STUDENT-TEACHER VERBAL INTERACTION AND ITS RELATIONSHIP TO CLASSROOM GROUP ACHIEVEMENT IN THE TEACHING OF SECONDARY SCHOOL MATHEMATICS: AN EXPLORATORY STUDY

By

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A. H. F.

ABSTRACT

Scope of Thesis

The present exploratory study is primarily one of method and procedure. It is directly concerned with verbal communication within the classroom group, and specifically student-teacher verbal interaction. The research sought to discover the nature of correlation between the quantity of student-teacher verbal interaction and classroom group achievement in the teaching of secondary school mathematics.

Sample

In the conduct of the study three secondary schools in Beirut were used: the International College, the New Beirut College and the National Protestant College. From these schools, four classes of fifth secondary level were selected as samples for the research. The subject of study was high school algebra, and the unit was an introductory lesson in logarithms.

Methods and Procedures

The procedures followed in the conduct of the study were as follows:

A. Administration of Examinations:

A pre-test and a post-test were administered to the four classes before and after instruction on the unit of study, [illegible] The differences between students' scores on pre-test and post-test

represented their achievement scores for the purpose of this study. An average achievement score was determined for each class.

B. Chronological Recording of Interaction:

With the use of a stop watch the time lapse of student-teacher verbal interaction was measured in each class over the entire period of instruction. The recorder's duties involved the following:

1. Identify every student-teacher verbal interaction in a classroom, being absolutely aware of its initial and terminal points.
2. Press button to start watch when interaction began, press button to stop watch when interaction ended, and record the time lapse.

A summation of these time lapses was made in each class for the entire period of instruction. By dividing the total interaction time in each class by the number of students in the class, an average interaction score for the class was obtained.

C. Hypotheses:

In order to determine the nature of correlation between the interaction scores and achievement scores of the four classes, three preliminary null-hypotheses and one major null-hypothesis had to be formulated and tested:

Preliminary null-hypotheses:

1. The change in students' achievement scores from pre-test to post-test is not statistically significant.
2. The achievement scores of the four classes are not significantly different one from the other.

3. The interaction scores of the four classes are not significantly different one from the other.

Major Null-Hypothesis:

There is no correlation between the quantity of student-teacher verbal interaction and classroom group achievement in the teaching of secondary school mathematics.

The testing of the major null-hypothesis could be undertaken only when the three preliminary null-hypotheses had been tested and rejected.

Results

It was not possible to test for correlation between quantity of student-teacher verbal interaction and classroom group achievement; because in testing the three preliminary null-hypotheses, the second and third preliminary null-hypotheses were accepted.

Four distinct factors led to the breakdown of this study:

1. Uncontrolled teacher variable.
2. Limited range of period over which study was conducted.
3. Large size of class samples.
4. Limited number of samples.

Author's Observations

In the conduct of the present exploratory study the following observations were made:

1. That if certain classes had been designated and planned as experimental groups in which interaction was explicitly encouraged, and others as control

groups in which no such provision was made, it might have been possible to observe significant differences among interaction scores. However, such an approach would definitely alter the setting of the study; for, by exerting control on the quantity of interaction in a classroom, the normality of the teaching-learning situation is being affected.

2. That the quantity of student-teacher verbal interaction appears to increase from day to day as work on a new topic progresses. Nevertheless, the rates of increase within the classes are by no means the same. It can be therefore hypothesized that if the number of instructional hours is increased, the likelihood of finding significant differences among interaction scores will be greater.
3. It was observed that the approach taken in the measurement of student-teacher verbal interaction was too gross to have produced very significant results. The approach was gross in the respect that it over-looked the "distribution" of interaction within the classroom. The technique devised for measuring student-teacher verbal interaction in the present study provided for the following:
    a. Measurement of the time lapse of each student-teacher verbal interaction in the classroom.

b. A summation of the time used in such interaction.

c. Obtaining of an average interaction time per instructional period for each class.

But when the distribution of interaction is taken into consideration, the following factors enter the picture:

a. The number of students who interacted in a particular class.

b. The number of times each student interacted.

c. Total interaction time for each student.

d. Correlation to be sought between a set of individual students' achievement scores and a set of individual students' interaction scores; rather than between a set of classroom group achievement scores and a set of classroom group interaction scores.

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CHAPTER ONE

INTRODUCTION

I. Purpose of Study:

A problem that has for centuries confronted educators is the problem of how to teach. Modern educators have inherited this problem from the ages. However, in the evolution of educational theories the boundaries of the problem have been constantly widening. With the emergence of new philosophies of education, and from results obtained through extensive research in the psychologies and social sciences, the modern educator has been forced to focus his attention on improving the over-all teaching-learning situation.

Some traditional educators, in addressing themselves to the problem of how to teach, assume that the teacher has a particular knowledge to offer, and the student is devoid of this knowledge. There seems to be a gap between the 'have' and the 'have not'. Teaching therefore involves the transmitting of knowledge across this gap. In this respect the student's involvement in the teaching learning situation is limited, because the teacher is the one who does the transmitting.

Progressive education, which draws from a pragmatic philosophy of life, emphasizes that the learner should not simply receive knowledge, but rather it is important that he acts on that knowledge which he receives. The pragmatist believes that the learner is constantly

interacting with his environment. For some reason, unforeseen contingencies arise to interrupt the continuity of this interaction. This provokes an inquiry on the part of the learner which can be terminated only by knowledge leading to the restoration of continuity.

The basic implication in the preceeding exposition is that, while the traditional educator exclusively emphasizes the importance of the teacher, the progressivist shifts this emphasis to include the learner. In a traditional classroom situation one would expect the teacher to be very well informed on the subject matter; that his subject matter is arranged in a logical order; that his appearance and presentation of the lesson is dominant and forceful, and that the learner's role is a receptive one, and tends to be passive. On the contrary, learning, for the progressivist, is problem solving. Problem solving implies activity, involvement, participation, and interaction. The teacher remains a vital factor in the teaching-learning situation. But attention is directed to the relationships in the situation, as well. The teacher is still well prepared and ready to teach. But that teaching proceeds in the form of vital interpersonal relationships, including interaction and communication.

Through interaction the teacher is able to appraise both himself and the learner, and thereby is able to improve his instructional methods and techniques. Interaction also allows him to detect interests, readiness, and aptitude in his students, which further enables him to select teaching-learning experiences appropriate to the condition of his class.

For the above reasons, the dynamics of the classroom group have been of particular concern to the modern progressivist. A deliberate effort is being made in progressive schools to enlist the participation of students in the classroom activities, in the hope that by so doing, they will help improve learning outcomes.

The present study proposes to isolate one aspect of student participation in classroom activities and measure it quantitatively. It seeks to discover the relationship that the quantity of student-teacher verbal interaction bears to the achievement of the classroom group. It is hoped that this study will throw some light on the significance of the quantity of student involvement in the teaching-learning situation as a factor which influences learning.

Let it be granted for the purpose of discussion that, in the conduct of this research, a positive correlation is seen to obtain between the quantity of student-teacher verbal interaction and the classroom group achievement in the teaching of secondary school mathematics. This would suggest to the secondary school educational administrator that a definite step should be taken to regulate the number of students in each mathematics class, in order to facilitate an involvement of each student in an interaction with the teacher. Similarly, it would suggest to the mathematics teacher that he has the responsibility to encourage such interaction. Furthermore, it becomes important that the teacher training program should provide the prospective teacher with training in the techniques necessary, in order to undertake such an instructional method.

On the contrary, if a negative correlation is seen to obtain,

it would indicate to the mathematics teacher that in his teaching he should allow only a limited amount of such interaction or none. In fact, the discovery of a zero correlation would suggest that, when the issue at hand is the improvement of classroom group achievement, the factor of student-teacher verbal interaction is probably irrelevant.

II. Related Research:

The issue of classroom recitation has its roots in a problem that is more profound, namely, the social structure of the classroom group and its influences on learning. Since the beginning of the twentieth century studies have been conducted to appraise instructional design used by or in classroom groups to determine their effectiveness, measuring such effectiveness specifically in terms of individual achievement and group productivity. Results obtained from such studies have indicated that the social structure of the classroom group may influence group performance and individual learning.[1]

A perennial problem that confronts teachers is that of evaluating teaching methods. A contemporary trend in education has involved experimentation with a shift of control from the teacher to the student in the classroom group. The many variations in the control pattern which have been tried can be briefly classified as teacher-centered and student-centered. The basic question has been to discover what approach would result in greater student mastery of subject matter. Studies which bear specifically on the problem of teacher-centered and student-centered classroom groups have yielded conflicting results.

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[1] Jennings, H.H., "Sociometry in Group Relations", Washington, D.C., American Council of Education, 1948.

Studies conducted by Asch[2], Husband,[3] and Guetzkow - et al,[4] show that there is a small but significant difference favouring the teacher-centered approach. A study done by Faw[5] shows a difference favouring the student-centered approach. Other studies were conducted by Smith and Johnson[6], Eglash[7], and Wispe.[8] These reported no significant difference between the two methods. It was specifically observed that a student would attain a high level of achievement regardless of what group he is in as long as the motivation is "grades". It was further discovered that if students in student-centered classroom groups are not required to learn via the grade examination system, they do not learn as much as do students in teacher-centered groups.

Despite these findings, the fact still remains that some students will tend to learn better in teacher-centered classroom groups while others will learn better in student-centered classroom groups.

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[2]Asch, M.J., "Non-directive Teaching in Psychology", Psychological Monograph, 65:24, 1951.

[3]Husband, R.W., "A Statistical Comparison of the Efficacy of Large Lecture versus Smaller Recital Sections upon Achievement in General Psychology", Journal Psychology, 31:299-300, 1951.

[4]Guetzkow, Kelly E.L. and W.S. McKeachie, "An Experimental Comparison of Recital, Discussion, and Tutorial Methods in College Teaching," Journal of Educational Psychology, 45:193-207, 1954.

[5]Faw, V., "A Psychotherapeutic Method of Teaching Psychology," American Psychologist, 4:104-105, 1949.

[6]Smaith H.C. and D. Johnson, "An Experimental Study of Attitudes and Achievement in the Democratic Classroom", 1951, meeting of A.P.A.

[7]Eglash, A. "A Group Discussion Method of Teaching Psychology," Journal of Educational Psychology, 45:257-267, 1954.

[8]Wispe, L.G., "Evaluating Section Teaching Methods in the Introductory Course, "Journal of Educational Research, 45:161-187, 1951.

In addition to the studies already listed, is a study conducted by Haigh.[9] This study differs from the preceeding ones in that it pushes beyond them into the area of student personality differences. Haigh assigned students to groups on the basis of their performance. Students in student-centered classroom groups were not required to learn the subject matter by the examination system. Results obtained from this study revealed no significant differences in achievement scores between the teacher-centered and student-centered groups.

Shellenberg,[10] in addressing himself to this problem of the social structure of the classroom and its influence on individual learning in general, has concerned himself specifically with the size of the classroom group. His study attempted to ascertain the effects that the size of the classroom group has on students' satisfaction, instructor's satisfaction, and students' achievement. The research was conducted with thirty-two academic discussion groups which were varied in size from four to ten students. Findings revealed a consistent inverse relationship between group size and students' satisfaction. Students in smaller groups claimed greater satisfaction. It was further discovered that teachers were more inclined than students to show satisfaction with larger groups. Finally, though the evidence was limited, there was indication that smaller groups also showed slightly higher academic achievement than did larger groups.

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[9]Haigh, Gerard V. and Warren Schmidt, "The Learning of Subject Matter in Teacher-Centered and Group-Centered Classes, "Journal of Educational Psychology, 47:295-301, 1956.

[10]Shellenberg, James A., "Group Size as a Factor in Success of Academic discussion Groups," Journal of Education Research, 53:73-79, 1959-1960.

The issue of student-teacher verbal interaction is certainly not a very new one. It is directly related to the age old problem of classroom recitation. Basically, it is an issue related to the area of methodology.

The traditionalists and modernists have very different interpretations of classroom recitation. For the traditionalists, recitation implies 'lesson hearing'. The student recites the portion of the lesson which he has memorized. The teacher's role in such a situation is to select and assign the learning material. It is then the students responsibility to commit the material to memory and make a rote rendition of it upon the request of the teacher.

The modern view of classroom recitation can be easily abstracted from the suggestion advanced by H.H. Parker[11], one of the most influencial writers on secondary school methods:

> "The common practice of using the class period for mere repetition of the material learned in the textbook is one of the most pernicious sources of waste and lack of interest to be found in schools.... Instead of such recitations the teacher should raise questions which keep the pupil actively thinking because they involve (1) interpretations, (2) criticism, (3) supplementing, or (4) application along the lines studied in the assignment."

Recitation for the modernists, therefore, implies classroom discussion. The teacher creates a problematic situation in which the students eagerly involve themselves in a search for a solution. The students also contribute to the formulation of the problem and the collecting of evidence.

In an attempt to further explore the problem of the social

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[11]Parker, S.C., as cited in Bossing, Nelson L., Teaching in Secondary Schools, Houghton Mifflin Company, Boston, 1952, p. 150.

structure of the classroom group and its effects on learning, the present research is specifically addressed to communication within the classroom group. It seeks to measure quantitatively the student-teacher verbal interaction, and to determine the nature of correlation between the quantity of student-teacher verbal interaction and classroom group achievement in the teaching of secondary school mathematics.

III. Specific Statement of the Problem:

An attempt is hereby made to examine student-teacher verbal interaction from an entirely quantitative standpoint. It seeks to discover a correlation between the quantity of this interaction and the classroom group achievement in a secondary school mathematics class.

The time span of the described interaction is being measured for four secondary school mathematics classes. The recording is given in seconds. The study is aimed at determining a correlation between the interaction scores and achievement scores of these four classes.

The term "interaction span" has been used in this document to mean the time lapse in any verbal communication between an individual student and the teacher.

IV. Hypotheses:

The present study is concerned with the relationship between the quantity of student-teacher verbal interaction and classroom group achievement. To serve the technical purpose of this study, a major null-hypothesis will be advanced, preceeded by three preliminary null-hypotheses.

The major null-hypothesis advanced is as follows: There is no correlation between the quantity of student-teacher verbal interaction and classroom group achievement in the teaching of secondary school mathematics.

Before proceeding to test this major null-hypothesis, it is absolutely necessary that the following three preliminary null-hypotheses be tested and rejected:

1. The change in students' achievement scores from pre-test to post-test in each class is not statistically significant.
2. The "achievement scores"[12] of the four classes are not significantly different one from the other.
3. The "interaction scores"[13] of the four classes are not significantly different one from the other.

V. Delimitations:

As a pilot project, the present study is by definition limited in scope. The following delimitations provide the boundaries within which the project will be executed:

A. The study is confined to only one subject area, namely, secondary school mathematics. The subject of mathematics has been selected for the purpose of this study precisely because its nature allows for a high objectivity in scoring.

B. Only four classes are being used in the conduct of the study.

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[12]The nature of the achievement score is discussed in Chapter Three under the section headed "Preparation and Administration of Examination."

[13]The nature of the interaction scores is discussed in Chapter Three under the section headed "Chronological Recording of Interaction."

C. The student-teacher verbal interaction that this study proposes to examine is exclusively that which goes on between individual students and the teacher. The time used by the teacher and students in verbal communication will be measured.

D. Measurement of the described interaction will be made on an entirely quantitative basis.

E. Since the study is not concerned with the nature of the interaction, or its causes, the qualifications and previous experience of the teachers are assumed to be constant.

F. This study will be conducted in a normal teaching-learning situation.

Before proceeding to discuss the testing of the hypotheses advanced in this chapter, it is important that the concept of interaction be clarified. For it is necessary that the nature of the idea whose measurement is in question be quite clear in our minds. Therefore, the chapter immediately following seeks to give a descriptive treatment to the concept of interaction.

CHAPTER TWO

THE CONCEPT OF INTERACTION

When the term interaction is used, one immediately thinks of a type of contact between individuals. Just as interdependence suggests the state of two or more individuals depending upon one another mutually, so also does interaction indicate the state of two or more individuals acting upon one another mutually.

In an interaction, the subjects involved receive impressions and perceptions or impacts from one another. In other words, interaction means an exchange of impacts.

Interaction can be classified into two major categories: physical and psychological. The interaction with which this study is concerned is psychological, in that the members involved in it function with a mind.[1]

The term interaction carries certain important connotations that are significant to this study, namely: (A) that it is an essential for life; (B) it implies plurality of persons and has an effect that is mutual; (C) it is overt, observable and measurable; and (D) that for the most part it implies communication.

A. Essential for Life:

For the human being, there is always the necessity of

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[1] The term 'mind' has been used in this study in an entirely maturalistic context.

interaction. His growth and development depend on his interaction with others and his environment. He is a social being; and all his associations are made possible because of his ability to interact.

According to the famous interactionist, Mead:

> All social . . . interactions are rooted in certain common sociophysiological endowments of every individual involved in them. These physiological bases of social behavior, are the bases of such behaviors precisely because they in themselves are also social; that is, they consist in drives or instincts or behavior tendencies on the part of the given individual, which he cannot carry out or give overt expression and satisfaction to without the cooperative aid of one or more other individuals.[2]

Human beings, therefore, interact with each other and with their environment around and about them in an attempt to satisfy physiological as well as social needs. The satisfaction of these needs is essential for human life. It follows logically that interaction is an essential of human life.

B. Plurality of persons and mutual Effects:

Some authors find it more convenient to define human interaction in terms of the human group. A group, they would say, is composed of two or more individuals. But it should be borne in mind that number is not ultimately the most significant defining characteristic of the human group. A group is defined by the interaction of its members.[3] That is, the element of interaction is that which gives whatever we call a group its groupness. Also

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[2]Mead, George H. Social Psychology, University of Chicago Press, Chicago 37, 1934, p. 216.

[3]Homans, George C., The Human Group, Harcourt, Brace & Co., New York, 1950, (for a comprehensive information, see p. 36).

this interaction, as it is govered by certain rules and codes,[4] gives the group its specific form.

Such scholars in social psychology as Mead, Cartwright, Homans and Bonner, who have addressed themselves to the issue of human interaction, have used different approaches in arriving at a definition of the term. Nevertheless, a common idea runs through all their definitions, namely, the idea of contact. All of them agree that interaction implies contact. Homans in this respect states:

> When we refer to the fact that some unit of activity of one man . . . is stimulated by some unit of activity of another, aside from any question of what these units may be, then we are refering to interaction.[5]

He goes on to point out that this interaction is neither words nor actions; but rather it is contact or association.[6] To further clarify the issue he gives an example of two men sawing a log. There is a contact, he says, between these men, which facilitates the performance of their task. The one knows exactly when to pull the saw, and the other knows when to relax; and vice-versa. These men are in contact mentally, and hence they are interacting.

C. Overt, observable and measurable:

According to the Behaviorist School of Educational Psychology,

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[4]Bird, Charles, Social Psychology, D. Appleton-Century Company, 1940, p. 7.

[5]Homans, op. cit., p. 36.

[6]Ibid., (For detailed explanation, see p. 36-37).

human nature can only be studied in terms of overt behaviors. In order to get as complete and objective a result as possible in their study of human nature, they have confined their description to what they can see of others' overt behavior.[7]

This document therefore accepts the premise that interaction is observable in agreement with the position held by behaviorists.

Granting that interaction is overt, it follows that it is measurable. Anything that exists, exists in some quantity and can be measured. "The charm of interaction is that it lends itself to quantitative measurement."[8] It distributes itself in units. Each unit tends to have an initial and a terminal point. Kantor describes these units in his very elegant expression, 'psychological events'.[9] There are perhaps billions of such events in the individual's life time. They consist in changes that tend towards the maintenance of the individual, and are caused by variations and changes in his environment.

D. Communication:

Communication and interaction are terms that can be used interchangably. "As the rate of communication between persons A and

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[7]For a comprehensive treatment, see: Brubacher, John S., Modern Philosophies of Education, McGraw-Hill Book Company, Inc., New York, 1950, pp. 42-43.

[8]Cartwright, Dorwin, Group Dynamics, Row, Peterson & Company Evanston, Illinios -- White Plains, New York, 1953, pp. 29-30.

[9]Kantor, J.R. Interbehavioral Psychology, the Principia Press, Inc., Bloomington, Indians, 1958, (For a comprehensive explanation, see pp. 86-90).

B increases, their attitudes towards one another become more favourable."[10] This statement bears a definite relationship to what was mentioned in the preceeding pages of this document concerning interaction as an essential to human life.

The medium of human communication is language. One uses language to communicate his affective and cognitive experience. This language one acquires through his culture. "It rests upon an organic basis but is developed into a super-organic product."[11]

It is this particular aspect of interaction that this study is concerned with, namely, verbal interaction - speech. In an attempt to define speech, Young asserts:

> Speech, in short, comprises spoken words, and the voice, in its various features, organized into a response. Through this complex of response, communication between persons who have a common universe of discourse or a common set of meanings may take place.[12]

Verbal interaction is overt and observable. Each verbal interaction is a psychological event; and these events can be counted, either by counting the events one by one, or by counting the words in the events, or by counting the time consumed in the utterance of words.

At this point it is necessary for the discussion to move out of a general context and confine itself specifically to the classroom.

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[10]Thibaut, J.W., and Harold H. Kelley, The Social Psychology of Groups, John Wiley & Sons, Inc., New York, 1953, p. 73.

[11]Bonner Hubert, Social Psychology, American Book Company, New York, 1953, p. 56.

[12]Young, Kimball, Social Psychology, New York, P.S. Crofts & Company, MCMXXX, 1930, p. 231.

The discussion will take note of two main features of classroom interaction: (A) the uniqueness of the classroom group, and (B) the distinct forms which classroom interaction takes.

A. Uniqueness of classroom group:

The classroom group, the human group with which this research is directly concerned, is a working social group. Like all other human groups, it has participants, common goals, diverse interests and needs, and leadership. But there is a basic uniqueness about this group which differentiates it from all other groups. That distinguishing element is learning; for in the classroom, learning is a prescribed objective and a consciously held goal.[13]

B. Forms of classroom Interaction:

Classroom verbal interaction takes three main forms: interaction between students; interaction between teacher and entire group; and the interaction between the teacher and individual students. Any of these three forms may prevail in a teaching-learning situation, depending on the temperament of the teacher. However, it should be acknowledged that in so far as learning outcomes are concerned, student-teacher interaction of any kind is a major determining factor.

After observing several teaching-learning situations, the author arrived at the conclusion that individual student-teacher verbal interaction represented a most promising object of study for the present research, for the following reasons:

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[13]Getzels, Jacob W. & Herbert Thelen, "The Classroom Group as a Uniques Social System", Dynamics of Instructional Groups, National Society for the Study of Education, University of Chicago Press, Chicago, Illinois, 1960, (for detailed information see pp. 53-64).

1. It is easily observable.
2. It is definite and can be measured quantitatively.
3. A natural control over quality is provided, because the teacher is constantly involved.

The present chapter has been primarily concerned with an examination of the general concept of interaction. It has also attempted to introduce the aspect of interaction with which the present research proposes to deal, namely, classroom interaction, and more specifically, student-teacher verbal interaction in a secondary school mathematics class.

In the following chapter the methods and procedures used in this study will be set forth. The chapter will deal specifically with the nature of the samples, the nature of the evidence, and the statistical treatment of the data.

CHAPTER THREE

METHODS AND PROCEDURES

1. Nature of Sample

A. School and Program:

The research was conducted in three secondary schools in Beirut, the capital of the Lebanon. These schools were: International College, New Beirut College, and the National Protestant College. The class level selected was the fifth secondary; and the subject of study was algebra. All three schools followed the National Lebanese Baccalaurate program. The medium of instruction was English.

B. Students and Classes:

In conducting this study, four classes were used. Two of them were held at the International College, a third at the New Beirut College, and the fourth at the National Protestant College. The classes at the International College were both taught by the same teacher. Each of the other two classes at New Beirut College and National Protestant College had individual teachers.

All the students concerned were males, and their ages ranged from sixteen to eighteen years. They represented three nationalities: Lebanese, Syrian, and Jordanian. Their socioeconomic backgrounds were varied. Nevertheless, it was ascertained that an average

intelligence existed in each class.[1]

C. Subject Studied:

The subject was algebra and the unit of study was an introductory lesson in logarithms. Topics selected to be covered in this unit were:

1. Definition of logarithms
2. Notations
3. Systems of logarithms
4. Properties of logarithms
5. Logarithms to the base ten
6. Effect of changing position of decimal point in numbers
7. Rules for determining the characteristic.

In keeping with the plan of this study, instruction covering these topics was carried on for three sessions in each of the four classes.

It is worth noting, however, that the subject of logarithms was in the syllabus of International College, but not in the syllabi of New Beirut College and National Protestant College. It was upon special arrangement that the teachers of these two schools agreed to teach this material.

II. Nature of Evidence

A. Intelligence Estimate:

In the absence of an intelligence test, an appraisal of

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[1]A detailed discussion on Intelligence Estimate appears in the section of this chapter headed Nature of Evidence.

general ability was requested from four teachers for each of the students under consideration. The design of the estimate was as follows: a chart was designed for each student, on which the mathematics, physics, Arabic and English teachers were to appraise him as excellent, very good, good, fair, or poor.[2] (See chart in Appendix No. 1.)

For purposes of interpretation, a numerical value was assigned to each of the categories of classification. The table immediately following is intended to illustrate these categories with their numerical correlates.

Table No. 1

Rating Scale for Intelligence Estimate

poor	=	1
fair	=	2
good	=	3
very good	=	4
excellent	=	5

On each student's chart these numerical correlates were added and the sum was divided by four. The result represented the numerical score for the individual student. This procedure was followed for each student. Afterwards a total of these scores was found in each

[2] Teachers' appraisals are given on the basis of students' performance. Research in intelligence testing has shown that there is a .50 correlation between school marks and IQ. For a comprehensive explanation, see Bradfield, James M., Measurement and Evaluation, The Macmillan Company, New York, 1957, p. 382.

class,[3] and the result in each class was in turn divided by the number of students in the class, thereby obtaining an average. This result represented the numerical intelligence estimate of the class. Finally, a theoretical interpretation was made of these scores in each class. This interpretation was derived from table No. 1. When decimals were involved, appropriate approximations were made, employing the statistical principle governing significant digits.[4]

B. Preparation and Administration of Examinations:

1. Pre-test: This test was administered before instruction started on the unit of study. The items on the test were selected from Palmer and Miser, College Algebra,[5] Chapter Fourteen. This book was considered appropriate for the purpose of this study because its chapter on logarithms is especially written for beginners.

Most of the items were copied directly from the exercises in this book. Others were modified to facilitate simplication and clarity.

The test was an objective power test. There were forty-six items, and each item had a value of one point. Maximum possible score, therefore, was forty-six. The time allowed for testing was the entire class period. For classes at the International College this time was fifty-five minutes; and for those at New Beirut College and National Protestant College, it was fifty minutes.

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[3]See Appendix No. 1 under the section headed "Results from Intelligence Estimate". This appendix shows the number of students that were rated excellent, very good, fair and poor in each class. It also shows the numerical intelligence estimate of each class.

[4]Guilford, Joy Paul; Fundamental Statistics in Psychology and Education, 3rd ed., McGraw-Hill Book Company, New York, 1956.

[5]Palmer, Claude Irwin and Miser, Lee Wilson; College Algebra, 2nd ed., Mcgraw-Hill Book Company, New York, 1937, Chapter Four.

There were five sections in this test:

a. Transforming logarithmic notations into exponential notations, and vice-versa; solving logarithmic equations.

b. Recalling and applying rules of addition, subtraction, multiplication and division.

c. Logarithms to the base ten.

d. Recalling and applying rules of addition, subtraction, multiplication and division on a higher level.

e. Determining characteristics of numbers. (See Appendix No. 2.)

2. Post-test: This test was administered in each class after the completion of instruction on the unit of study. It was constructed parallel to the pre-test. Construction proceeded as follows:

a. Items on pre-test were modified by simply changing a few numerical values.

b. The number of items in the sections were in some instances increased and in other instances reduced.

c. A few problems were simply stated differently, while others were copied directly from the pre-test.

d. The total number of items was forty-six. Each item valued one point, making the maximum possible score forty-six. (See Appendix No. 2.)

3. Scoring: The scoring technique devised for this study was as follows:

a. Each student's pre-test and post-test were graded in each class.

b. A numerical difference between these scores was determined. This difference represented the student's real grade.

c. The grades in each class were added and divided by the number of students in the class, thereby obtaining an average grade for the class.

C. Chronological Recording of Interaction:

A stop watch was used to record the time lapse of interaction in all classes. The recorder was present at each class session, and his duties involved the following:

a. Identify the described interaction, being fully aware of initial and terminal points.

b. Press button to start watch when interaction commenced, press button to stop watch when interaction ended, and record time span.

The procedure was followed for each observable interaction in all classes.

When instruction on the unit ended, a summation of time lapses in interaction for each class was made. For classes at the International College, each total was multiplied by 60/55, and for those at New Beirut College and National Protestant College, the totals were multiplied by 60/50. The result for each class was finally divided by three. In this way the average interaction score for each class was obtained.

III. Statistical Treatment of Data

A. Limitation of Interpretation of Statistical Data:

The aspect of this study which endeavoured to estimate the level of intelligence of each class had to rely entirely on the appraisal of teachers. It consequently rendered the information provided by the data highly subjective. It was therefore considered unnecessary to subject such data to heavy statistical processing. Hence, after the average numerical appraisal was determined for each class, these averages were compared simply in terms of the author's subjective judgement. The comparison was made by inspection, and it was arrived at that each class was of average intelligence.

B. Statistical Procedures:

In order to discover a correlation between the quantity of classroom interaction and classroom group achievement, it was necessary to ascertain four main facts:

1. It had to be established that following the three periods of instruction a significant change in scores from pre-test to post-test was realized.
2. It was necessary to demonstrate also that the achievement scores of all four classes were significantly different among themselves.
3. It was necessary to establish that the interaction scores of all four classes were significantly different one from the other.

4. After these preceeding three conditions had been satisfied, a test for correlation between quantity of interaction and group achievement could then be made.

In endeavouring to establish these conditions on statistical grounds, the following hypotheses were to be formulated and tested for each condition.

Hypothesis No. 1: The change in students' achievement scores from pre-test to post-test in each class is not statistically significant.

Since the samples were composed of the same classes there was dependence between samples of students that took the pre-test and those that took the post-test. Hence the test used for this hypothesis was the t-test:

$$t = \frac{M}{\frac{S}{\sqrt{N}}}$$

This formula gives the observed value of (t)

(M) represents the mean of the sample obtained by taking differences between paired observations for all classes; i.e. paired observation being a student's scores on pre-test and post-test.

(S) represents the over all variation; which can be expressed as:

$$S = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2 + \ldots\ldots + (n_4 - 1)s_4^2}{N - 4}}$$

(s_i^2) represents the variance within the i(th) class or sample.

(N) is equal to $(n_1 + n_2 + n_3 + \ldots + n_i)$; where n_i is the size

of the i(th class or sample.[6]

The numeral (4) in the formula for (S) represents the number of classes or samples in the present study.

From the table of the t-distribution the expected value of (t) can be found. The (t) distribution approaches the normal distribution as the number of degrees of freedom, which depends on the size of the samples, increases. Practically for number of degrees of freedom greater than or equal to thirty the t-distribution can be approximated by the normal distribution.

Hence if the observed value of (t) is less than 1.96, the expected value of (t) in a normal distribution, the hypothesis is accepted; but if it is equal to or greater than 1.96, the hypothesis is rejected at the five percent level of significance.

Hypothesis No. 2: The achievement scores of the four classes are not significantly different one from the other.

To determine whether there is significant difference among the achievement scores of the four classes, it has to be shown that u_1, u_2, u_3, ..., u_i, where (u_i) represents the achievement score for the i(th) class or sample, were significantly different one from the other. To accomplish, this, these scores had to be taken in pairs and tested, using the following t-test:

$$t = \frac{u_1 - u_2}{S\sqrt{\frac{n_1 + n_2}{n_1 n_2}}}$$

[6] i = 1, 2, 3, or 4.

This formula is employed to test for significant difference between means. It should be remembered that these achievement scores are averages.

Since the number of observations is greater than thirty, in the test of the present hypothesis, the t-distribution can be approximated by the normal distribution. Therefore, if the observed value of (t) is less than 1.96 the hypothesis is accepted; but if it is greater or equal to 1.96 then the hypothesis is rejected at the five per cent level of significance.

(u_i) represents the achievement score of the i(th) class or sample; the subscript (i) being 1, 2, 3, or 4.

(S) represents the over all variation and can be expressed as:

$$S = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2 + \ldots + (n_4 - 1)s_4^2}{N - 4}}$$

(s_i^2) represents the variance within the i(th) class or sample.

(N) is equal to ($n_1 + n_2 + n_3 + \ldots + n_i$); where ($n_i$) represents the number of students in the i(th) class or sample.[7]

In this test, it is time saving to arrange the achievement scores in decending order. Testing should proceed by taking the highest and lowest scores first. If there is significant difference between the highest and lowest scores, then the researcher may proceed to test every possible pair of scores. On the contrary, if there is no significant difference between the highest and lowest scores, it should follow by necessity that there can be no significant difference

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[7] i = 1, 2, 3, or 4.

between the scores in any of the possible pairs.

Hypothesis No. 3: The interaction scores of the four classes are not significantly different one from the other.

The testing procedure to be followed in testing the present hypothesis is exactly the same as that used in testing hypothesis No. 2; namely: technique for testing for significant difference between means.

$$t = \frac{M_1 - M_2}{S\sqrt{\frac{n_1 + n_2}{n_1 n_2}}}$$

It should be remembered also that the interaction scores represent averages.

The expected value of (t) with four degrees of freedom while testing at the five per cent level of significance is 2.776. Therefore, if the observed value of (t) is less than 2.776 the hypothesis is accepted; but if it is greater than or equal to 2.776, the hypothesis is rejected.

M_i represents the interaction score of the i(th) class or sample.

S represents the over-all variation, and can be expressed as:

$$S = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2 + \ldots + (n_4 - 1)s_4^2}{N - 4}}$$

s_i^2 is the variance within the i(th) class or sample, and can be represented by the formula:

$$s_i^2 = \frac{nA_i^2}{n - 1}\left\{\left(\frac{x_1^2 + x_2^2 + \ldots\ldots + x_i^2}{n}\right) - M_i^2\right\}$$

A_i is a constant term used in determining the average interaction score of the i(th) class or sample.[8] For classes at international College $A_i = 60/55$; for those at New Beirut College and National Protestant College, $A_i = 60/50$.

x_i represents the interaction score recorded for the i(th) class on the i(th) day.

N is equal to $(n_1 + n_2 + ... + n_i)$; where n_i is the number of days during which interaction was recorded for the i(th) class.

Hypothesis No. 4: There is no correlation between the quantity of student-teacher verbal interaction and classroom group achievement in the teaching of secondary school mathematics.

The test of the present hypothesis can be undertaken only after the three preceeding hypotheses have been tested and rejected. To determine the degree of correlation between the two variables the Pearson's formula for correlation is most satisfactory. The test for correlation is represented by the formula:

$$r = \frac{\Sigma XY - N\bar{X}\bar{Y}}{s_x^2 s_y^2 (n-1)^2}$$

Σ is the sigma notation which means summation.

X_i represents interaction score for the i(th) class.

Y_i represents achievement score for the i(th) class.

$\bar{X}$ represents the mean of interaction scores for all classes.

$\bar{Y}$ represents the mean of achievement scores for all classes.

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[8] i = i, 2, 3 or 4.

s_x^2 represents the variance within the sample of interaction scores for all classes.

s_y^2 represents the variance within the sample of achievement scores for all classes.

If (r) is equal to zero, then interaction and achievement are independent of each other. If (r) approaches plus one, it indicates a positive correlation between interaction and achievement; i.e., achievement tends to increase as interaction increases. But if (r) approaches minus one, then there is a negative correlation; i.e., achievement tends to decrease as interaction increases. Or it tends to increase as interaction decreases.

If the first condition obtains, that is: that (r) is equal to zero, the hypothesis is accepted. But if any of the latter conditions obtain, the hypothesis is rejected provided the correlation coefficient (r) is large enough to be significant.

CHAPTER FOUR

RESULTS

The preceeding chapters have dealt with the nature and purpose of this study, related research, the concept of interaction, method and procedure of conducting the study, and the statistical analysis necessary in order to arrive at relevant conclusions. The present chapter is devoted to the exposition and interpretation of such results as were obtained from pre-test, post-test, and interaction recording.

In the conduct of the project, certain factors emerged as limitations to the originally designed study. Because two of the three preliminary null-hypotheses were not rejected correlation between the recorded interaction and the classroom group achievement could not be determined. The results obtained from testing the hypotheses advanced in Chapter Three will be discussed in the remaining sections of this chapter.

I. Achievement Results

A. Test for significant change in students' scores from pre-test to post-test:

The first preliminary null-hypothesis was stated as follows: The change in students' scores from pre-test to post-test in each class is not statistically significant.

With the (t) test, employed to test this hypothesis, a result was obtained which indicated that the change in students' scores from pre-test to post-test was very significant. The following statistical analysis will further emphasize how significant this change was.[1]

$$t = \frac{M - 0}{\frac{S}{N}} = \frac{M}{S}\sqrt{n_1 + n_2 + n_3 + n_4}$$

$$t = \frac{19.34}{6.67}\sqrt{94}$$

$$t = 28.16$$

The observed value for (t) as shown in the above analysis is larger than the 1.96, the expected value of (t). Upon this ground the hypothesis was rejected, thus establishing that the change in students' scores from pre-test to post-test was statistically significant.

B. Test for significant difference among achievement scores:

The second preliminary hypothesis was stated as follows: The achievement scores of the four classes are not significantly different one from the other.

As indicated in Chapter Three, the (t) test for significant difference between means was employed to test hypothesis number two.

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[1]See chapter three, page 25 for interpretation of unknowns in the formula for testing hypothesis number one. Also see appendix number 3 for the calculations of M and s_1^2 (i = 1, 2, 3 or 4).

Results obtained revealed that the observed value of (t) was less than 1.96, the expected value, for every possible pair of scores out of a sample of four such scores. It was thus ascertained that there was no significant difference among these achievement scores.

Table No. 2

Classroom Group Achievement Scores

Classes	Scores
International College Section (C)	21.96
National Protestant College	19.70
International College Section (B)	19.63
New Beirut College	17.84

In testing this hypothesis, it was enough to establish that there was no significant difference between the highest and lowest scores. Employing the formula:

$$t_1 = \frac{u_1 - u_4}{S\sqrt{\frac{n_1 + n_4}{n_1 n_4}}}$$

the result was as follows:

$$t_1 = \frac{21.96 - 17.84}{6.67\sqrt{\frac{47}{510}}}$$

$$t_1 = \frac{4.12}{(6.67)(.3)} = 2.06$$

greater than 1.96.

There is significant difference between the highest and lowest achievement scores. Hence we proceed to test for significant difference between the highest and third highest achievement scores, employing the same formula:

$$t_2 = \frac{u_1 - u_3}{S\sqrt{\frac{n_1 - n_2}{n_1 n_2}}}$$

$$t_2 = \frac{21.96 - 19.63}{(6.67)\sqrt{\left(\frac{60}{900}\right)}}$$

$$t_2 = \frac{2.33}{(6.67)\sqrt{1/15}}$$

$$t_2 = \frac{2.33}{(6.67)\sqrt{(.06)}} = \frac{2.33}{(6.67)(.25)} \text{ approx.}$$

$$t_2 = \frac{2.33}{1.67}$$

$$t_2 = 1.39 \qquad \text{less than } 1.96$$

Since there is no significant difference between the highest and third highest achievement scores, it follows that there can be no significant difference between the scores in any of the possible remaining pairs of scores out of a sample of four achievement scores. The null-hypothesis under consideration is therefore accepted.

II. Interaction Results

The third preliminary null-hypothesis was stated as follows: The interaction scores of the four classes are not significantly different one from the other.

Table No. 3

Classroom Group Interaction Scores

Classes	Scores
National Protestant College	713.5 Seconds
International College Section (C)	590.5 Seconds
International College Section (B)	568.0 Seconds
New Beirut College	564.5 Seconds

As has been stated in Chapter Three, the procedure followed for testing hypotheses numbers two and three are identical. The nature of these hypotheses is the same. Both of them are formulated to test for significant difference among means.

Therefore, in order to test for significant difference among the above tabulated interaction scores, the (t) test for testing for significant difference between means was employed. The test yielded results that justified the acceptance of the hypothesis, thereby indicating that these interaction scores were not significantly different one from the other.

To accept this hypothesis, it was enough to demonstrate that there was no significant difference between the highest and lowest interaction scores. The test proceeded as follows:

$$t = \frac{M_1 - M_4}{S\sqrt{\frac{n_1 + n_4}{n_1 n_4}}}$$

$$t = \frac{713.5 - 564.5}{316\sqrt{\frac{2}{3}}}$$

$$t = \frac{149}{(316.75)(.81)} \quad \text{less than unity.}$$

The readings taken from the table of (t) distribution under four degrees of freedom showed that the expected value of (t) was 2.776. Since observed (t) was less than this value, the difference between the highest and lowest interaction scores was statistically insignificant. Therefore there was no significant difference between the scores of any of the possible pairs out of a sample of four interaction scores. The third preliminary null-hypothesis was thus accepted at the 5% level of significance.

C. Breakdown of Experiment:

Since the achievement scores of the four classes, were not significantly different one from the other, and since the interaction scores of these classes were themselves not significantly different from one another, it was impossible to continue the test for correlation between student-teacher verbal interaction and classroom group achievement.

The exploratory nature of this study warrants that the limitations that led to its breakdown be examined, and that relevant recommendations be made that will serve as guides to future research.

For this reason. The fifth chapter of this document is devoted to a discussion of the present study and the factors leading to its premature termination.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

In order to test for correlation between the quantity of student-teacher verbal interaction and the classroom group achievement, it was first necessary to formulate and test three preliminary null-hypotheses:

1. The change in students' achievement scores from pre-test to post-test in each class is not statistically significant.
2. The achievement scores of the four classes are not significantly different one from the other.
3. The interaction scores of the four classes are not significantly different one from the other.

The tests proceeded in the sequence as given above. It is important to note that the testing of the major null-hypothesis of this study was warranted only when these preliminary null-hypotheses had been rejected.

In the process of testing, hypothesis number one was rejected; but hypotheses number two and three were accepted. This eventually brought the research to a premature termination. The purpose of this chapter is to examine the factors that rendered the study abortive.

I. Evaluation of the Project.

After a careful investigation into the causes that led to

the premature termination of the present study, certain definite observations were made. It may be concluded that the over-all design of this exploratory project could have fulfilled the prescribed objective. But due to certain unforeseen procedural difficulties that emerged in the conduct of the study, and also because of certain uncontrolled variables, the third hypothesis proved to be the terminal point in the analysis of the data. The question therefore is, why was it impossible to study the correlation between the quantity of student-teacher verbal interaction and the classroom group achievement? This problem will be explored in terms of its implications for future study.

A. Factors that led to the breakdown of the Study

Four distinct factors emerged as limitations to the completion of this exploratory study as originally designed. They are the following:

1. Uncontrolled teacher variable.
2. Limited range of period over which study was conducted.
3. Large size of class samples.
4. Limited number of samples.

In the succeeding pages of this section, an attempt will be made to analyze each of the factors enumerated above.

1. Uncontrolled Teacher Variable

In planning this exploratory study, it was considered desirable that the research be conducted in a normal teaching-learning situation. Teachers were not informed of the nature of the experiment; for it was assumed that if they were, it was quite probable that they might

have interfered with the natural course of the classroom interaction.

However, from the insignificant statistical results obtained from the interaction scores, (see analysis of hypothesis number three in Chapter Three), it may be seen in retrospect that the most productive way to seek a significant difference among interaction scores would have been to exert control over the quantity of interaction in each class, either by the designation of experimental and control groups, or by identifying in advance several classrooms in which the teachers in charge are known to differ in their characteristic use of student-teacher verbal interaction. The interaction scores obtained from such experimental and control groups, when compared, would have been more likely to show significant differences.

2. Limited range of period over which study was conducted

During the process of recording the quantities of interaction, it was observed that, there appeared to be an increase in student-teacher verbal interaction from day to day as the work on a new topic progressed. Nevertheless, the rates of increase were by no means equal for any two classes. One reason for this may have been that the inhibiting effect of the experimenter's presence diminished with time. Again, it may be hypothesized that if the number of instructional hours were increased, the likelihood of finding significant differences among interaction scores might have been greater. Thus, by extending the number of class periods, and thereby allowing the relative rate of increase significantly to influence the interaction scores of all classes, a researcher would do justice to the dynamic, cumulative, as it were, "self-propagating nature" of the classroom interaction.

3. Large Size of class samples

The exceedingly large number of students in some of the classes placed the observer at a disadvantage. This is perhaps a mechnical problem; but in large classes, it is only natural that some of the interaction will go unobserved by the recorder. It is therefore quite possible that such limitations in recording would introduce some degree of error into the data, and thereby contribute to the problem confronted in carrying the study to completion.

As stated in Chapter One, preliminary "trial-run" observations were carried out prior to the commencement of the actual project; but these observations were unavoidably made in classes that were smaller than those used in the actual study. The small size of these trial classes prevented the above difficulty from being anticipated. Post facto, from experience gained in the execution of the project, it may be stated that asingle observer can adequately record interaction for not more than twelve students. This becomes increasingly true during the advanced periods of instruction in a given unit of study. With the usual increasing rate of interaction, and as the number of students increases beyond twelve, the accuracy of the recorder decreases. Therefore, in classes with more than twelve students it is advisable that more than one recorder be employed. It might be thought particularly desirable if the experiment were designed for use in classes limited to twelve students. However, the limited nature of the present study could not provide for more than one observer.

4. Limited number of samples:

The small number of classes or samples used in conducting the present study was primarily necessitated by the nature and scope of the original design. Moreover, it was particularly limited to four classes due to the paucity of classes available in Beirut for this type of research at the time it was undertaken.

Statistically, the smaller the number of samples, the smaller would be the probability of recognizing variation. As the number of individuals under consideration increases, the factor of individual differences naturally becomes more significant.

It is therefore likely that the number of samples in this exploratory study was so small as to provide for too limited a variation among the samples might have helped to produce the insignificant differences seen in achievement scores.

B. Appraisal of Interaction Recording Techniques

Four factors have been discussed which may have contributed to the breakdown of this study. In addition to these factors the technique of recording interaction should be examined. For it was observed that the approach taken in the measurement of interaction was too gross to have produced very significant results. The approach was gross in the respect that it over-looked the factor of the distribution of interaction in the classroom. This factor of distribution is a factor that might significantly affect the results of such a study.

The technique devised for the measurement of interaction in the present study provided for the following:

1. measurement of time lapse of each interaction.
2. summation of the time; and
3. the obtaining of an average interaction score for each class.

It is seen that the collection of interaction data apparently was too gross. The technique was just not precise enough.

When the distribution of interaction is taken into consideration, the following factors would enter the picture:

1. The number of students who interacted in a class.
2. The number of times each student interacted.
3. Total interaction score for each student; and
4. Correlation in terms of individual student's scores on interaction and achievement.

This approach would definitely require that the recording of interaction proceed on a more detailed basis. In the first place, permanent seating arrangements would have to be assigned in each class. The observer would be required to prepare a diagram of the seating arrangement in each class. This diagram would be prepared in such a manner as to provide the opportunity for recording the student's interaction scores in the space alloted to that student on the diagram.

Such an approach would provide for the number of students who interacted, the number of times each student interacted, and would also facilitate the summation of each student's interaction scores.

The present study was designed to determine the nature of correlation between the gross average quantity of student-teacher verbal interaction in a class and the average classroom group achievement. Hence it was engaged in finding a correlation between two sets of averages. But averages as a rule do not give a precisely accurate account of a situation. They are very much affected by extreme scores.

However, following the proposal for interaction measurement advanced in this section, the use of averages would be unnecessary, and the statistical procedures would have a slightly different orientation.

Recording interaction in terms of its distribution provides for each student to have a pair of scores: an interaction score and an achievement score. This would facilitate the testing for correlation in terms of the individual student's scores over the entire number of observations, rather than in terms of class averages. A pair of scores for each student would be recorded over the entire number of observations. The results then obtained would be of much higher significance. From such results more accurate inferences might be drawn.

II. Implication for Future Research

When a study of this nature is taken byond the exploratory stage, themagnitude will of necessity increase. Certain additional factors will definitely have to be taken into consideration if valid

generalizations are to be anticipated. In the first place, a wide range of school subjects would have to be included. Secondly, the investigation would have to be carried out at different class levels. Thirdly, the magnitude of the study would raise a major question as to whether or not a single individual is capable of undertaking the research.

With an adequate sample of school subjects used in the study, and at the same time with provisions made for the investigation to be carried out at different class levels, a comprehensive nature would be given to the research. Results would then give a clear picture of the subjects and class levels for which a positive, negative or zero correlation obtains between interaction and achievement. Hence these results would suggest in what subjects and at what class levels to encourage or discourage student-teacher verbal interaction; and those in which the matter appears to be irrelevant.

From experience gained in the conduct of the present exploratory study, it can be estimated that the magnitude of such a study is such that it could be adequately undertaken either by a team of research workers, as an in-service project in a school system, or by a research institution.

The study is primarily one of method and procedure. Any study of method is essentially very specific in scope. To enlarge it means to increase the number, kind and length of situations. Therefore in attempting to embark on a large scale design of the problem advanced in this document, it is important for the researcher

to reconcile himself to this fact, and provide an adequate number of personnel in the execution of the project.

APPENDICES

APPENDIX NO. 1

INTELLIGENCE ESTIMATE

Name of Student: _____

School: _____

I, the undersigned, do hereby submit my sincere appraisal of this student. In my judgment he rates:

Excellent	Very Good	Good	Fair	Poor

	Name	Course
1st Teacher		
2nd Teacher		
3rd Teacher		
4th Teacher		

Results From Intelligence Estimate

The following charts show the number of students classified in different categories in each class.

International College Section B

	Excellent	Very Good	Good	Fair	Poor	
Number of Students	0	3	8	18	1	Total = 73. Average = 2.43

Categories

International College Section C

	Excellent	Very good	Good	Fair	Poor	
Number of Students	0	3	12	13	2	Total = 76. Average = 2.53

Categories

National Protestant College

	Excellent	Very Good	Good	Fair	Poor	
Number of Students	0	1	8	8	0	Total = 44. Average = 2.58

Categories

New Beirut College

	Excellent	Very Good	Good	Fair	Poor	
Number of Students	0	2	5	8	2	Total = 41 Average = 2.41

C a t e g o r i e s

Numerical Values from Intelligence Estimate for all Four Classes

Classes	Scores
International College Section B	2.43
International College Section C	2.53
National Protestant College	2.58
New Beirut College	2.41

By inspection, these values were seen to be not significantly different from one another. Hence an average intelligence was assumed for each class.

Excellent = 5
Very Good = 4
Good = 3
Fair = 2
Poor = 1

APPENDIX NO. 2

Examinations

Logarithms Test No. I

5th Secondary Level

Beirut

Instructions: Answer as many Questions as you can. Only answers are required. You may use the back of the sheets for rough work.

PART I

Express in Logarithmic notation.

1. $b^a = N$

2. $5^3 = 125$

3. $9^{1.5} = 27$

4. $8^{2/3} = 4$

Express in exponential notation

5. $\text{Log}_2 8 = 3$

6. $\text{Log}_{10} 0.01 = -2$

7. $\text{Log}_e 1 = 0$

Solve for N in the following examples

8. $\text{Log}_{10} B = 2$

9. $\text{Log}_3 N = 0$

10. $\text{Log}_4 N = -2.5$

Find the base (b) of each of the following logarithms

11. $\text{Log}_b 8 = 3/4$

12. $\text{Log}_b 32 = 5/2$

13. $\text{Log}_b 3 = 1/4$

Find the logarithms of the following

14. $\text{Log}_2 128$ =

15. $\text{Log}_{\frac{1}{2}} 2$ =

16. $\text{Log}_{\frac{1}{2}} 1/64$ =

17. $\text{Log}_2 \frac{1}{4}$ =

PART II

Encircle T if the statement is Ture and F if the statement is False.

18. T. F. $\text{Log}_a X = Y$ is the same as $A^Y = X$

19. T. F. Log AX is identical to Log A + Log X

20. T. F. $\text{Log } X^{\frac{1}{2}} = \text{Log } X - \text{Log}_{\frac{1}{2}}$

21. T. F. $\text{Log } X^3 = 3 \text{ Log } 3$

22. T. F. Log b/a = Log b Log a

23. T. F. Log a/xy = Log a - Log X - Log Y

24. T. F. $\text{Log } X^{3/4} = 3/4 \text{ Log } X$

25. T. F. $\text{Log } a^2 + \text{Log } 1/a + \text{Log } a = 3/2 \text{ Log } a$

PART III

Complete the following assuming that the base is 10.

26. Log 100,000 =

27. Log 10,000 =

28. Log 1,000 =

29. Log 100 =

30. Log 10 =

31. Log 1 =

32. Log 0.1 =

33. Log 0.01 =

34. Log 0.001 =

35. Log 0.0001 =

36. Log 0.00001 =

PART IV

If log 2 = 0.3010, Log 3 = 0.4771, Log = 0.6990, Log 10 = 1,
Log 7 = 0.8451, Solve the following

37. Log 63 =

38. Log 98 =

39. Log 140 =

40. Log $(7/12)^{3/5}$ =

In each of the following state the characteristic to the base 10

Number	Characteristic
41. 923	
42. 435.3	
43. 1.111	
44. 8.004	
45. 0.04766	
46. $10^{-3} \times 6$	

Logarithms Test No. 2

5th Secondary Level

Beirut

Instructions; Answer as many questions as you can. Only answers are required. You may use the back of the sheets, for rough work.

PART I

Express in Exponential forms:

1. $\log_b 1 = 0$

2. $\log_b b^{\frac{1}{2}} = 1/3$

3. $\log_b 4 = 1/2$

Express in Logarithmic forms

4. $e^x = y$

5. $8^{-2/3} = 1/4$

6. $10^2 = 100$

7. $5^{-2} = 0.04$

Solve for N in the following

8. $\log_7 N = 3$

9. $\log_8 N = -1/3$

10. $\log_{10} N = -3$

Find the base (b) of each example:

11. $\log_b 81 = 4$

12. $\log_b 16 = 1$

13. $\log_b 3^{\frac{1}{2}} = 1/4$

14. $\log_b 4 = 0.5$

Find the Logarithms of the following:

15. $\log_2 1/32$ =

16. $\log_2 0.25$ =

17. $\log_{0.5} 4\frac{1}{8}$ =

18. $\log_{16} 1/4$ =

PART II

Encircle T if the statement is **true** and F if it is false.

19. T. F. $\log_p ax + \log_p 1 = \log_p a + \log_p x$

20. T. F. $\log Z^{3/2} = 3/2 \log Z$

21. T. F. $\log b/a = \log b - \log a$

22. T. F. $(\log XY)^2 = 2 \log XY$

23. T. F. $\log a/xy = \log a - \log x - \log y$

24. T. F. $\log a^2 + \log 1/a + \log a^{\frac{1}{2}} = 3/2 \log a$

25. T. F. $\log_a 1 = a$

26. T. F. $\log 10 = 0$

27. T. F. $\log \left(\frac{x - 3}{x + 3}\right)^{\frac{1}{2}} = \frac{1}{2} \log (x - r) - \frac{1}{2} \log (x + 3)$

28. T. F. A logarithm is the power to which the base must be raised to get a given number.

29. T. F. The index to which a base must be raised to give a power is called a logarithm.

PART III

Complete the following, assuming the base is 10.

30. log 100 =

31. log 1/10 =

32. log 1/1000 =

33. log 100,000 =

34. log 0.00001 =

35. $2 \log 10^{-3}$ =

36. $\log 10^{-x}$ =

PART IV

If log 2 = 0.3010, Log 3 = 0.4771, Log = 0.6990, Log 10 = 1
log 7 = 0.8451, Solve the following:

37. 2 Log 9 + Log 7 =

38. 2 Log 7 + Log 2 =

39. Log 420 =

40. Log $(12.7)^{3/5}$ =

In each of the following state the characteristic to the base 10.

41. 9

42. 23.4

43. 0.01

44. 698.004

45. 0.04056

46. $10^{-4} \times 3$

APPENDIX NO. 3

ACHIEVEMENT RESULTS

International College

Fifth Secondary, Section B

Names	Pre-test Scores	Post-test Scores	(x) difference
R. Hadj	0	18	18
S. Dub	0	31	31
B. Bikhazi	3	22	19
H. Wahbe	0	18	18
A. Kutteh	4	31	27
A. Naifeh	2	25	23
S. Fadil	3	21	18
N. Mroud	1	28	27
S. Idris	0	20	20
G. Nueim	6	35	29
A. Haddad	2	29	27
S. Khassar	1	25	24
Z. Shible	2	29	27
G. Zanur	0	19	19
A. Sidani	0	30	30
S. Bibi	4	31	27
Abdu-Khadi	0	25	25
R. Larra	0	20	20
I. Issa	0	18	18
K. Bitan	1	22	21
S. Gharreebi	0	20	20
L. Gureidini	0	25	25
I. Shammas	3	21	18
G. Mukaddan	4	28	24
Y. Mansour	0	24	24
F. Tarabouki	0	20	20
A. Najjar	4	30	26
G. Tumeh	2	27	25
H. Sawwan	1	21	20
M. Druki	0	26	26

$N_1 = 30$

$M_1 = 19.63$

$M_1^2 = 385.3769$

$X_1^2 = 11377$

$$S_1^2 = \left(\frac{X_1^2}{N_1} - M_1^2 \right) \frac{N_1}{N_1 - 1}$$

$$S_1^2 = \left(\frac{11377}{30} - 385.3369 \right) \frac{30}{29}$$

$$S_1^2 = 33.1248$$

N_1 represents number of students in the class.

M_1 represents the mean of the class.

Σ means summation.

X_1 represents difference between student's score on pre-test and post-test.

International College

Fifth Secondary, Section C.

Names	Pre-test Scores	Post-test Scores	(x) difference
Amal Mussalam	3	20	17
Muhamed Vylazlot	0	22	22
M. Kandis	4	15	11
G. Moubassabh	0	26	26
S. Ballaz	2	23	21
R. Ghrizi	0	20	20
G. Zaydan	6	9	3
H. Shawkey	0	17	17
B. Itayam	4	28	24
Z. Idris	0	24	24
R. Khoury	4	26	22
K. Dowk	0	8	8
A. Issam	1	24	23
M. Gandour	2	30	28
N. Al-Asaad	5	23	18
N. Fallahal	4	20	16
S. Saad	2	20	18
S. Thabbani	5	18	13
R. Ghrizi	3	28	25
A. Bikhazi	3	22	19
B. Abdalah	3	18	15
G. Louise	2	30	28
S. Hasbany	3	19	16
H. Fares	4	21	17
M. Razzak	3	13	10
S. Shalalouh	0	22	22
N. Zakhour	3	22	19
W. Suleiman	5	23	18
M. Haddad	6	23	17
F. Karam	5	27	22

$N_2 = 30$

$M_2 = 21.96$

$M_2^2 = 482.2416$

$X_2^2 = 15183$

$$S_2^2 = \left(\frac{X_2^2}{N_2} - M_2^2 \right) \frac{N_2}{N_2 - 1}$$

$$S_2^2 = \left(\frac{15183}{30} - 482.2416 \right) \frac{30}{29}$$

$$= 24.5758$$

N_2 represents number of students in the class

M_2 represent the mean of the class

Mean summation

X_2 represents difference between student's scores on pre-test and Post-test.

New Beirut College

Fifth Secondary

Names	Pre-test Score	Post-test Scores	(X) difference
A. Hammour	13	27	14
Rafic Mattar	0	0	0
Rabi Baz	0	30	30
Nabil Sarrfini	0	32	32
Bishan Mizhar	6	22	16
Nadeem Khoury	0	18	18
Boulos Boylos	0	26	26
Makram Salem	0	33	33
Marroum Andrawus	0	27	27
Nabil Azar	12	16	4
Waleed Moubarak	6	15	9
George Dandan	0	9	9
G. Yousef	0	21	21
H. Danito	0	25	25
Bassem Fares	0	20	20
H. Itani	0	8	8
Eid Elias-Bishad	13	27	14

$N_3 = 17$

$M_3 = 17.84$

$M_3^2 = 321.8436$

$X_3^2 = 7033$

$$S_3^2 = \left(\frac{X_3^2}{N_3} - M_3^2 \right) \frac{N_3}{N_3 - 1}$$

$$S_3^2 = \left(\frac{7033}{17} - 321.8436 \right) \frac{17}{16}$$

$$= 97.3716$$

N_3 represents number of students in the class

M_3 represents mean of the class

means summation

X_3 represents difference between student's scores on pre-test and Post-test.

National Protestant College

Fifth Secondary

Names	Pre-test Scores	Post-test Scores	(X_4) difference
Muhammad Khalify	0	14	14
W. Lala	0	23	23
Rind Khashan	0	23	23
Muhammed Bibi	0	24	24
N. Bammariel	0	15	15
Victor Cedon	0	24	24
John Khoury	0	22	22
Tayseer Sbahi	0	24	24
Michael Layyows	0	4	4
Musallem	0	30	30
Samir Diab	0	24	24
Farid Hajjar	0	17	17
H. Nawas	0	12	12
G. Faqhali	0	11	11
R. Alaun	0	24	24
R. Khoury	0	21	21
M. Dow	0	19	19

$N_4 = 17$

$M_4 = 19.70$

$M_4^2 = 388.0900$

$X_4^2 = 6875$

$$S_4^2 = \left(\frac{X_4^2}{N} - M_4^2\right) \frac{N_4}{N_4 - 1}$$

$$S_4^2 = \left(\frac{6875}{17} - 388.0900\right) \frac{17}{16}$$

$$= 48.4314$$

N_4 represents number of students in the class.

M_4 represents mean of class.

Σ means summation

X_4 represents difference between student's scores on pre-test and Post-test.

$$S = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2 + (n_3 - 1)s_3^2 + (n_4 - 1)s_4^2}{N - 4}}$$

$$S = \sqrt{\frac{(29)\ (33.1248) + (29)\ (24.5758) + (16)\ (97.3716) + (16)(48.431}{90}}$$

$$S = \sqrt{\frac{960.6192 + 712.6982 + 1557.9456 + 774.9024}{90}}$$

$$S = \sqrt{\frac{4006.1654}{90}}$$

$$S = \sqrt{44.5129}$$

$$S = 6.67$$

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