete when compared, for example, to those of Bellack, Smith and Meux, Aschner and Gallagher, or to the cognitive levels of Bloom's Taxonomy.

The Bellack system (1966) is more comprehensive than any of the systems discussed above. BelTack divides classroom discourse into two major areas of meaning that he labels 'substantive' and 'instructional'. Categories for each of these dimensions are further analyzed for their logical structure. More importantly, Bellack's system was developed in the context of a broad theoretical view of classroom discourse as a 'language game' (after Wittgenstein, 1953). This theory permitted the identification of a unit of analysis, referred to as the 'pedagogical move', which was not only relatively unambiguous but also provided a framework for developing a general description of the nature of the discourse. In particular, the distinction between teacher and student roles and the notion that discourse tends to proceed in 'cycles' emerged from the analysis.

From his analysis Bellack determined the 'rules of the classroom game' in some detail. He found that students did not set forth regulations, and structured less than they solicited, responded, or reacted, which indicates that students do not take initiative in the classroom. Observation of the teacher led to development of 'rules for the teacher'. These rules include that the teacher (1) structured the lesson; (2) did most of the questioning and reacting to student answers; (3) was the most active person in the classroom; and (4) talked more than the students.

Bellack also studied cycles of teacher-student interaction. He found that the two basic cycles of 'solicitation followed by response' and 'solicitation followed by response followed by reaction' account for

more than 48 percent of all teaching cycles. In addition, the question-answer cycle comprised the core of most other teaching cycles, therefore teachers in general do not seem to deviate radically from a general teaching pattern that consists basically of asking questions and receiving answers. Bellack's teaching cycles can be used to stimulate teachers to consider the effects of breaking the rules of the classroom game, and creating classroom climates in which, for instance, the teacher is not the most active member of the class, or in which the students do evaluate the teacher and evaluate each other, or in which the students do the questioning and reacting. Although the system was designed for use in economics classes, it can be adapted for use in any subject matter area.

Although the Bellack system is more comprehensive than the other systems discussed, it does possess a number of limitations for the analysis of non-conventional classroom settings. There is no provision made for the analysis of physical actions. The issue of control is not clearly dealt with except in the rating reaction categories. Also, for analyzing science activities as required in the present study, the substantive meaning dimension is more appropriately conceptualized in process rather than subject matter terms.

Barker (1963) with his 'behavior setting' and 'behavior streaming' constructs provides the possibility of developing a broader view of classroom interactions than does the language game idea. The behavior stream is regarded by Barker as being the ongoing behavior of an individual in a particular setting. The behavior stream might have

'currents' in the form of underlying unifying themes which run throughout the stream, serving to link together seemingly isolated behavior units. Barker suggests that the behavior stream is determined by the perceived goal. Considering the behavior setting to be a macro-unit within which specific behaviors occur, Barker proposes the basic hypothesis that the specific behaviors observed are a function of the nature of the setting. This setting is bounded by a number of parameters. Crocker (1975) quotes Sherman as saying that in the particular case of the classroom, the setting may be regarded as being bounded by such parameters as group size, nature of the subject matter of the lesson, student and teacher characteristics, pacing, and availability of materials.

Summary of Observational Systems Literature

A review of the interaction analysis literature gives an indication of the voluminous number of systems that have been developed, either originally or as derivatives of the existing systems. These interaction systems were developed for specific purposes. For example, Flanders (1960) and Bales (1950) concentrate on identifying degrees of control over the discourse, the Smith and Meux (1963) and Aschner and Gallagher (1963) systems deal with the logical content of the discourse units, while Taba (1964) tries to categorize both of these dimensions.

From review of the literature it can be seen that no single system is capable of analyzing the type of lesson where science activities are occurring, which is of primary interest in this study. The Bellack

system comes closest to what was needed for the purpose of this study. However, this system has a number of limitations which have already been discussed. The Bellack system and how it relates to the new system which was developed will be discussed later in the methodology section.

CHAPTER 3

THE DESIGN OF THE STUDY

This chapter will discuss the sample of the study, and the procedures followed and instruments used in the data collection phase of the study. A description of the analysis procedures will also be given.

1. The Sample

The sample consisted of 38 students in grades 2, 4, and 6 who were doing the Elementary Science Curriculum Study program in eight different elementary schools in rural Newfoundland. These schools were chosen because the Elementary Science Curriculum Study program was being used to some extent in these schools, and because personnel in the district were favorable to experimentation. Also, most of the teachers involved had completed a science methods course for elementary teachers at Memorial University of Newfoundland and thus had some association with the investigators of the major study. Videotapes were made of students. No attempt was made to choose classes or individual students based on any student or teacher characteristics.

Students were chosen based on who were in the best position for recording, once the audio-visual equipment was set up for maximum use in the classroom.

Sample representativeness may be a limitation because the sample consisted of teacher volunteers. Another possible limitation of the sample was the lack of exposure of the students to science

activities. Most students had carried out very few laboratory investigations in the way that they did during the taping for this study. Their behavior thus may not be typical of what might be expected from classes with prolonged exposure to this type of activity.

II. Operational Procedures

As mentioned in Chapter 1, this study is a segment of a larger study, designed to develop an interaction analysis system for the purpose of analyzing the verbal and manipulative actions of students engaged in laboratory activities in elementary school science. Part of the data used were collected for the larger study prior to the initiation of this study. These data were collected from October, 1974 to January, 1975 in the Bonavista-Trinity-Placentia Integrated School District. The remainder of the data were collected by members of the larger study, including this investigator, in May, 1975 in the Avalon North Integrated School District.

Permission from superintendents was requested and received for the research to be conducted in their district. Teachers from all elementary schools in the respective districts were then asked to volunteer for the project. Once the participating teachers were decided the sequence of events was as follows:

(1) An initial meeting was planned with the teacher, or teachers if there were several from the immediate area, to discuss the nature of the research, to set up the lessons, and to arrange a time schedule. At this meeting the teachers were given instructions

related to teaching strategy. The lesson was to be taught by posing a problem, allowing the students to investigate the problem in laboratory groups, and concluding the lesson with a summary. This lesson pattern was typical of that in the science program being used. The specific directions were given in order that all lessons take a fairly standard format. Teachers were given two lessons taken from the Elementary Science Curriculum Study program and asked to select and prepare one of them for presentation. Teachers were then asked to present the lesson, considering the above teaching strategy, in as normal a manner as possible.

(2) Following the initial meeting, after the teachers had time to look at the lessons, make a selection and plan the lesson, they were contacted by telephone and any problems which existed were discussed.

(3) Approximately two weeks after the initial meeting the lessons were taped.

The lessons chosen for taping were taken from the Elementary Science Curriculum Study developed by Crocker (1973). This is an activity program, having as one of its main objectives the development of science processes. The lessons chosen consisted of such topics as balancing, floating and sinking, density, the pendulum, and the relationship between the weight of displaced water and the loss of weight of an object in water.

Following standard procedure for the curriculum, the class

was divided into groups with two students in each group. Throughout the activity, the teacher circulated among the students, discussing the activity with various groups of students. Two pairs of students from each class were recorded using two independently operated videotape recorders and cameras. Directional microphones were placed in front of the students being recorded in order to minimize extraneous sounds. Other dummy microphones were placed at various positions within the classroom. Students were aware that recordings were taking place but the particular subjects used usually were not aware that they were being singled out.

After the videotaping was completed, the students were administered the Junior Eysenck Personality Inventory, a questionnaire designed to measure self-concept, and the Raven Colored Progressive Matrices, Sets A, Ab, B, designed to measure nonverbal IQ.

After all data were collected, typed transcripts were prepared from the audio portion of the tapes. After the transcripts were edited, they were used in the refinement of the coding system. Reliability of the system was then determined. All the tapes were then coded by this investigator, along with three other people involved in the major project. This coded data was then keypunched with each unit of analysis on a separate card, and the punched data transferred to a computer desk file. From this data base the sections related to teacher intervention were isolated and analyzed.

III. Instrumentation

1. The Coding System

As stated earlier, the coding system used in this study was developed for the larger study of which this study forms a segment. The new coding system used as a starting point an interaction analysis system developed by Bellack (1966) previously discussed under the review of related literature section.

The new coding system is unique as follows: the emphasis is on the intervention that occurs in small groups rather than the whole class; the dimension of primary interest is the substantive logic of the discourse; a dimension is included to classify the manipulation of apparatus; and videotape was used instead of direct observation or audiotapes as has been the usual practice.

The coding system consists of a number of dimensions. Each dimension will now be described briefly, pointing out its relationship to the Bellack system where applicable.

Speaker: The coding of the speaker is more detailed in this system than in the Bellack system, with only teacher (T), pupil (P) and audiovisual device (A) being coded in Bellack's system. The person speaking and the person or group spoken to is coded in this system. Provision is made to allow identification of the speaker, if it is the teacher, or any student under analysis, or someone extraneous to the group under analysis. Such coding is advantageous for this study in that teacher intervention in laboratory groups can immediately be

recognized. For example, a code of 1, 2 means that the teacher (1) is speaking to the first student (2) in the group under analysis.

Pedagogical Move: This dimension refers to the four major categories of verbal behavior that occurs in a classroom between students and teacher as identified by Bellack. These moves are defined as structuring (STR), those behaviors that overtly change the direction of the discourse or action; soliciting (SOL), any questions, imperatives, and requests which require a response on the part of the receiver; responding (RES), which bears a reciprocal relationship to the soliciting move and occurs only in relation to that move; and reacting (REA) moves, which are designed to modify, clarify, or rate the previous move. Although this dimension was not a necessary one for the purposes for which this system was developed, it was decided to include the dimension to allow for comparability with Bellack's results.

Substantive-logical: Bellack defines this dimension as the cognitive processes involved in dealing with the subject matter. This dimension has been expanded in the new system to include processes of science, as well as the logical elements of discourse identified by Bellack. An attempt was also made to classify these elements by levels of thinking. The processes include observing, classifying, quantifying, inferring, predicting, communicating, hypothesizing, defining operationally, interpreting data, controlling variables, experimenting, and forming models. Products include defining, describing, fact stating, interpreting, explaining, evaluating, opining, and justifying. For example, a statement might be coded as classifying (CLS), level 1, meaning a correct classification.

Bellack's system also includes a substantive dimension which refers to the subject matter of the lesson. However, this dimension was not included in the new system because the actual subject matter was not an important consideration of this study. Considered more important were the various science processes and products that the student was using during the activity.

Lesson phase: This dimension consists of categories of problem specification, data collection, data interpretation, summarization, and clean up. Each category has three levels -- off-task (0), direct (1), and indirect (2). For example, when the teacher is explaining the general idea of the lesson at the beginning, the general lesson phase would be problem specification (PRB), level 1. When students are performing laboratory activities collecting data, it would come under the lesson phase of data collection (DAG), level 1.

Instructional: The instructional dimension in Bellack refers to such matters as assignments, materials and routine classroom procedures that are part of the instructional process. In the new system the instructional dimension has been divided into a number of subdivisions each with a number of categories as follows:

Controlling, consisting of the categories of gives, requests, and commands.

Type of instruction, with categories of performance, clarification, elaboration, example, attention, repetition, teacher requirement, student requirement, statement of intention, assistance, and procedure.

Nature of Reference, with categories of statement, person,

action general, action physical, action vocal, action cognitive, action emotional, logic reference, language mechanics, apparatus, assignment, procedure, expected outcome, class results, individual results, event or phenomenon, and recording equipment.

Rating, with categories of repeating, qualifying, positive, negative, and positive/negative.

For example, a statement made by the teacher to the student could be one giving procedure and referring to apparatus. This would be coded in the gives category (GIV) of the controlling subdimension, in the procedure category (PRC) in the type of instruction subdimension, and in the apparatus category (APP) in the nature of reference subdimension.

This dimension uses Bellack's system as a basis. However, many more subcategories have been included in order to have the system yield a clearer picture of how the discourse is controlled. Also, some of the added categories occur because of the unique nature of laboratory activities, particularly the numerous references to apparatus, observed phenomena, and physical action.

Physical Action: This dimension consists of three subdimensions each with a number of categories as follows:

Apparatus Manipulation: which include categories of setting up (STA); dismantling (DIS); adjusting (ADJ); taking readings or measurements (MEA); watching (WAT) which refers to observation of phenomena; moulding, shaping or cutting (SHA); action non-specific (NON), which refers to 'playing'

with apparatus; and no action (NOA).

Recording: which include categories of writing (WRI); drawing (DRA); graphing (GRA); tabulating (TAB); calculating (CAL); and non-specific recording, which is coded whenever the other categories of this subdimension are not discernable.

Management Moves: which include categories of fetching, returning (FTC); changing position for an activity related reason (REL); changing position for no discernable reason (NOM); raising hand (RHA); off task (OFF); cleanup (CLE); recording equipment (REC), which is coded whenever the recording equipment is handled during the activity; and not codable (NOC), which refers to situations where the students under analysis cannot be seen, or the teacher can be heard but not seen.

This dimension is coded for every sentence, or in the absence of discourse every six seconds. The dimension is not included in Bellack's system but was deemed a necessary dimension in this system because of the nature of the classroom activities. For a more comprehensive discussion of the coding system, refer to Crocker et al. (1975).

Coding Procedure

When coding using this system, each sentence is analyzed by coding using those dimensions that are applicable discussed above. The coding unit is a single sentence. If activities are occurring in the absence of discourse, the physical action dimension is coded every six seconds.

Following are a number of examples of coded sentences. The

codes can be interpreted by referring to the coding instrument in Appendix A.

1. Student: Teacher, can we put the plasticene in?
2. Teacher: Yes.
3. Teacher: No, leave the plasticene out.

. . . . . .

1. Morley: I'm getting to work.
2. Morley: It floats.
3. Scott: What?
4. Morley: This stuff here floats.

. . . . . .

1. Scott: Do you mark them down like this?
2. Teacher: Well just turn over the sheet and write it down.

. . . . . .

CODING SHEET

Sent.	Time sec.	Speaker S	Speaker R	Move	Substantive logical	Task	Inst.		Ref.	Rating	Phy. Action P_2	Phy. Action P_3	Phy. Action T
1	120	3	1	SOL	--	DAG 1	REQ	PRF	ACP	--	ADJ	ADJ	NOC
2	126	1	3	RES	--	DAG 1	GIV	PRF	STA	POS	NON	NOA	NOC
3	132	1	3	RES	--	DAG 1	COM	PRF	ACP	NEG	NOA	NOA	NOC
1	72	2	3	STR	--	PRB 2	GIV	INT	ACT	--	STA	STA	NOC
2	78	2	3	REA	OBS 1	PRB 1	--	--	PHE	--	WAT	WAT	NOC
3		3	2	SOL	--	PRB 1	REQ	CLA	ACV	--	WAT	WAT	NOC
4	84	2	3	RES	OBS 1	PRB 1	GIV	CLA	ACV	--	ADJ	WAT	NOC
1	60	2	1	SOL	COM 1	DAG 1	REQ	PRF	ACP	--	WRI	WAT	NON
2	66	1	2	RES	COM 1	DAG 1	COM	PRF	ACP	--	NOA	NOA	NOC

Interrater reliability of coding followed a procedure suggested by Smith and Meux (1963) of using pairs of coders working together on each transcript. Initially two pairs of the research team coded a transcript consisting of 200-300 discourse units, and the overall proportion of identical coding for each dimension was determined. Thus each dimension, rather than each category, had a reliability coefficient calculated.

Because of the complexity of the instrument, with so many categories and subcategories, the initial reliability coefficient ranged from .5 - .9 for the various dimensions. To improve reliability for those dimensions below .9, the two coders met and identified discrepancies. It was found that a single source of error usually accounted for most of the differences in a cluster. Thus, if a concensus was met on one point, the reliability increased substantially. A reliability of .85 or greater was considered adequate.

Literature dealing with the validity of interaction analysis systems is sketchy (McGaw, 1972; Rosenshine and Furst, 1973). Construct validity, which refers to the instrument's validity with respect to theoretical considerations, is difficult to substantiate for most of the interaction systems. In the Bellack system the 'moves' dimension has the 'language game' idea as its theoretical base, and thus can be considered to have a degree of construct validity in that the language game notion can be used as a basis for interpretation of data. As discussed earlier, the new system keeps Bellack's 'moves' dimension and so is valid in the same sense. Also, in the new system the substantive-

logical dimension, consisting of the processes and products of science, has as a theoretical base a particular model of the nature of science. This dimension has construct validity to the degree that the American Association for the Advancement of Science process model (1965) represents a reasonable picture of the processes of science.

Content validity is demonstrated by showing how well the content of the test or system samples the class of situations for which it was designed. As with the Bellack system, the new system has many of the dimensions with its subcategories developed post facto, after analyzing the classroom interaction. This gives the system a degree of validity, since the categories reflect what is going on in the classroom as determined from observation.

For an overall view of the coding system, see the Appendix.

2. The Junior Eysenck Personality Inventory

This inventory was designed to measure the two major personality variables of neuroticism and extraversion-introversion in children. The 60 item scale is an extension of the Mauslsey Personality Inventory and the Eysenck Personality Inventory. (Manual for the Junior Eysenck Personality Inventory, 1963).

Split-half as well as test-retest reliability coefficients have been found. The reliabilities average between 0.7 and 0.8. Reliability tends to increase with age for extraversion, somewhat less so for neuroticism.

Very little is known about the validity of the Junior Eysenck Personality Inventory. However, in one study two hundred and twenty-nine children, guidance clinic subjects, were tested and rated with respect to the extraverted or introverted nature of their symptoms, and it was found that the group as a whole was very significantly above the standardization group with respect to neuroticism, and that there was a very significant difference with respect to extraversion between children showing extraverted symptoms and those showing introverted symptoms.

3. The Raven Coloured Progressive Matrices, Sets A, Ab, B.

This is a non-verbal test that can be used for children below the age of eleven, old people, or by people who cannot understand or speak the English language. This test can be used to assess the degree to which a person's capacity for observation and clear thinking has developed. It adequately covers all the cognitive processes of which children under the age of eleven are usually capable. The test is arranged to assess mental development up to the stage when a person is sufficiently able to reason by analogy to adapt to this way of thinking as a consistent method of inference.

For children under the age of seven years there is a low re-test reliability of 0.65, and a correlation of about 0.5 with both the Crichton Vocabulary Scale and with the Terman-Merrill Scale, Form L. By age nine, the re-test reliability has been found to increase to 0.80, and to correlate about 0.65 with the above mentioned scales. Over the whole range of development for which the test is constructed, the re-test

reliability is approximately 0:9. (Manual for the Raven Coloured Progressive Matrices, Sets A, Ab, B, 1947).

4. Self-Concept Questionnaire

The questionnaire that was administered to measure self-concept of ability was a modified version of the Michigan State General Self-Concept of Ability Scale, Form A (SCA). The modified test consisted of two five-choice and four four-choice items. The modification was considered necessary because the SCA was developed for grades 7 to 10. Those items that were too advanced for elementary students, or that were inappropriate because of reference to high school or college were replaced with simpler questions drawn from the original pool of questions used during development of the SCA.

For the SCA the reliabilities of the general self-concept total scores were 0.82 for males and 0.77 for females. A test-retest correlation over a one-year period (between 8th and 9th grade) was calculated and found to be 0.75 for males and 0.77 for females. Since it is expected that self-concept is not constant but fluctuates with changes in interpersonal relations, these correlations are high.

Predictive validity as measured by correlating estimated grade point average (GPA) and actual GPA was 0.70 for females and 0.71 for males (Brookover, 1962).

It is realized that the above statistics apply to the SCA and cannot be generalized to the modified version used in this study. No reliability or validity is available for the modified version. A test-

retest reliability was decided against because of the limited number of items. Despite lack of evidence on reliability and validity it was decided to use the test since the results of the test for this study will only be dealt with in a descriptive manner, and will be presented only in a highly tentative sense.

IV. Statistical Analysis

Since a major part of this study concerned itself with a descriptive analysis of teacher interventions, a number of frequency tabulations were made. Such statistics as the mean, standard deviation, and range were used to determine descriptions of the length and number of interventions for a group, for both groups in a class, and for classes within a grade.

In an attempt to determine the different types of interventions that occurred, a critical incidence technique was employed. This technique consisted of making a search of each intervention, making notes for each intervention considering such things as who initiated the intervention, for what reason, and the response following the initial sentence. This information was then placed on a file card. This procedure was followed for all interventions. Following this, the types of interventions were delineated by placing those interventions of a similar type in the same pile. Frequency counts were then made of each type.

Cross tabulations were made between the speaker (teacher and each student under analysis) and move, whether or not there were substantive-logical statements made during the intervention, the nature

of the controlling statements, the nature of the reference, and the type of rating that occurred.

T-tests were used to determine whether or not there was a significant difference between groups in a class with respect to the mean length of the interventions.

One-way analysis of variance was used to determine whether or not there was a significant difference between classes and between grades with respect to the mean length of the interventions.

A correlation coefficient was employed to see if there was a correlation between the number of interventions that occurred and the mean length of the interventions.

Correlations were computed between the student characteristics of IQ, extraversion, neuroticism, and self-concept and the student behavior variables of the proportion of sentences made, the proportion of solicits, the proportion of responses, the proportion of requests, and the proportion of commands which occurred during the interventions. Also correlated were the same student behavior variables overall and those same student variables which occurred during the interventions.

Some of the correlational relationships were further analyzed using multiple linear regression. The criterion variables consisted of the following student behavior variables which occurred during the interventions: the proportion of sentences made; the proportion of solicits; the proportion of responses; the proportion of requests; and

the proportion of commands. The predictor variables consisted of two sets of variables: those student behavior variables already mentioned, but for overall rather than during the interventions only; and the student characteristics of IQ, extraversion, neuroticism, and self-concept.

Summary

The sample consisted of 38 students, from grades 2, 4, and 6. Two pairs of students from each class were observed using videotape. The lessons chosen for taping were activity oriented, having the development of processes as one of their main objectives. After videotaping was completed, students were administered the Junior Eysenck Personality Inventory, a self-concept questionnaire, and the Raven Colored Progressive Matrices, Sets A, Ab, B, designed to measure IQ. Transcripts were then coded using the new coding system.

CHAPTER 4

RESULTS

The presentation and discussion of the results will follow a format as outlined below.

A general description of the interventions will be given in the first section of this chapter. Descriptive statistics such as the mean, standard deviation, and range for length and number will be discussed for the total number of interventions.

Following the general description of the intervention the questions as outlined earlier in Chapter 1 will be considered. Each question will be stated, results related to that question will be presented, followed by discussion.

A number of questions raised in Chapter 1 requires analysis at three levels: a comparison of one group with another group in the same class; a comparison of one class with another class in the same grade; and comparison of one grade with another grade. In effect, there is analysis between groups, between classes, and between grades. For questions requiring this tri-level analysis, where possible, discussion will proceed one level at a time.

Section A: A General Description of Interventions

Table I shows the mean, standard deviation, and range for length and number of the interventions overall. Figure II gives the distribution of the length of interventions overall.

TABLE I

MEAN, STANDARD DEVIATION, AND RANGE
FOR LENGTH AND NUMBER OF INTERVENTIONS OVERALL

	MEAN	STANDARD DEVIATION	RANGE	TOTAL
SENTENCE LENGTH	7.44	3.58	1 - 63	
NUMBER OF INTERVENTIONS PER GROUP	7.89	3.94	3 - 16	149

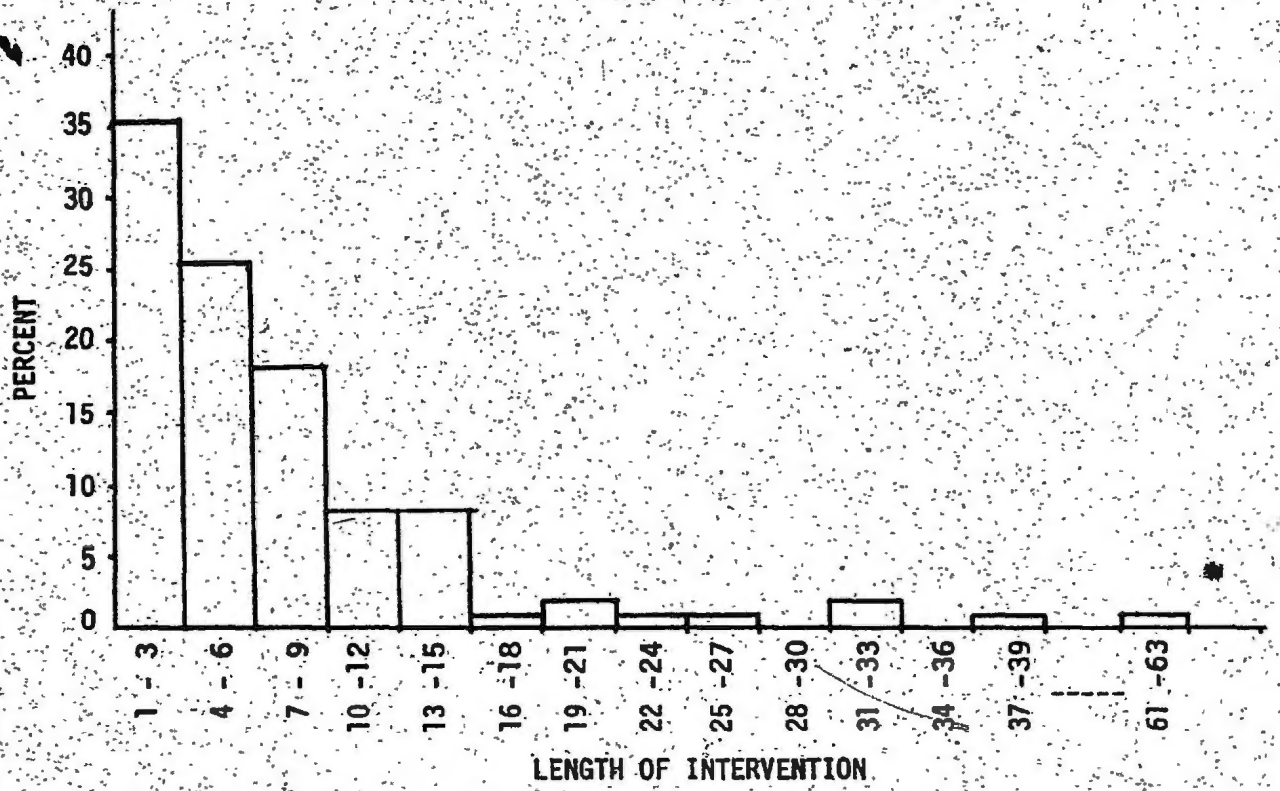

Figure II

Distribution of Intervention Length Overall

Figure III gives the distribution of the number of interventions overall.

Discussion

It can be seen from Table I that the distribution for length of interventions was 1-63 sentences. Figure II gives a clearer picture of the percentage of interventions falling in various length categories. The intervention length with the greatest percentage was 1-3 sentences. The percentage decreased as the length of the interventions increased. Of the total number of interventions, 79% had a distribution of 1-9 sentences. Generally, then, intervention length appeared to be kept to a minimum. This may be a result of the notion that there is a problem at hand, and time is at a premium. Such a notion would result in the intervention lengths being short. Another consideration is that the teacher had to interact with as many as fifteen groups in the class. This would be a very strong case for shorter interventions. A closer examination of how the range of length varied from one grade to another will be discussed later in this chapter.

Table I also considers the number of interventions that occurred in this study. The number of interventions per group ranged from 3-16. Figure III shows a clearer picture of the percentage of interventions falling in the various categories. It shows that the greatest percentage of groups received 5-6 interventions. An initial study of this graph might lead one to believe that the number of interventions was unusually low. However, when one considers that

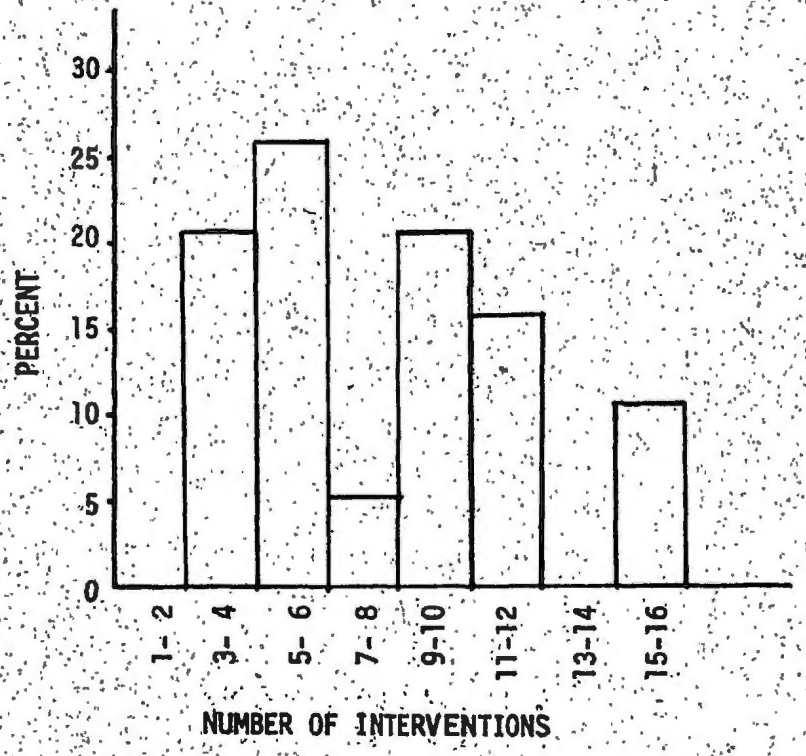

Figure III

Distribution of Number of Interventions per Group

teachers were interacting with groups of two, for some classes with a total of fifteen groups, and that this data is based on an analysis of only two groups per class, the number of interventions appears more realistic. The relationship that existed between the number of interventions, and the length of these interventions will be discussed later in this chapter.

Section B: Research Questions

Question 1

(a) What is the distribution of length and number of the interventions?

(b) What is the mean length and number of interventions in a lesson for a particular group?

(c) How does the mean length vary from group to group, class to class, and grade to grade?

(d) What is the mean length of teacher versus student initiated interventions?

Results

Figures II and III, giving the overall distribution of intervention length and number respectively, have already been discussed.

Figures IV and V give the distribution of intervention length and number respectively, for each grade level.

Table II gives the mean, standard deviation, and t-test results for intervention length for groups within a class. For all

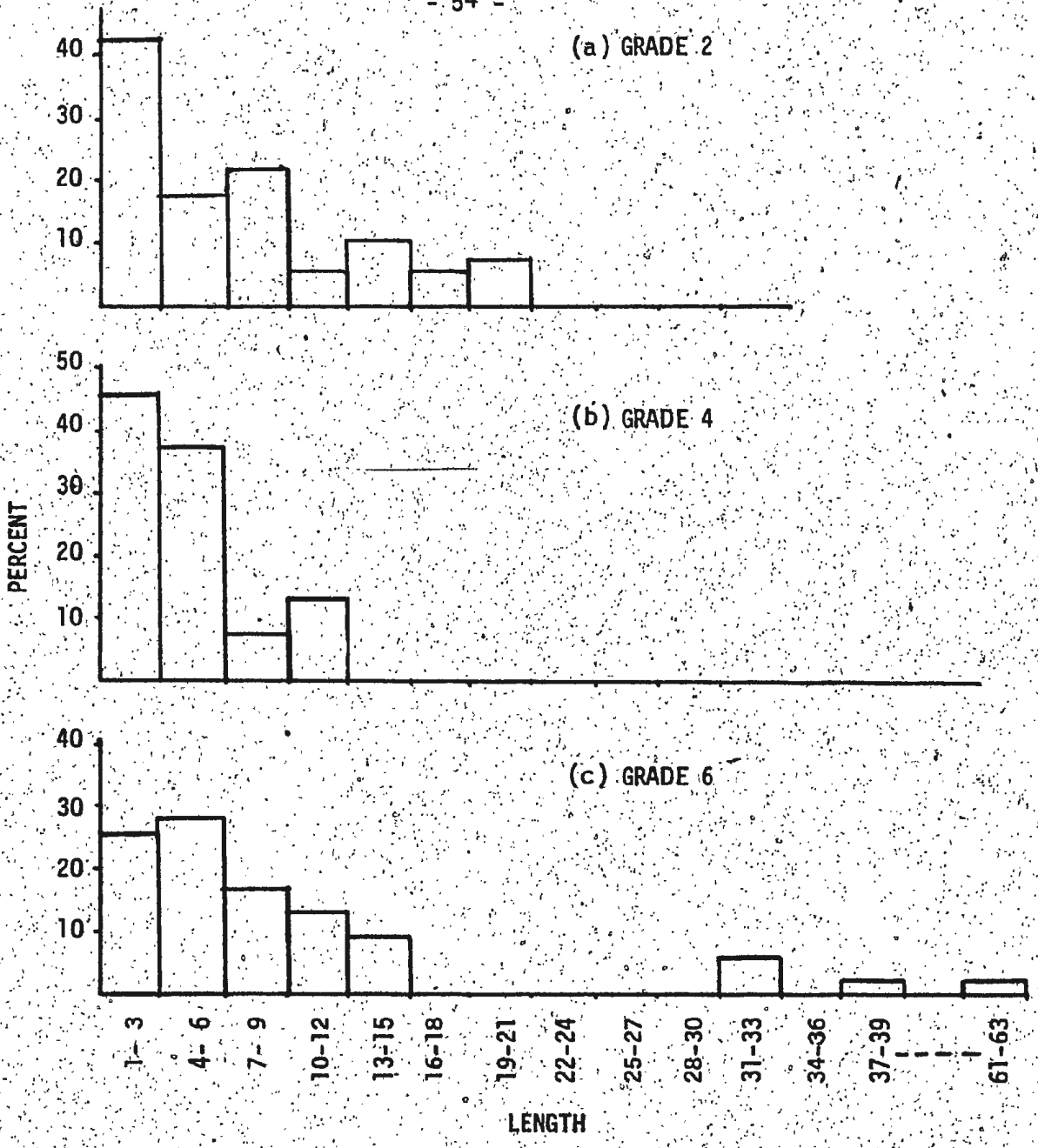

Figure IV

Distribution of Intervention Length -- Grades 2, 4, 6.

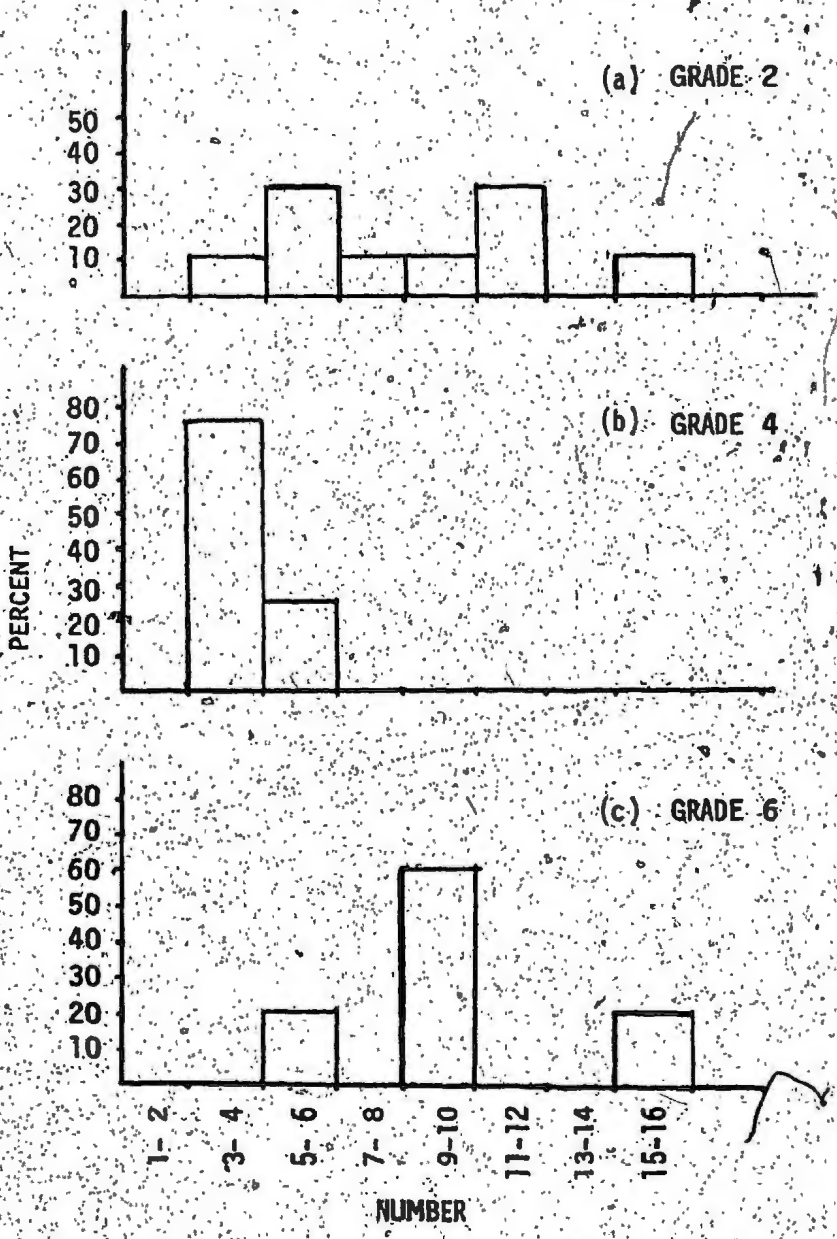

Figure V

Distribution of Intervention Number -- Grades 2, 4, 6.

TABLE II

MEANS, STANDARD DEVIATION AND T-TESTS FOR INTERVENTION LENGTH FOR GROUPS WITHIN A CLASS

GRADE	CLASS	GROUP	MEAN	STANDARD DEVIATION	DEGREES OF FREEDOM	T-VALUE	PROBABILITY	SIGNIFICANCE
2	1	1	5.64	4.13	20	.1348	.4470	N.S.
		2	4.00	2.41				
2	2	1	4.06	3.04	24	.3632	.3598	N.S.
		2	4.50	3.10				
2	3	1	7.64	5.63	16	.4215	.3395	N.S.
		2	7.14	3.98				
2	4	1	9.67	7.50	8	.1812	.4304	N.S.
		2	13.50	2.64				
2	5	1	7.80	7.33	13	.0730	.4714	N.S.
		2	16.00	8.72				
4	6	1	4.33	0.58	5	.0955	.4637	N.S.
		2	3.00	1.41				
4	7	1	5.00	4.36	7	.2582	.4018	N.S.
		2	6.83	3.54				
6	8	1	6.00	4.09	16	.4772	.3198	N.S.
		2	5.89	4.01				
6	9	1	13.11	9.88	12	.3149	.3791	N.S.
		2	10.20	11.78				
6	10	1	7.00	7.12	--	--	--	

groups at all grade levels, at the .05 level of significance, there was no significant difference between groups within a class with respect to intervention length.

Table III gives the mean and standard deviation for intervention length by class for each grade level.

Table IV gives the results of an analysis of variance of length of intervention as a function of class. For grade 2, the F-value was 7.636 with an associated probability ($p < 0.05$). This indicated a significant difference between classes within grade 2 with respect to intervention length. In grade 4, the F-value was 1.239 with an associated probability ($p > 0.05$). This indicated no significant difference between classes within grade 4 with respect to intervention length. In grade 6, the F-value was 3.038 with an associated probability ($p > 0.05$). This indicated no significant difference between classes within grade 6 with respect to intervention length.

Table V gives the mean and standard deviation for length of intervention at each grade level, while Table VI gives the results of an analysis of variance of length of intervention as a function of grade. The F-value was 2.185 with an associated probability ($p > .05$). This indicated no significant difference between grades with respect to intervention length.

Table VII gives the total number of interventions for groups within a grade, while Table VIII gives the mean number of interventions per grade level.

TABLE III

MEAN AND STANDARD DEVIATION FOR INTERVENTION LENGTH BY CLASS FOR EACH GRADE LEVEL

GRADE	CLASS	MEAN SENTENCES	STANDARD DEVIATION
2	1	4.82	3.40
2	2	4.23	3.01
2	3	7.44	4.92
2	4	11.20	6.12
2	5	11.90	8.79
4	6	3.57	1.27
4	7	5.22	3.73
6	8	5.94	3.93
6	9	12.07	10.24
6	10	7.00	7.12

TABLE IV

ANALYSIS OF VARIANCE OF LENGTH OF INTERVENTION
AS A FUNCTION OF CLASS

GRADE	SOURCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F-RATIO	F-PROB.	SIGNIFICANCE
2	BETWEEN GROUPS	4	719.0364	179.7591	7.636	0.000	S
	WITHIN GROUPS	81	1906.8359	23.5412			
	TOTAL	85	2625.8723				
4	BETWEEN GROUPS	1	10.7300	10.7300	1.239	0.284	N.S.
	WITHIN GROUPS	14	121.2700	8.6621			
	TOTAL	15	132.0000				
6	BETWEEN GROUPS	2	322.5952	161.2976	3.038	0.057	N.S.
	WITHIN GROUPS	44	2335.8733	53.0880			
	TOTAL	46	2658.4685				

TABLE V

MEAN AND STANDARD DEVIATION FOR LENGTH OF INTERVENTION AT EACH GRADE LEVEL

GRADE	MEAN	STANDARD DEVIATION
2	6.76	5.56
4	4.50	2.97
6	8.11	7.60

TABLE VI

ANALYSIS OF VARIANCE OF LENGTH OF INTERVENTION
AS A FUNCTION OF GRADE

SOURCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F-RATIO	F-PROB	SIGNIFICANCE
BETWEEN GROUPS	2	162.11	81.06	2.185	0.114	N.S.
WITHIN GROUPS	146	5416.34	37.09			
TOTAL	148	5578.46				

TABLE VII

TOTAL NUMBER OF INTERVENTIONS
FOR GROUPS WITHIN A GRADE

GRADE	CLASS	GROUP	NUMBER OF INTERVENTIONS
2	1	1	11
		2	11
	2	1	16
		2	10
	3	1	11
		2	7
	4	1	6
		2	4
	5	1	5
		2	5
TOTAL GR. 2			86
4	6	1	3
		2	4
	7	1	3
		2	6
TOTAL GR. 4			16
6	8	1	9
		2	9
	9	1	9
		2	5
	10	1	15
TOTAL GR. 6			47

TABLE VIII

MEAN NUMBER OF INTERVENTIONS PER GRADE LEVEL

	GRADE 2	GRADE 4	GRADE 6
MEAN NUMBER	8.6	4.0	9.6
MEAN LESSON LENGTH (SENTENCES)	426.2	321.5	721.6

Table IX gives the correlation between the length and number of interventions occurring. The r value was -.2551. This value was significant at the .05 level of significance for 17 degrees of freedom.

Table X gives the mean and standard deviation of intervention length for teacher versus student initiated interventions. A t-test resulted in a t-value of 1.42, $p > .05$, and thus non-significance.

Discussion

As discussed in Section A, the interventions which had the greatest frequency was 1-3 sentences in length, with the longest intervention being 63 sentences (Figure II). The greatest percentage of number of interventions in a group fall in the 5-6 category.

Figure IV shows that the distribution of interventions varied in length up to 21 sentences for grade 2. This variability was reduced in grade 4, with the longest intervention being only 12 sentences in length. At the grade 6 level, this variability increased, the longest intervention being 63 sentences.

It should be noted that for grades 2 and 4 the length of interventions having the greatest frequency was 1-3 sentences. At the grade 6 level, the length of interventions having the greatest frequency was 4-6 sentences. To discuss these differences, consideration has to be given to the number of interventions occurring at each grade level. A comparison was made between the length of the interventions and the number of interventions occurring and will be reported in Question 2.

TABLE IX

MEANS, STANDARD DEVIATIONS, AND CORRELATION BETWEEN LENGTH AND NUMBER OF INTERVENTIONS OCCURRING

	MEAN	STANDARD DEVIATION	CORRELATION COEFFICIENT
Length	7.44	3.58	-.2551
Number per 100 Sentences	1.75	0.78	

TABLE X

MEAN LENGTH AND STANDARD DEVIATION OF TEACHER VERSUS STUDENT INITIATED INTERVENTIONS

	MEAN LENGTH	STANDARD DEVIATION	T-VALUE	PROBABILITY	SIGNIFICANCE
STUDENT	7.56	6.57	1.42	> .05	N.S.
TEACHER	6.36	5.73			

Figure V shows that the various groups within grade 2 had numbers of interventions well spread over the overall range of 3-16. The most commonly occurring number of interventions were clustered, with 75% falling in the 3-4 category and the remainder falling in the 5-6 category. At the grade 6 level, the majority of groups had 9-10 interventions. Caution should be exercised when interpreting the percentages for this figure because of the small number of groups represented.

None of the t-tests done on intervention lengths in the various groups within classes were significant. This means that intervention length was not determined by groups within a class.

The analysis of variance done to determine if intervention length and class was significant showed a high degree of significance for grade 2, with grades 4 and 6 being non-significant, even though grade 6 is close to being significant. A result of significance for class but not for group as discussed above would support the notion that the teacher is an important variable in determining intervention length. However, this does not appear to be the case.

An analysis of variance done to determine if intervention length changed as a function of grade resulted in non-significance. This implied that generally length of intervention was not dependent on the grade.

Table IX shows a significant negative correlation between the number and length of the interventions. The number of interventions had

to be pro-rated because of the varying lengths of each lesson. It would make no sense to try and do a correlation between number and length of interventions, without controlling the variable of the length of the lesson.

One would expect a negative correlation between the number and length of the interventions. If the teacher was involved in long interventions, one would expect fewer interventions to occur. If the teacher was involved in long interventions, and was making interventions as frequently as another teacher who was involved in short interventions, it is possible that the teacher was not distributing herself equally among all groups in the class.

A t-test done to determine if there was a significant difference between student versus teacher initiated interventions resulted in it being non-significant. This means that no matter who initiated the interventions, they tended to be approximately the same length.

Question 2

What is the ratio of teacher initiated to student initiated interventions?

Results

Table XI shows the comparison of student and teacher initiated interventions overall. It can be seen that for each speaker the number of initiated interventions was approximately equal. It must be stressed that for each group there were two students to only one teacher. Thus,

TABLE XI

COMPARISON OF STUDENT VERSUS TEACHER INITIATED INTERVENTIONS

INITIATOR	FREQUENCY	PERCENTAGE
Teacher	74	49.7
Student	75	50.3

on the average, each student initiated only half as many interventions as the teacher.

Question 3

Why are interventions initiated and what is the outcome?

To answer this question it became evident that the same approach could not be followed for interventions of different lengths. Consequently, the interventions were analyzed by considering two intervention lengths, those interventions which were from 1-3 sentences in length; and those that were greater than three sentences in length.

In order to analyze the intervention to determine the outcome of the intervention, a critical incidents technique was employed. This procedure involved searching each intervention, identifying each according to its purpose at successive stages throughout the intervention, and recording the information on file cards. Each intervention of length 1-3 sentences was considered by looking at the initiating move and then the response made to it. Frequency counts were then made of similar types.

To determine the pattern for interventions greater than three sentences, the critical incidents technique was also employed, where each intervention was analyzed and the main changes in the intervention were noted. Because of the varying length of these longer interventions, and the number of changes that occurred in each intervention, it was decided to report this pattern in three phases according to the initial

purpose, purpose at the middle (approximately) of the intervention, and the purpose at the end of the intervention. Even though these three arbitrary positions were chosen, because of the variety of purpose after the initial intervention segment, it was impossible to make frequency counts as was done for the shorter interventions of 1-3 sentences in length.

Results

Table XII shows the pattern of interventions of length 1-3 sentences. The table separates the teacher initiated from the student initiated interventions. It also groups interventions of both types under main headings of Giving; Requesting, and Reacting, with subcategories under each major category. The frequency and percentage of each subcategory is then given. The percentage figures are, of course, unstable because of the very low incidence of certain subcategories.

Table XIII gives the results of the patterns of interventions of length greater than three sentences for teacher and student initiated interventions. It must be realized that because three arbitrary positions were chosen for the longer interventions, there will not be a logical flow. For the shorter interventions of 3-6 sentences, this logical flow of purpose was evident in most cases. For example, for a shorter intervention the initial purpose might be for the teacher to request clarification of phenomena, the purpose in the middle of the intervention would logically be that the student give clarification of the phenomena, with the end purpose having a number of possibilities,

TABLE XII

PATTERN OF INTERVENTIONS OF LENGTH 1-3 SENTENCES

	TYPE OF INTERVENTION	FREQUENCY	PERCENTAGE
TEACHER INITIATED	GIVING instructions related to procedure where the student:		
	(a) accepts instructions without replying	15	60
	(b) gives progress report	2	8
	(c) requests clarification	2	8
	(d) reports data	3	12
	(e) reacts	3	12
	TOTAL GIVING	25	
	REQUESTING		
	(a) observation, followed by student giving observation	2	100
	(b) information of progress followed by:		
	i) no comment by student	4	22
	ii) progress report from student	13	72
	iii) request from student for clarification	1	6
	(c) clarification followed by:		
	i) no comment by student	3	33
	ii) student giving clarification	6	67
	(d) action cognitive followed by student giving ACC	3	100
	(e) individual results followed by:		
	i) no comment by student	2	71
	ii) student giving individual results	5	29
	TOTAL REQUESTING	39	

TABLE XII (Continued)

	TYPE OF INTERVENTION	FREQUENCY	PERCENTAGE
STUDENT INITIATED	GIVING		
	(a) progress report followed by:		
	i) teacher giving procedure	5	50
	ii) teacher requesting clarification	4	40
	iii) teacher correcting student	1	10
	(b) procedure followed by the teacher giving procedure	2	100
	(c) observation followed by:		
	i) no comment from the teacher	6	17
	ii) teacher giving instructions	15	42
	iii) student requesting clarification	10	27
	iv) teacher giving clarification	2	5
	v) teacher reacting positively	3	8
	TOTAL GIVING	48	
	REQUESTING		
	(a) procedure followed by teacher giving procedure	7	100
	(b) clarification followed by:		
	i) teacher giving clarification	9	82
	ii) teacher giving procedure	2	18
	(c) attention of teacher to report results followed by teacher giving procedure	3	100
	TOTAL REQUESTING	21	
	REACTING TO		
	(a) procedure followed by teacher giving procedure	1	100
	(b) apparatus followed by teacher:		
	i) giving procedure	2	67
	ii) requesting report of progress	1	33
	TOTAL REACTING	4	

TABLE XIII

PATTERN OF INTERVENTIONS OF LENGTH > 3 SENTENCES

TEACHER INITIATED

INITIAL (1-3)	MIDDLE	END (last 3)
1. (i) Teacher GIVES procedure	Student reacts to instructions	Teacher gives procedure
	S reports progress	T gives procedure
	S reports data	T reacts positively
2. Teacher REQUESTS (i) information on progress	S gives action cognitive when requested	T gives explanation
	S reports progress	T gives instructions
	S reports progress	T gives clarification of results
	S reports progress	T requests clarification
	S gives progress	T gives explanation
	S gives progress	T gives direction
	S gives progress	T gives clarification
(ii) observation	S gives observation	T gives procedure
(iii) clarification of phenomena	S gives clarification	T gives procedure
(iv) individual results	S gives individual results	T gives procedure
	S gives individual results	T gives procedure
	S gives clarification of individual results	T gives procedure

TABLE XIII (Continued)

STUDENT INITIATED

INITIAL (1-3)	MIDDLE	END (last 3)
1. Student GIVES: (i) procedure	T corrects procedure	S makes observation
(ii) progress report		T corrects student
	S reports observation	T gives procedure
	T gives procedure	T requests action cognitive
	S gives clarification	T requests action cognitive
(iii) observation	T gives instruction	S follows instruction
	T requests action cognitive	S gives procedure
		T gives procedure
	S gives clarification	T gives procedure
		T gives procedure
	S requests clarification	T gives clarification
	S gives clarification	T gives procedure
	T gives clarification	T gives procedure
	S requests apparatus	T gives procedure
	T requests clarification	T gives clarification
	T requests observation	T gives procedure
		T gives procedure
		T gives procedure
(iv) individual results	T requests clarification	T gives procedure
2. Student REQUESTS: (i) procedure	T gives procedure, followed by S requesting clarification	T gives procedure
		T gives procedure
	S reports progress	T gives procedure
	T requests ACC- S gives ACC	T gives procedure
(ii) attention to apparatus; recording equipment	T requests procedure	S gives clarification
	T requests clarification	T gives procedure
(iii) clarification of: apparatus procedure		T gives clarification
		T gives clarification
3. Student REACTS to: (i) apparatus:		T requests progress report

one of which could be the teacher giving further instructions. However, for the longer interventions, where the purposes changed in some cases as much as seven or eight times, when one chose the initial, middle and end purposes, some of the logical flow was lost, and cannot be seen from the table. For example, one intervention of length 25 sentences began with the student giving an observation, the teacher requesting clarification, the student giving the clarification, the student requesting apparatus, and ended with the teacher giving procedure. By analyzing only the beginning, middle, and end of this intervention, this intervention would be recorded in the table as the student giving an observation, the student requesting apparatus, and the teacher giving procedure. It can readily be seen that the table is not all inclusive. However, to report each intervention in detail would be very laborious and cumbersome.

Discussion

Tables XII and XIII are included to give the reader as close an idea of what went on during the interventions as is possible, without the reader having to read all of the interventions. The percentages of the various types of interventions must be considered with caution, because of the very low frequency within the various categories. These tables are best used as descriptive of the interventions that occurred in this study.

When comparing the number of student initiated to teacher initiated interventions for the longer interventions, it can be readily seen that students initiated these longer interventions more than did teachers.

For both speakers the initial part of the intervention can be for any of the following reasons: to Give, Request, or React. During the middle of the intervention there were many possible types of statements being made by either student or teacher. At the end of these longer interventions it is interesting to note that there was a more systematic statement made, where usually the teacher made procedural statements. It appeared that no matter who initiated the intervention, why the intervention was initiated, or what went on during the intervention, at the end of the intervention the teacher usually tried to get the students back to work again, to get them back to the problem at hand by making a procedural statement.

Question 4

What types of interventions occur, and what is the frequency of occurrence of each type?

This question relates closely to question 3 discussed previously. In question 3 the main concern was the specific reasons why interventions were initiated and the outcome of these interventions. Question 4 is confined to trying to place these specific interventions into general patterns.

In order to analyze the question related to the frequency of the varying types of interventions that occurred, the critical incidents technique was employed, as described for question 3. This was necessary because of the complexity of the interaction analysis instrument, and because the total number of possible combinations of

codes was so great. Consequently, each intervention was searched, classified according to the main type, and placed on index cards. The major types of interventions were then delineated, and frequency counts made.

Results

Table XIV gives the frequency and percentage of occurrence of each intervention type. Each intervention can be classified broadly as teacher initiated or student initiated for a particular purpose. As discussed earlier for question 3, once past the initiating sentence, the purpose of the intervention can be realized or changed several times depending on the length of the intervention.

Discussion

The types of intervention have been divided into three main categories: Giving, Requesting, and Reacting. Again, the frequency counts must be treated with caution, because of the low incidence of categories. Keeping this limitation in mind, it is interesting to analyze the percentage occurrence of some of the types of interventions.

Of the total number of teacher initiated interventions for the purpose of Giving, 32% were spent giving procedure to students. Of the teacher initiated interventions for the purpose of Requesting, 24% were spent by the teacher trying to obtain information regarding progress. For the student initiated interventions for the purpose of Giving, 61% involved giving observations or giving a progress report, while 14% involved requesting clarification.

TABLE XIV

FREQUENCY AND PERCENTAGE OF OCCURRENCE OF EACH INTERVENTION TYPE

	TYPE OF INTERVENTION	FREQUENCY	PERCENTAGE
TEACHER INITIATED INTERVENTIONS	GIVING instructions related to (i) procedure (ii) forming groups (iii) sharing equipment (iv) clean-up	 25 3 3 2	
	TOTAL -- GIVING	33	22
	REQUESTING (i) observations (ii) information regarding progress (iii) clarification (iv) action cognitive (v) individual results (vi) apparatus	2 18 9 3 7 1	
	TOTAL -- REQUESTING	40	27
	REACTING TO (i) procedure	1	
	TOTAL -- REACTING	1	1
	TOTAL -- TEACHER INITIATED INTERVENTIONS	74	49.7
STUDENT INITIATED INTERVENTIONS	GIVING (i) progress reports (ii) procedure (iii) observation	10 2 36	
	TOTAL -- GIVING	48	32
	REQUESTING (i) procedure (ii) clarification (iii) attention to report individual results	8 11 4	
	TOTAL -- REQUESTING	23	16
	REACTING TO (i) procedure (ii) apparatus	1 3	
	TOTAL -- REACTING	4	2
	TOTAL -- STUDENT INITIATED INTERVENTIONS	75	50.3

It seems then that for this study the teacher intervened in a group mainly to give direction regarding procedure, or to ask the students how their work was progressing. The student initiated the intervention to report his observations from the activity at hand, or to tell the teacher how his work was progressing.

In comparing student and teacher interventions initiated for the purpose of Giving, it can be seen that there were 32% of student initiated interventions compared with 22% of teacher initiated interventions. In comparing interventions initiated for the purpose of Requesting, there were 16% of the student initiated interventions for this purpose compared with 27% of teacher initiated interventions for the same purpose. Interventions initiated for Reacting for both students and teachers were extremely low, with students initiating 2% of all interventions for this purpose, compared with 1% for teacher initiated interventions.

It is interesting to note that the students initiated interventions more than did the teacher for the purpose of Giving. Also, the teacher Requested more often than did the student.

Question 5

What patterns of teacher and student moves, substantive-logical, controlling, reference, and rating behavior occur?

Results for Pedagogical Move

Table XV gives the percentage of moves made by the teacher

TABLE XV

PERCENTAGE OF MOVES MADE BY TEACHERS AND STUDENTS BY GROUP, CLASS AND GRADE

	TEACHER	GROUP	PERCENTAGE OF TEACHER MOVES	PERCENTAGE OF STUDENT MOVES
	1	1	43.5	56.5
		2	54.5	45.5
MEAN - CLASS 1			49.0	51.0
	2	1	46.2	53.8
		2	57.8	42.2
MEAN - CLASS 2			52.0	48.0
	3	1	51.2	48.8
		2	58.0	42.0
MEAN - CLASS 3			54.6	45.4
	4	1	69.0	31.0
		2	50.0	50.0
MEAN - CLASS 4			59.5	40.5
	5	1	46.2	53.8
		2	57.5	42.5
MEAN - CLASS 5			51.8	48.1
MEAN - GRADE 2			53.2	46.6
	6	1	46.2	53.8
		2	40.0	60.0
MEAN - CLASS 6			43.1	56.9
	7	1	60.0	40.0
		2	71.9	28.1
MEAN - CLASS 7			65.9	34.0
MEAN - GRADE 4			56.2	43.8
	8	1	51.9	48.1
		2	54.7	45.3
MEAN - CLASS 8			53.3	46.7
	9	1	56.8	42.2
		2	52.9	47.1
MEAN - CLASS 9			54.8	44.6
CLASS 10	10	1	69.3	28.3
MEAN - GRADE 6			60.3	39.7

and students by group, class, and grade, as well as the mean percentage of moves by grade.

Table XVI gives the frequency of occurrence of the four moves for teachers and students that occur overall. A chi-square test resulted in a X^2 value of 192.47, d.f. = 4, with an associated probability ($p < .001$).

Discussion for Pedagogical Move

From Table XV it can be seen that for grade 2, in four of the five classes, the speaker (either teacher or student) who had the greater percentage of moves varied from group to group within a class. If the initiation was controlled by the teacher, it is fair to assume that the percentage of moves would be highest for both groups within the same class. The percentage of teacher moves was higher for both groups in a class in only one instance. This implies that the teacher in that particular class talked more than the students.

For grade 4, in one class the teacher made more moves than either group of students, while in the other class the teacher made fewer moves than either group of students.

For grade 6, in all groups for all classes the teacher made a higher percentage of moves than the students.

In four out of five grade 2 classes, the percentage of moves made by the teacher was greater than by the students. For grade 4, one class had a higher percentage of moves made by the teacher, while another class had the higher percentage of moves made by the students.

TABLE XVI

PATTERN OF MOVES OVERALL

	STRUCTURE	SOLICIT	RESPONSE	REACT	NOT CODABLE	TOTAL
TEACHER	93	351	61	119	2	626
STUDENT	22	153	199	96	15	485

$X^2 = 192.47$, d.f. = 4, $p < .001$. Significant.

For grade 6, in all classes the teacher made more moves than did the students.

It might be assumed that the amount of time spent talking, as determined from the number of moves made, is dependent on the characteristics of the teacher and the group. A teacher who tended to talk a great deal would make a greater number of moves than either group within a class. If the students in the groups were extraverted, they could possibly talk more and thus have a greater percentage of moves than the teacher.

Overall the teacher made more moves than the students during the interventions. There is not, however, a great discrepancy between the two. This table also shows that the number of teacher moves increased with an increase in grade. Because of the reciprocal relationship between teacher and student moves, the number of student moves must decrease with grade, given an increase in the number of teacher moves.

Table XVI shows that the teacher and student moves followed a clear pattern. The most common move made by the teacher was soliciting, while for the students both soliciting and responding occurred to a similar degree. A further analysis showed that this move was most common for all of the groups in grade 2, three of the four groups in grade 4, and four of the five groups in grade 6.

While the most common move for the students was not as obvious as for the teachers, the majority move made was responding. This is to

be expected, since the reciprocal of a solicit move is a response. It appeared that overall, the teacher was soliciting for the majority of cases, while the student was responding. However, many fewer student responses than teacher solicits occurred. This indicates that many solicits by the teacher went unresponded (or else were responded to by physical action and thus not recorded).

Results for Substantive Logical

Table XVII gives the percentage of substantive logical statements for teachers and students for each group and grade.

Table XVIII gives the pattern of substantive logical statements. A chi-square test resulted in a X^2 value of 2.439, d.f. 1, with an associated probability ($p > .05$).

Discussion for Substantive Logical

From Table XVII it can be seen that for grade 2, in four of five classes, the percentage of substantive logical statements varied from one group to another within a class. In grade 4, one of the classes had high variability between groups, for both teacher and student statements containing substantive logical meaning. In grade 6, there was not a great deal of variability between groups for any class when considering the teacher statements containing substantive logical meaning. The variability between groups of the same class becomes much more pronounced when considering the student statements containing substantive logical meaning.

Table XVII also shows that for both the teacher and students,

TABLE XVII

PERCENTAGE OF SUBSTANTIVE LOGICAL STATEMENTS FOR TEACHERS AND STUDENTS FOR EACH GROUP AND GRADE

	TEACHER	GROUP	PERCENT SUBSTANTIVE LOGICAL FOR STUDENT	PERCENT SUBSTANTIVE LOGICAL FOR TEACHER
	1	1	40	37
		2	40	33
	2	1	40	40
		2	47	50
	3	1	29	35
		2	62	59
	4	1	53	58
		2	27	44
	5	1	43	50
		2	33	35
MEAN-GRADE 2			39.5	43.5
	6	1	86	33
		2	87	83
	7	1	50	0
		2	11	0
MEAN-GRADE 4			64.1	24.0
	8	1	19	50
		2	42	59
	9	1	16	31
		2	42	41
	10	1	51	51
MEAN-GRADE 6			30.3	45.9

less than half of all of the statements made by each speaker during the interventions contained substantive logical meaning. This might be expected when one considers the reasons why interventions are initiated. As discussed in question 3, quite a number of interventions were initiated by the teacher to give procedural statements, and initiated by the students to report progress. Both types of interventions typically result in statements containing no substantive logical meaning.

The proportion of teacher statements containing substantive logical meaning is low for grade 4 comparative to the other grades. At the same time, the number of substantive logical statements made by the students is higher than in any of the other grades. The reason for this trend is not obvious and suggests a need for further investigation.

From Table XVIII it can be seen that there was no significant difference between the teacher and student with respect to the statements that they made containing substantive logical meaning. This could be accounted for partially because of the reasons why the interventions were initiated as discussed earlier.

Results for Gives/Requests/Commands

Table XIX gives the percentage of teacher and student discourse spent on the subcategories of 'Give, Requests, Commands' for group, class, and grade. This table should be read with caution, considering the low numbers in some of the cells.

TABLE XVIII

PATTERN OF SUBSTANTIVE LOGICAL STATEMENTS

	NO SUBSTANTIVE LOGICAL	SUBSTANTIVE LOGICAL
TEACHER	357	269
STUDENT	300	185

$X^2 = 2.439$, d.f. = 1, p = .12, Not significant.

TABLE XIX

PERCENTAGE OF TEACHER AND STUDENT DISCOURSE SPENT ON THE SUBCATEGORIES OF 'GIVES', 'REQUESTS', 'COMMANDS' FOR GROUP, CLASS, AND GRADE

GRADE	TEACHER	GROUP	TEACHER DISCOURSE			STUDENT DISCOURSE		
			GIV	REQ	COM	GIV	REQ	COM
2	1	1	14.8	37.0	37.0	28.6	5.7	22.9
		2	12.5	41.7	25.0	20.0	0.0	40.0
2	2	1	23.3	40.0	16.7	45.7	5.7	14.3
		2	3.8	42.3	26.9	26.3	15.8	26.3
2	3	1	23.3	44.2	30.2	48.8	12.2	12.2
		2	27.6	48.3	13.8	47.6	4.8	9.5
2	4	1	22.5	45.0	7.5	52.9	5.9	5.9
		2	11.1	66.7	11.1	50.0	0.0	11.5
2	5	1	11.1	55.6	11.1	47.6	14.3	14.3
		2	19.6	50.0	8.7	69.7	6.1	12.1
TOTAL			16.9	47.1	18.8	43.7	7.1	16.9
4	6	1	50.0	0.0	33.3	28.6	28.6	42.9
		2	33.3	58.3	8.2	26.7	26.7	20.0
4	7	1	0.0	33.3	66.7	16.7	33.3	0.0
		2	17.4	17.4	39.1	33.3	11.1	11.1
TOTAL			25.1	27.3	36.8	26.3	24.9	18.5
6	8	1	53.6	21.4	10.7	23.1	15.4	7.7
		2	48.3	17.2	17.2	25.0	41.7	20.8
6	9	1	0.0	0.0	100.0	49.3	13.4	25.4
		2	37.0	7.4	40.7	12.5	20.8	29.2
6	10	1	32.2	31.3	11.3	57.4	12.8	14.9
TOTAL			34.2	15.5	18.0	33.4	20.8	19.6

Table XX gives the pattern of teacher and student discourse on the subcategories of 'Give, Requests, Commands' for the total number of interventions. A chi-square test resulted in a X^2 value of 58.880, d.f. = 2, $p < .001$. Table XX also gives the pattern of teacher and student discourse spent on the subcategories of 'Give, Requests, Commands' for each grade level. Chi-square tests resulted in X^2 values of 113.1300, d.f. = 2, $p < .001$; 2.9323; d.f. = 2, $p = .23$; .1185, d.f. = 2, $p = .94$ for grades 2, 4, and 6 respectively.

Discussion for Gives, Requests, Commands

From Table XIX it can be seen that for grade 2, the greater percentage of the three subcategories for teacher discourse fell in the Request subcategory. This trend became more varied for the grade 4 level. At this grade level, the majority of the subcategories varied from group to group and from class to class. For the grade 6 level, the highest proportion of the subcategories is distributed between the Gives and Commands subcategories.

For student discourse, at the grade 2 level, the greater percentage of the student discourse fell in the Gives subcategory. Again, as in the case of the teacher discourse, the higher proportion of the subcategories became more varied with the higher grades.

Table XX shows that overall, the teachers made more Requests than any other of the subcategories, while the students made more Give statements. The difference between the teacher and student discourse was significant at the .05 level of significance. This trend is what

TABLE XX

PATTERN OF TEACHER AND STUDENT DISCOURSE SPENT ON THE SUBCATEGORIES OF 'GIVES', 'REQUESTS', 'COMMANDS' FOR GRADES 2, 4 AND 6 AND OVERALL

GRADE	SPEAKER	GIVES	REQUESTS	COMMANDS	X^2	PROB.	SIGNIFICANCE
2	TEACHER	56	145	57	113.1300	.001	S
	STUDENT	121	19	44			
4	TEACHER	11	14	18	2.9323	0.2308	N.S.
	STUDENT	12	9	7			
6	TEACHER	109	58	49	.1185	0.9425	N.S.
	STUDENT	59	34	26			
TOTAL	TEACHER	176	217	124	59.880	< .001	S
TOTAL	STUDENT	192	62	77			

one would expect, since there is a reciprocal relationship between the teacher and student discourse. If the majority of the teacher discourse was Requesting, it can generally be expected that the majority of student discourse would be Giving. This pattern also followed the pattern outlined for the moves dimension. The majority of teacher moves was soliciting, and the majority of student moves was responding. It follows logically that the teacher in most cases would Request when soliciting, and that the student in most cases would Give when responding. Table XX also shows that on further analysis of the pattern of Gives, Requests, Commands for grade level, only at the grade 2 level did the pattern between teacher and student discourse differ significantly. The reason for this is not clear and requires further research.

Results for Reference

Table XXI gives the pattern of References made by teachers and students for the total number of interventions. A chi square test resulted in significance. Cells with less than 15 cases were deleted from the analysis.

Table XXI also gives the pattern of References made by teachers and students by grade. Chi square tests resulted in significant results for grade 4 only. Cells with less than 15 cases were deleted from the analysis.

Discussion for Reference

It can be seen from Table XXI that when considering the overall interventions, there is a relationship between the speaker and

TABLE XXI

PATTERN OF REFERENCES MADE BY TEACHERS AND STUDENTS BY GRADE AND OVERALL

GRADE	SPEAKER	PRC	ACT	ACV	ACC	APP	IND	EXP	PHE	X^2	d.f.	PROB.	SIGNIFICANCE
2	TEACHER	22	4	17	17	157	36	21	17	13.75	7	> .05	N.S.
	STUDENT	10	3	4	13	98	30	16	30				
4	TEACHER	8	7	3	1	18	3	0	0	22.63	7	< .05	S.
	STUDENT	2	1	0	1	12	14	0	4				
6	TEACHER	17	33	6	23	136	16	0	4	8.91	7	> .05	N.S.
	STUDENT	15	9	3	8	77	17	0	2				
TOTAL	TEACHER	47	44	26	41	311	55	21	21	34.87	7	< .001	S.
TOTAL	STUDENT	27	13	7	22	187	61	16	36				

the references made. Both the teacher and the students made reference to apparatus more than any other subcategory. The subcategory of next highest incidence was reference to individual results.

The teachers made more reference to apparatus than did the students. There was a relatively high incidence of reference to individual results during the interventions by the students. Also, students made reference to phenomena fairly often.

It is interesting to note the relatively low frequency of action cognitive by both the teachers and students. This subcategory included those statements made of a cognitive nature, such as "just think about it" or "why do you think this happens?" Again, this seems consistent with the interpretation that procedural concerns override other concerns in the classroom.

Table XXI also shows that there was a relationship between the speaker and the Reference for grade 4 only. The reason for this result is not obvious and requires further research.

Worthy of note is the increase in the frequency of action cognitive reference by the teacher at the grade 6 level. Such evidence could mean that the teachers at the higher elementary level tended to "force" the students to think to a greater degree about what they were doing. This generalization is made being aware of the limited data available in this study, and thus the need for further research.

In addition to making reference to apparatus for a great deal of the time, students also tended to make reference to individual

results and phenomena. This is to be expected since in many cases the students initiated interventions to report what they had found, or what they were seeing, and the teacher initiated the interventions to request from the students what they had found out or were observing.

Results for Rating

Table XXII gives the overall pattern of rating by teachers and students for the interventions. A chi square test resulted in $X^2 = 31.30$, d.f. = 3, $p < .001$.

Discussion of Rating

Table XXII shows that most of the statements made by the teacher and students were not of a rating natdre. This is to be expected since many of the statements made during an intervention were routine procedural statements and thus did not require a rating. Teachers tended to rate less than students and to be more diverse in their rating. This is contrary to what one might expect since the traditional role of the teacher would place him in a role of authority, having the power to rate the student discourse. Often during laboratory activities the student initiates an intervention to report progress, observations, or individual results, fully expecting the teacher to rate his performance.

Of those statements which were rated, the majority of the ratings made by both teachers and students were either positive or negative. The incidence of positive and negative rating by the teacher can give some valuable information on the teacher. A high

TABLE XXII

PATTERN OF RATING BY TEACHERS AND STUDENTS FOR THE TOTAL INTERVENTIONS

	POS	QAL	RPT	NEG	TOTAL RATING
TEACHER	43	15	28	28	114
STUDENT	62	5	5	52	124

$X^2 = 31.30$, d.f. = 3, $p < .001$. Significant.

proportion of negative rating as compared to positive rating might indicate that a teacher is giving continuous negative reinforcement to students. The implications of such a practice in terms of learning theory are obvious.

A breakdown of student and teacher ratings by grade was not practical because of the low numbers in each cell.

Results for Question 5

Chi Square analyses showed that:

(1) For the Moves dimension, there was a relationship between the speaker and the type of move made. The teacher tended to solicit while the students tended to respond. There were many more teacher solicits than student responses, which implies that many solicits by the teacher went unattended (or were responded to by a physical action). Student solicits and responses were fairly evenly distributed.

(2) In general, less than half of all statements had substantive-logical meaning. There was no relationship between the speaker and whether or not statements made had substantive logical meaning.

(3) For the Gives, Requests, Commands dimension, there was a relationship between the speaker and the subcategories used. Teachers tended to request more, and students tended to give more. This is consistent with the solicit-response pattern already noted.

(4) For the Reference dimension, there was a relationship between the speaker and the reference made by the speaker. Both the teacher and the students made reference to apparatus more than any other subcategory. The teacher made more reference to apparatus than did students. There was a realtively high incidence of reference to individual results by the students during the interventions.

(5) Most of the statements made by the teacher and students were not of a rating nature. Teachers tended to rate less than students and to be more diverse in their rating. Of the ratings made by teachers and students, the majority were either positive or negative.

Question 6

How do the student characteristics of IQ, extraversion, neuroticism, and self-concept affect the student behavior variables of proportion of sentences, solicits, responses, requests, and commands made?

An attempt was made to determine if the student variables of IQ, extraversion, neuroticism, and self-concept determined student behaviors during the interventions. The student behavior variables of proportion of sentences made, the proportion of solicits, responses, requests, and commands were chosen, since these variables appeared to be important behaviors which occurred during the interventions.

Because a correlational analysis between these two sets of variables resulted in little light being shed on the pattern of

relationships between student characteristics and student behaviors, it was decided to explore further to find out how the student behaviors outside the interventions compared with the same student behaviors during the interventions.

Findings

Table XXIII shows the correlation of student characteristic variables with student behavior variables during the interventions.

Table XXIV shows the correlation of student behavior variables overall with student behavior variables during the interventions.

Table XXV shows a comparison of the means and standard deviations of proportions, and student behaviors for the four characteristics analyzed overall and during the interventions.

Discussion

From Table XXIII it can be seen that there was little correlation between the student characteristics of IQ, extraversion, neuroticism, and self-concept, and student behavior variables of proportion of sentences spoken, proportion of solicits, responses, requests, and commands, which occurred during the interventions. The correlation between extraversion and the proportion of sentences spoken during the intervention was significant. It might be expected that a student who scored highly on extraversion would speak a high proportion of the sentences. A regression analysis was run to predict the variables of proportion of sentences made during the interventions

TABLE XXIII

CORRELATION OF STUDENT CHARACTERISTIC VARIABLES WITH STUDENT BEHAVIOR VARIABLES DURING THE INTERVENTIONS

STUDENT CHARACTERISTICS	STUDENT BEHAVIORS DURING INTERVENTIONS				
	PROPORTION OF SENTENCES	PROPORTION OF SOLICIT	PROPORTION OF RESPONSE	PROPORTION OF REQUEST	PROPORTION OF COMMAND
IQ	0.074	0.090	-0.076	0.104	0.048
Extraversion	0.405	0.081	-0.490	0.371	0.059
Neuroticism	0.072	-0.027	-0.035	-0.000	0.007
Self-Concept	0.269	0.037	0.089	-0.087	0.103

TABLE XXIV

CORRELATION OF STUDENT BEHAVIOR VARIABLES OVERALL WITH STUDENT BEHAVIOR VARIABLES DURING THE INTERVENTIONS

STUDENT BEHAVIORS OVERALL	STUDENT BEHAVIORS DURING INTERVENTIONS				
	PROPORTION OF SENTENCES	PROPORTION OF SOLICIT	PROPORTION OF RESPONSE	PROPORTION OF REQUEST	PROPORTION OF COMMAND
Proportion of Sentences	0.656*	-0.172	-0.030	-0.176	-0.316
Proportion of Solicit	-0.205	0.212	-0.075	0.195	-0.051
Proportion of Response	0.147	0.287	-0.548	-0.018	0.529
Proportion of Request	-0.353	0.589*	-0.348	0.567*	0.313
Proportion of Command	0.017	0.036	0.025	0.019	-0.276

* significant at the .05 level.

TABLE XXV

MEAN AND STANDARD DEVIATION OF PROPORTIONS OF SOLICITS AND RESPONSES OUTSIDE AND DURING THE INTERVENTIONS

	STUDENT BEHAVIOR VARIABLES	MEAN PROPORTION	STANDARD DEVIATION	CASES
OVERALL	SOLICIT	34.50	10.15	38
	RESPONSE	10.95	6.28	38
INTERVENTION	SOLICIT	33.91	18.32	32
	RESPONSE	41.31	17.64	32
OVERALL	REQUEST	8.73	5.34	37
	COMMAND	22.50	7.92	38
INTERVENTION	REQUEST	19.09	13.99	23
	COMMAND	20.63	11.92	30

from the student characteristic variables and the student behavior variables overall. This resulted in a $F = 3.831$, d.f. = 1.14, $p > .05$ and thus was not significant. This means that extraversion, in the presence of the other predictor variables, was not a good predictor of the proportion of sentences made by the students during the interventions. This result means that at best the extraversion variable was marginally useful as a predictor of the proportion of sentences made during the interventions.

A multiple linear regression analysis was done which treated the student behavior variable of proportion of sentences uttered during the intervention as the criterion variable and the five student behavior variables overall and four student characteristic variables as predictor variables. This analysis resulted in the overall $F = 5.3603$, d.f. 9,14, $p < .001$. This means that all of the predictor variables together were useful in predicting the student behavior variable of proportion of sentences made. A further breakdown, however, showed that each of the predictor variables in themselves were not good predictors of the criterion variable.

The same analysis was made using each of the following as criterion variables in turn: the proportion of solicits; the proportion of responses; the proportion of requests; and the proportion of commands. The same variables as outlined above were used as predictor variables. These analyses resulted in no significant difference for each criterion variable. That is, all of the predictor variables together were not useful predictors of each of the student behavior variables under analysis.

The results of the analysis done to determine if student characteristics determine student behavior variables during the interventions showed that with the exception of neuroticism and the proportion of sentences made during the interventions, all other characteristics were not related to the student behaviors which occurred during the interventions.

A correlation was also computed between the student behavior variables of proportion of sentences, the proportion of solicits, responses, requests, and commands made during the intervention, and the same student behavior variables which occurred overall.

Table XXIV shows that there was a significantly positive correlation ($p < .05$) between the proportion of sentences spoken by a student overall, and the proportion of sentences spoken during the interventions. Such a result is to be expected. There was also a significantly positive correlation between the proportion of requests made overall, and the proportion of solicits made during the interventions. Results also indicated that there was a significantly positive correlation between the proportion of requests made overall and the proportion of requests made during the interventions. It might be expected that if a student made a high proportion of requests during the overall lesson, then he will make a high proportion of requests during the interventions.

Despite the significant correlations discussed, multiple linear regression analysis, using the student behavior variables during

the interventions as criterion variables, and student behavior variables overall together with student characteristic variables as predictor variables, resulted in no significant differences for those correlations discussed above. It appears that those correlations which were significant when considered alone, were at best only marginally significant.

By comparing some of the student behavior variables overall with the same student behavior variables during the interventions (Table XXV), it can be seen that the pattern of solicit-response overall changed compared to the pattern of solicit-response during the interventions. Also, the pattern of request-command overall differed from the pattern of request-command during the interventions. Both of these observations give evidence to support the notion that the behavior of the students changed dramatically when the teacher was present.

Summary

In considering intervention length and number, the results indicated that overall the length of the interventions was relatively short, and the number of interventions was relatively low. These results were not surprising when one considers the number of other groups that the teacher had to cope with in the classes under analysis.

T-tests done on groups within a class resulted in no significant difference between groups within a class for intervention length. An analysis of variance resulted in a significant difference between classes

within grade 2 only, with respect to intervention length, with grades 4 and 6 being non-significant. It appears then that intervention length was not dependent on class. An analysis of variance also resulted in no significant difference between grades with respect to intervention length.

Intervention length and number showed a significant negative correlation. Lessons which had long interventions had fewer interventions.

Results indicated that, overall, teachers and students initiated interventions approximately an equal number of times. An analysis of intervention length resulted in no significant difference in the length of teacher versus student initiated interventions.

Interventions were initiated by teachers and students for a variety of purposes (Tables XII, XIII). For both speakers, the initial reason for the intervention was to Give, Request, or React. What was being given, requested, or reacted to, varied widely from one intervention to another. At the end of the longer interventions a more systematic statement was made, where usually the teacher made procedural statements. Also, students initiated more of the longer interventions than did the teachers.

In this study the teachers intervened in a group mainly to give direction regarding procedure, or to ask the students how their work was progressing. The students generally initiated the intervention to report their observations from the activity at hand, or to tell

the teacher how their work was progressing. The teachers requested more often than did the students. There were very few incidences of Reacting by either students or teachers.

An attempt was made to determine whether a relationship existed between speaker (teacher or student) and the dimensions of: Moves; Substantive Logical; Gives, Requests, Commands; Reference; and Rating.

Results showed that there was a relationship between the speaker and:

(i) the type of pedagogical move, where teachers tended to solicit while students tended to respond.

(ii) the Gives, Requests, Commands dimension, where teachers tended to request more, and students tended to give more.

(iii) the Reference dimension, where both teachers and students tended to make reference to apparatus and individual results to a fair degree.

(iv) the Rating dimension, where both teachers and students rated either positively or negatively in the majority of cases.

Results showed that there was no relationship between speaker and whether or not the sentences uttered contained substantive-logical content.

Correlations were computed between the student characteristics of IQ, extraversion, neuroticism and self-concept and the student behavior variables of proportion of sentences, solicits, responses, requests, and

commands which occurred during the interventions. Results indicated that there was very little correlation between the two sets of variables. The extraversion variable did correlate significantly with the proportion of sentences uttered, as would be expected.

An analysis of the student behavior variables of proportion of sentences, solicits, responses, requests, and commands made during the interventions and the same student behavior variables overall resulted in significance for the following variables: the proportion of sentences spoken overall correlated positively with the proportion of sentences spoken during the interventions; the proportion of requests made by a student overall correlated positively with the proportion of solicits made during the interventions; and the proportion of requests made overall correlated positively with the proportion of requests made during the interventions.

A comparison of some of the student behavior variables overall with the same student behavior variables during the interventions resulted in a change in pattern for the following: the proportion of solicit-responses made, and the proportion of requests-commands made. Both patterns changed which supported the notion that behavior of the students changed when the teacher was present.

CHAPTER 5

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

I. Summary

This study was designed to analyze teacher interventions in laboratory groups of elementary school students. The study attempted to find information on the number and length of interventions, who initiated the interventions and for what reason, and to ascertain the outcome of the interventions. These variables were considered overall, and by group, class, and grade where possible. Student variables of IQ, self-concept, extraversion, and neuroticism were analyzed to see if there was a relationship between student characteristics and the student behavior variables of proportion of sentences, solicits, responses, requests, and commands which occurred during the interventions. These same student behavior variables were also correlated overall and for the interventions only.

Research Design

Data were collected from grades 2, 4, and 6 classes of elementary school students, a total of ten classes. Two pairs of students from each class were recorded using two independently operated videotape recorders and cameras.

The lessons chosen for taping were taken from the Elementary Science Curriculum Study developed by Crocker (1973). This is an activity program, having as one of its main objectives the development of science processes. The lessons chosen consisted of such topics as

balancing, floating and sinking, density, and the pendulum.

Throughout the activity, the teacher circulated among the students, discussing the activity with various groups of students.

After the videotaping was completed, the students were administered the Junior Eysenck Personality Inventory, a Self-Concept questionnaire, and the Raven Colored Progressive Matrices, Sets A, Ab, B, designed to measure IQ.

After the collection of all data, typed transcripts were prepared, and then this investigator along with two other people coded all transcripts. The coded data were then placed on a computer disk file and the sections related to teacher interventions were isolated and analyzed.

Descriptive statistics such as the mean and standard deviation were computed on intervention length and number. T-tests were computed to determine if intervention length was a function of groups within a class. Analyses of variance were done to determine if intervention length was a function of class and grade. Chi square tests were computed to determine if a relationship existed between speaker and the dimensions of move, substantive logical, controlling, reference, and rating. Correlations were computed between the student characteristics of IQ, extraversion, neuroticism, and self-concept, and the student behavior variables of proportion of sentences, solicits, responses, requests, and commands which occurred during the interventions. Correlations were also computed between the student behavior variables given above and for-

the same student behavior variables which occurred overall. Multiple linear regression was used using the student behavior variables which occurred during the intervention as the criterion variables, and the same student behavior variables which occurred overall, together with the student characteristics as predictor variables:

Findings

In considering intervention length and number, the results indicated that overall the length of the interventions was relatively short, and the number of interventions was generally low.

There was no significant difference between (i) groups within a class, (ii) classes, or (iii) grades, with respect to intervention length. Intervention length was, however, significantly negatively correlated with the number of interventions. Those lessons having longer interventions also had fewer of them.

Overall, teachers and students initiated about an equal number of interventions, although the interventions were initiated for different reasons. Teachers intervened mainly to give directions regarding procedure, or to solicit progress reports. Students generally initiated interventions to report observations or to give a progress report. Teachers requested more often than did students. Both teachers and students did very little reacting.

The coding system consisted of the following dimensions: Speaker; Lesson Phase; Pedagogical Move; Substantive-logical;

Controlling; Type of Reference; Ratings; and Physical Action. For a more detailed description see the Appendix.

There were significant relationships between speaker and the dimensions of: Move; Gives, Requests, Commands; Reference; and Rating. Teachers tended to solicit whereas students tended to respond. Teachers tended to request more, and students tended to give more. Both teachers and students tended to make reference to apparatus and individual results, and both rated either positively or negatively in the majority of cases.

There was no significant relationship between speaker and the substantive logical dimension.

Only the student characteristic of neuroticism correlated significantly positive with the student behavior variables of the proportion of sentences spoken during the intervention. There was not a significant correlation between any of the other student characteristics and the student behavior variables which occurred during the interventions.

A comparison of student behavior variables overall with the same variables during the intervention resulted in significance for the following variables: (1) the proportion of sentences spoken overall correlated positively with the proportion of sentences spoken during the interventions; (2) the proportion of requests made overall correlated positively with the proportion of solicits made during the interventions; and (3) the proportion of requests made overall correlated positively with the proportion of requests made during the interventions.

A comparison of some of the student behavior variables overall with the student behavior variables during the interventions resulted in a change in the pattern of proportion of solicits-responses, and the proportion of requests-commands.

II. Conclusions

As mentioned in Chapter 1 in the Background to the Study section, this study was designed to provide any type of descriptive information that might be discernible on teacher interventions in laboratory groups in science. While information did exist on small group interaction, as discussed in Chapter 2, virtually no information existed on interventions in laboratory groups in science. Because of the limited sample size, and since most of the data used in this study was collected initially for the purpose of developing an interaction analysis instrument, generalizations of the findings of this study are questionable. The conclusions to be reported must be considered with caution. The findings are best viewed as sources of hypotheses which should be tested using larger and more representative samples.

The following conclusions were drawn considering the above limitations:

1. During science laboratory activities, intervention length and number will be kept to a minimum. This is probably due to the fact that teachers generally have many groups to deal with, so that the time spent with any one group will be limited.

2. For science activity sessions, intervention length and number will be negatively correlated. Therefore, if intervention length is long, there will be fewer interventions and conversely, more interventions will lead to shorter ones. While the conclusion appears trivial, it does give further support to the notion that time is a problem in these classes.

3. Intervention length is not dependent on groups within a class, classes within a grade, or grades.

4. Teachers and students generally initiate interventions approximately to the same degree, although for different reasons. Teachers tend to initiate interventions to give procedures and to solicit progress reports. Students tend to report observations or give progress reports. Both teachers and students do little reacting.

5. Generally, it can be expected that there will be a relationship between the speaker and the dimensions of: Move; Gives, Requests, Commands; Reference; and Rating. During science laboratory activities teachers will tend to solicit whereas students will tend to respond. Teachers will tend to request more, while students will tend to give more. Such reciprocal relationships are to be expected, since it follows logically that a solicit will be followed by a response, and a request will be followed by a give statement.

Both teachers and students tend to make reference to apparatus and individual results. With students actively engaged in experimentation,

it might be expected that the discourse focuses around apparatus and results.

During a laboratory activity, most of the discourse will not be of a rating nature. Where rating does occur, it can be expected that both teachers and students will rate mainly positively or negatively.

6. Student characteristics do not appear to determine student behaviors during interventions to any great extent.

7. There will be a change in student behavior patterns during the interventions when the teacher is present, compared to student behavior patterns outside the interventions when the teacher is not present.

III. Implications for Further Research

From the limitations and results of this investigation a number of recommendations are offered for further research. Recommendations related to methodological changes are given first, followed by recommendations of a substantive nature.

1. To facilitate comparisons across grades, there should be an even number of classes at each grade level. Furthermore, more groups within a class should be studied. Such changes would help alleviate the severe limitation of this study, namely, the small sample size and the consequent low frequencies in certain categories of the coding system. This low frequency problem might be solved to some

extent by collapsing certain categories within some of the dimensions of the coding instrument.

2. More research is needed to compare all of the possible student behavior variables which might occur during the interventions, with the same student behavior variables which might occur outside the interventions. Such a study might provide information on whether or not the discourse within a group during the interventions differs much from the discourse when the class as a whole is interacting.

3. A comparison of interventions under differing teaching strategies might provide more information on the whole area of interventions in small groups. A controlled experimental design using possibly structured and unstructured modes of teaching, and analyzing the possible variations occurring during interventions would be most interesting.

4. More research is needed to identify variables which determine number and length of interventions. Both teacher and student variables should be considered in greater detail.

5. Some attempt should be made to try and ascertain the importance that the teacher places on the time factor. The teacher's attitude towards time might have a tremendous affect on the number and length of interventions that occur during a lesson.

6. The notion of whether or not interventions lead to changes in behavior after the intervention ends is an interesting one and should be explored.

7. Research is needed to identify the effect that matching pairs of students has on student behavior within the group. For example, for an extraverted-introverted pair of students, to determine what affect the extraverted student has on the introverted student.

8. More research is needed to provide a more powerful theoretical base for describing intervention types.

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APPENDIX

THE CODING SYSTEM

SPEAKER

0 Unidentifiable or Indefinite (Class)
1 Teacher
2 Students in Group 1
3
4 Students in Group 2
5
6 Student Extraneous to Group under Analysis
7 Student in the group, when the specific group member cannot be identified

LESSON PHASE

0 - Off Task
1 - Direct
2 - Indirect

1 PRB Problem Specification
2 DAG Data Collection
3 DAI Data Interpretation
4 SUM Summarization
5 CLE Cleanup

PEDAGOGICAL MOVE

1 STR Structuring
2 SOL Soliciting
3 RES Responding
4 REA Reacting
5 NOC Not codable

SUBSTANTIVE-LOGICAL

0 - Incorrect
1 - Correct
2 - Unique or Unusual
Blank - for no level

Process Meanings

1	OBS	Observing	7	HYP	Hypothesizing
2	CLS	Classifying	8	OPD	Defining Operationally
3	QUA	Quantifying	9	DAI	Interpreting Data
4	COM	Communicating	10	COV	Controlling Variables
5	PRE	Predicting	11	EXP	Experimenting
6	INF	Inferring	12	MOD	Forming Models

Product Meanings

13	FAC	Fact stating	17	XPL	Explaining
14	DEF	Defining	18	OPN	Opining
15	DES	Describing	19	JUS	Justifying
16	INT	Interpreting	20	EVL	Evaluating

NOTE: Process OR Product meanings coded, but NOT BOTH.

CONTROLLING

1	GIV	Gives or States
2	REQ	Requests
3	COM	Commands

1	TRE	Teacher Requirement
2	PRE	Pupil Requirement
3	PRF	Performance
4	PRC	Procedure
5	INT	Statement of Intention
6	ATT	Attention
7	RPT	Repetition
8	ASS	Assistance
9	CLA	Clarification
10	ELA	Elaboration
11	EXA	Example

TYPE OF REFERENCE

1	STA	Statement
2	LOG	Logic Reference
3	LAM	Language Mechanics
4	ASG	Assignment
5	PRC	Procedure
6	PER	Person
7	ACT	Action General
8	ACP	Action Physical
9	ACV	Action Vocal
10	ACC	Action Cognitive
11	ACE	Action Emotional
12	APP	Apparatus
13	IND	Reference to individual results
14	CLA	Reference to class results
15	EXP	Reference to expected or desired outcome
16	PHE	Reference to an event or a phenomenon
17	REC	Reference to recording equipment or personnel

RATINGS

1	POS	Positive
2	QAL	Qualifying
3	RPT	Repeating
4	NEG	Negative
5	PON	Positive/Negative

PHYSICAL ACTION

Apparatus Manipulation

1	STA	Setting up
2	DIS	Dismantling
3	ADJ	Adjusting
4	MEA	Taking reading or measurement

END

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5 WAT Watching
6 SHA Moulding, shaping, cutting
7 NON Action non-specific
8 NOA No action

Recording

9 WRI Writing
10 DRA Drawing
11 GRA Graphing
12 TAB Tabulating
13 CAL Calculating
14 NOR Non-specific recording

Management Movement

15 FTC Fetching/returning
16 REL Changing position
17 RHA Raising hand
18 OFF Off task
19 CLE Clean up
20 REC Recording Equipment
21 NOM Non-specific management
22 NOC Not codable

For a detailed description of the coding system, see Crocker et al. (1975).