

THE RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT  
ACHIEVEMENT IN SELECTED GRADE IX CLASSES  
IN THE HIGH SCHOOLS OF MANITOBA



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by  
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## ABSTRACT

The main purpose of the study was to attempt to determine the relationship between class size and student achievement in Grade IX classes in the high schools of Manitoba. Respondent classes were selected from schools outside of Metropolitan Winnipeg and the city of Brandon.

The data collected from the records of the Department of Education of the Province of Manitoba provided information about 6,585 students in 261 classes of 140 schools.

Students were grouped on the basis of three criteria: number of Grade IX classes registered in the school, number of students enrolled in the class, and the quartile distribution of ability.

Comparisons were made of the pass rates in each class size by applying the pass-fail criterion and the aggregate mark criterion to the whole set of examinations on the basis of school categories, all students, and the quartile distribution of ability. Comparisons were also made in each subject on the basis of school categories, all students, and the quartile distribution of ability. Finally an analysis of covariance was performed on a ten-percent random sample to determine whether any significant difference in achievement existed when ability as determined by intelligence was controlled.

Results of the comparisons were as follows:

1. There was no significant difference in pass rates in any school category using either the pass-fail criterion or the aggregate mark criterion.
2. Students of above-median ability achieved significantly higher pass rates in language in large classes. Their achievement in the other subjects tested was not significantly related to class size.
3. Students of below-median ability tended to achieve significantly higher pass rates in smaller classes in language, mathematics, and science. Their achievement in social studies was not significantly affected by class size.
4. The analysis of covariance with ability as determined by intelligence controlled indicated that there was no statistically significant difference in the aggregates of marks obtained by students in any class size.

Because of these results, the following conclusions were reached:

1. Class size is a significant factor in the achievement of students in language (English);
2. Class size is not a significant factor in the achievement of students in social studies;
3. Class size is a significant factor in the achievement of students in mathematics or science only for students of below-median ability.

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## CHAPTER I

### STATEMENT OF THE PROBLEM AND DEFINITION OF TERMS

#### I. INTRODUCTION

In recent years there has been a large growth in the high school enrolment in Manitoba. This increase has been caused by a number of factors: a slight increase in population, a greater emphasis on the need for a high school education in order to enter employment, the raising of the school-leaving age from fourteen to sixteen years, and a greater diversification of the types of education offered to students. The increase in enrolment has brought with it a number of problems. Among these are the necessity of building schools with a greater variety of programmes and of staffing these schools with competent teachers.

The building of schools and the hiring of teachers cost money, and all levels of government have become acutely aware of the high cost of education. Increased taxation is evidence of this high cost level. The federal government has increased grants to the provinces for the purpose of implementing training programmes in which Manitoba has shared. The provincial government has instituted a revised system of grants to school divisions for the establishment of a foundation system of education. Municipal governments have been forced

to increase taxation because of the increase in their share of support of the system of education in the province.

The growth in enrolment has augmented the demand for teachers, thus contributing to a teacher shortage which has become especially severe at the high school level.

These factors, cost, space shortage, and teacher shortage, demand that the best possible use be made of the supplies available; that the greatest value possible be obtained from the money spent on education, from the space available, and from the teaching force. Since the effectiveness of a system of education is often measured by the achievement of students in a set of examinations, i.e. by the students' pass rate, a study of the factors affecting the achievement of students in a set of examinations could provide information which would allow educational administrators to effect those practices which would produce better results, and thus make better use of the resources which are available. Recent experimentation with new organizational patterns such as team teaching indicate a search for systems which might produce results better than those achieved by systems presently utilized. While it may be that new methods of teaching can produce better results than old methods did, it is also possible that teaching effectiveness can be increased by making changes other than in the methods of teaching. For instance, if it can be shown that there is a relationship

between class size and academic achievement, a more effective distribution of students into classes could be made, and such a redistribution might produce a significant increase in the academic achievement of the students concerned.

## II. STATEMENT OF THE PROBLEM

Main Problem: Is there a relationship between class size and the academic achievement of students as measured by the pass rate obtained in a set of external examinations?

Sub-Problems: (1) Is there an optimum size of class in which students can achieve higher pass rates in external examinations? (2) What is the best class size for each of the four subjects used as the basis for this study?

## III. IMPORTANCE OF THE PROBLEM

The answers to the stated questions could be of great benefit to administrators, school boards, and even governments. School principals could use such knowledge to determine class size and teacher workload. School administrators could use it to make the best use of space presently available and to determine future requirements. The information could be used as a guide in future building programmes and to the number of teachers required. Departments of Education could use such information to assist in planning for and calculating the costs of educational programmes.

The relationship between class size and academic achievement could have an effect on the number of teachers needed to teach any given number of students. Should large classes prove to be as good as or better than small or medium-sized classes, and if other factors did not make small classes preferable, then the number of teachers required to teach the students in the high schools of Manitoba would be considerably smaller. The number of classrooms necessary would also be decreased, with an attendant decrease in equipment and supplies. Thus an overall lowering of costs would take place. Conversely, if small classes produce a better academic achievement, the opposite could also be true, unless other factors dictated the use of larger classes.

#### IV. DEFINITIONS, ASSUMPTIONS, LIMITATIONS, AND DELIMITATIONS

##### Definitions

Class size. For the purpose of this study class size refers to "the number of pupils regularly scheduled to meet in an administrative and instructional unit, known as a class or class section, generally under the direct guidance of a single teacher".<sup>1</sup>

Small class. For the purpose of this study a small

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<sup>1</sup>Fred von Borgerode, "Class Size," Encyclopedia of Educational Research, ed. Walter S. Monroe (New York: Macmillan Co., 1941), p. 197.

(Category I) class refers to a class containing twenty or fewer students.

Medium-sized class. For the purpose of this study a medium-sized (Category II) class refers to a class containing from twenty-one to twenty-nine students.

Large class. For the purpose of this study a large (Category III) class refers to a class containing thirty or more students.

Above-average ability. This refers to the ability of students whose I.Q. is in the first quartile.

High-average ability. This refers to the ability of students whose I.Q. is in the second quartile.

Low-average ability. This refers to the ability of students whose I.Q. is in the third quartile.

Below-average ability. This refers to the ability of students whose I.Q. is in the fourth quartile.

Department of Education examinations. The term Department of Education examinations refers to examinations set for the Department of Education by a committee of teachers and school inspectors. In this study these examinations were written by all students and were marked externally by a committee of teachers chosen for this task.

### Assumptions

It is assumed that Department of Education examinations are a valid test of academic achievement. It is further

assumed that only lack of knowledge and not some other factor such as illness made any student achieve poorly in any of the examinations used in this study.

### Limitations

Other factors enter into academic achievement besides class size. Some of these, and the way in which their effects will be minimized in this study are as follows:

(1) Teacher factor. The teacher's age, sex, education, and experience could affect his method of presentation and the student's response. However, since the sample is quite large, it is quite unlikely that any large number of students were placed in such a situation that they were affected by only positive or only negative factors; rather, it is quite likely that, where a large number of teachers and students is involved, differing teacher characteristics tend to neutralize one another.

(2) Physical surroundings. Good physical surroundings such as new school buildings and other facilities could affect a student positively by creating within him a feeling conducive to good academic achievement. Conversely, poor physical surroundings could be expected to affect the student adversely. However, in view of the large sample, it is unlikely that any large number of students were found to be in poor physical surroundings while at school. Furthermore, the extensive building program at the high school level in

Manitoba in recent years tends to minimize this possibility.

(3) Influence of Parents. Parental influence can be either positive or negative. Some parents, rich or poor, tend to encourage their children to obtain as much education as they can; others, for various reasons, tend to discourage their children from proceeding to higher education. It might be argued that well-to-do parents encourage their children more, and are better able to provide higher education. Studies have shown a correlation between the financial status of the parent and the academic achievement of the child. However, the schools chosen for this study are those in areas too small to have separate schools for children from different financial strata of society. Thus in all cases students from parents having one kind of financial background have been thoroughly mixed with those having other financial backgrounds.

(4) Pupil interests. A student might feel that he is not interested in the subjects that the school is offering. He may wish to take others which the school, for whatever reason, is not able to offer. The resulting lack of interest could affect the attitude of the pupil to such an extent that he would achieve more poorly than he otherwise would. It is felt that, with a large sample, the body of pupils who fall into this category will be more or less evenly divided among various class types. It is also considered unlikely that the percentage of dissatisfied pupils in one I.Q. level will be

any larger than in any other.

### Delimitations

The data collected for this study have been restricted to schools outside of Metropolitan Winnipeg and the city of Brandon. Schools north of the Swan River Valley were also omitted. City schools have been omitted from this study because in cities people tend to live in large socio-economic or ethnic groups. These groups are often large enough to provide the majority of students for a school. This would mean that students from one school could have a background completely different from that of the students in another, and thus different attitudes and different opportunities. Their examination results could be different because they had a different experience to draw upon and not because their ability to achieve was different. In smaller centres of population there are fewer schools, also a greater mixing of the population; thus there will be more heterogeneous populations and more heterogeneous classes.

Schools north of the Swan River Valley were omitted from this study because they present different situations with atypical populations. For the same reason private schools and Indian schools were omitted from the study.

Continuation schools, one-room high schools, and all other schools not large enough to have a separate Grade IX class were also omitted from the study because where there



is more than one grade in a classroom the situation is quite different from that in the single-grade classroom. The teacher in such schools cannot teach any grade full time as is the case in all schools having a separate room for each grade. Because conditions in these schools are different, any comparison including these schools would be an unfair one.

## CHAPTER II

### REVIEW OF THE LITERATURE

The purpose of this chapter is to survey the related literature to determine conclusions and research methodology. This is done largely on a study by study basis. This chapter also draws conclusions from previous studies as to the trends, if any, in the results obtained.

#### I. STUDIES COMPLETED PRIOR TO 1960

The history of research into the relationship between class size and student achievement began with J. M. Rice, the "father" of achievement testing. After studying the results of arithmetic tests administered to 6,000 elementary school pupils in eighteen elementary schools in eight cities, he concluded that achievement had little to do with class size. Because no attempt had been made to control variables or to give advanced statistical analysis, no general conclusions could be drawn from this study.<sup>1</sup>

From that time until World War I various other studies into class size-achievement relationships were undertaken. In one of these Charles Harlan<sup>2</sup> was the first to use stand-

<sup>1</sup>J. M. Rice, "Educational Research: A Test in Arithmetic," The Forum, XXXIV (Oct., 1902), pp. 281-297.

<sup>2</sup>Charles L. Harlan, "Size of Class as a Factor in Schoolroom Efficiency," Educational Administration and Supervision, I (March, 1915), pp. 203-209.

ardized tests to relate class size to achievement.

Hudelson probably best summarizes investigation into the class size-achievement relationship until the First World War as follows:

The results of investigations conducted before 1917 indicate that, in general, unless elementary school classes exceeded forty-five or fifty, there is no clear evidence of diminished efficiency. Thus far, however, there has not been taken into consideration a number of factors which may reasonably be expected to affect the results of teaching. No devices were then available for measuring some of these factors. Progress had gone about as far as it had the means of going; consequently after 1915-16 there was a lull of four or five years while educational scientists were deriving, refining, and standardizing intelligence and achievement test materials. When experimentation was resumed about 1920, these powerful instruments were at hand to aid investigators in measuring factors, that theretofore they had not been able to control.<sup>3</sup>

After World War I, increased enrolments and rising costs initiated more studies into the question of class size-student achievement relationship. These post-war studies may be considered more significant than those preceding them because the scientific conduct of the investigations was much improved. Some attempt was now being made to pair the classes and to take pupil intelligence into account.

In spite of these improvements in research methodology, the results were as inconclusive as before. After reviewing studies of the period from World War I to the mid 1930's,

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<sup>3</sup>Earl Hudelson, Class Size at the College Level (Minneapolis: University of Minnesota Press, 1928), pp. 17-18.

Otto concludes:

The experimental evidence produced during this period was conflicting in nature. In general, unless class size rose above 45 or 50 students, there appeared to be little significant relationship between size of class and achievement as commonly measured by schools. If, in final summary of all studies, an advantage was to be noted, it accrued to the large classes.<sup>4</sup>

Between 1935 and 1960 few educators conducted research into the relationship between class size and pupil achievement. There were during this period, however, several surveys of past research. Findings were little different from those obtained by earlier researchers. Writing in the 1941 edition of the Encyclopedia of Educational Research Otto and Borgersrode state:

On the basis of criteria used in the experimental studies published to date and under typical group teaching procedures, mere size of class has little significant influence on educational efficiency as measured by achievement in the academic subjects.<sup>5</sup>

In 1950, in the same publication, Otto reviewed the more important studies and concluded:

Of the 73 studies 16.4 percent were reported as significantly in favor of large classes, 23.3 percent in favor of large classes but not significantly so, 38.4 percent in favor of neither, 17.8 percent in favor of small classes but not significantly so, and 4.1 percent significantly in favor of small classes. Of the 24 controlled studies the corresponding percentages are 20.8, 29.2, 29.2, 16.6, and 4.2.<sup>6</sup>

<sup>4</sup>Henry J. Otto et al., Class Size Factors in Elementary Schools (Austin: University of Texas Press, 1954), p. 8.

<sup>5</sup>Henry J. Otto and Fred von Borgersrode, "Class Size," Encyclopedia of Educational Research, ed. Walter S. Monroe (New York: Macmillan Co., 1941), p. 215.

<sup>6</sup>Henry J. Otto, "Class Size," Encyclopedia of Educational Research, ed. Walter S. Monroe (New York: Macmillan Co., 1950), p. 212.

He concluded that "on the whole, the statistical findings definitely favor large classes at every level of instruction except the kindergarten".<sup>7</sup> This conclusion was also reached by Shane and Polychrones<sup>8</sup> in 1957, and by Goodlad<sup>9</sup> in 1958.

By 1960 researchers were dubious whether a simple answer to the class size-achievement question existed. Even if students achieved higher in a certain size of class, it could not be stated conclusively that the size of the class alone was responsible for the difference. Regarding this matter Pfnister states:

If class size is effectively isolated from all other factors, the issue becomes simply (or perhaps not so simply) whether the presence of a greater or lesser number of warm bodies in a room affects the learning of those assembled in the room...Class size, as a single factor, may be beside the point! As nearly as I can determine, psychologists have not given us any conclusive evidence that the mere number of persons in a room listening to a lecture has any effect upon the learning of a normal, non-psychotic individual. They interact with each other and with the instructor. But that is another matter. Class size is only a limiting factor, not a determining factor.<sup>10</sup>

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<sup>7</sup>Ibid., p. 215.

<sup>8</sup>Harold G. Shane and James Z. Polychrones, "Class Size," Encyclopedia of Educational Research, ed. Walter S. Monroe (New York: Macmillan Co., 1957), p. 427.

<sup>9</sup>John I. Goodlad, "Classroom Organization," Encyclopedia of Educational Research, ed. Chester W. Harris (New York: Macmillan Co., 1960), p. 224.

<sup>10</sup>Allan O. Pfnister, "Review of Research on Class Size," Annual Conference on Higher Education in Michigan, (University of Michigan, LXI, 80: Jan. 1, 1960), pp. 21-22.

Because of the conclusions of previous researchers, only one relatively recent study from the pre-1960 period (the Spitzer study) has been considered in any detail.

## II. THE SPITZER STUDY

In 1953-4 Spitzer made a study of all third-grade and sixth-grade classes in Iowa cities of 5,000 population or over which had participated in the 1953 administration of the Iowa Every-Pupil Tests of Basic Skills.<sup>11</sup>

Data were available for 94 third-grade classes and 85 sixth-grade classes. Classes were defined as follows: a large class had 30 or more pupils; a small class had 26 or fewer pupils. Only 50 small and 26 large classes were used in the study because of the limitations imposed by these definitions.

The achievement instruments were a battery of four tests called the Iowa Every-Pupil Tests of Basic Skills. Test A was a test of reading comprehension; Test B was a test of study skills; Test C was a test of language skills; and Test D was a test of arithmetic skills.

The average scores made by each class in each of the four tests were used to determine the relation between class size and achievement in the four areas of instruction.

Spitzer found that at both grade levels three of the

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<sup>11</sup>Herbert F. Spitzer, "Class Size and Pupil Achievement in Elementary Schools," Elementary School Journal, LV 2 (Oct., 1954), pp. 82-86.

four tests showed results favoring the small classes. At the third-grade level no difference was greater than one-tenth grade, a difference too small to be considered significant. At the sixth-grade level no difference was statistically significant, the closest being only at the 20 percent level. Spitzer concluded, therefore, that class size, within the range studied, was not a factor in academic achievement.

### III. STUDIES COMPLETED SINCE 1960

Were one seeking a general conclusion from past research, he would be inclined to agree that "investigations have failed to prove that class size is an important factor in determining educational efficiency in terms of pupil achievement".<sup>12</sup> This conclusion was also reached in 1964 by Menniti<sup>13</sup>, who had traced research about class size related to academic achievement that had been carried out from 1896 onward. He stated that research had shown no simple answer to the class size-achievement question, and that other factors such as grade level, subject area, ability of the pupil, and ability of the teacher were involved.

Since 1960 there have been several experiments attempting to relate class size to pupil achievement. Because these

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<sup>12</sup>Manley E. Irwin, "Educators Have Not Solved the Class Size Puzzle," *Nation's Schools*, X: 6; (Dec., 1932), p. 23.

<sup>13</sup>Daniel J. Menniti, "A Study of the Relationship Between Class Size and Pupil Achievement in the Catholic Elementary School" (unpublished Doctor's thesis, The Catholic University of America, Washington, D.C., 1964), pp. 38-40.

experiments have been more scientifically conducted, and because more sophisticated methods of analysis have been available to the experimenters, the conclusions arrived at by the researchers may be considered to be more accurate than those of most earlier researchers. For that reason several of these more recent studies are considered in some detail.

#### IV. THE GRIFFIN AND BOWERS STUDY

Griffin and Bowers of the University of Kansas experimented with a class of 297 students enrolled in a fundamentals of speech course.<sup>14</sup> They chose half the class arbitrarily to form the experimental group and used the remainder as the control group. This control group was given the usual type of speech instruction, meeting in sections of fourteen students, each with their own instructor, three times per week. Short student speeches were delivered and criticized during class periods. The experimental group attended one mass lecture and two small section meetings each week.

Two pre-term and two post-term tests were given to each group. One test was an oral examination rated on a simple ten-point general-effectiveness scale. The other was a written short-answer test rated on the number of items missed. These were the achievement instruments. The evaluation of the test

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<sup>14</sup>Kim Griffin and John Bowers, "Does Class Size Make a Difference?" Educational Executives' Overview, IV (Jan., 1963), p. 16.



results showed Griffin and Bowers that both groups had almost identical increases in mean scores in the oral test and identical decreases in errors in the short-answer written tests. They concluded that, within the scope of their study, learning was not significantly affected by the size of the group.

#### V. THE FELDHEUSEN STUDY

Feldheusen of Wisconsin State College used 100 sophomores enrolled in an educational psychology course for his study.<sup>15</sup> He divided them into one large class of seventy-two students and one small group of twenty-eight students. Twenty-two students from each group were used as the experimental samples.

All the students were given two pre-term and two post-term tests. One was a short-answer test on the principles of educational psychology; the other was The Minnesota Teacher Attitude Inventory. The larger group attended three mass lecture-demonstration sessions per week, and separated into two groups for one weekly discussion session. The smaller group met together all four times, and received the same lectures and demonstrations.

Feldheusen found that there was no significant difference in the post-test achievement of the two groups; however

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<sup>15</sup>John Feldheusen, "Does Class Size Make a Difference?" Educational Executives' Overview, IV (Jan., 1963), p. 16.

after a covariance analysis of the pre-test and post-test mean scores from The Minnesota Teacher Attitude Inventory, he found a significant relationship in positive attitudes towards teaching and child development in the small class.

## VI. THE WILLIAMS STUDY

Williams of Michigan State University wrote a thesis in 1962 on his experiment to determine the effects of different class sizes and scheduling on the educational development of students in high school physics, chemistry, and senior English.<sup>16</sup>

In the experimental school class size varied from 60 to 100, while in the control school, chosen by the state education department, classes were of approximately 30 pupils each. Pupils were selected on the basis of the number of high school and college years completed by the parents. Size and location of the schools were made as nearly equal as possible.

In the experimental school the students met in double periods twice a week together with one small class (from 6 to 24 pupils) seminar for each pupil. Laboratory classes were held for appropriate subjects. In the control school students met five times a week in 50-minute periods, again with laboratory classes for appropriate subjects.

The achievement instruments were those provided by the

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<sup>16</sup>Clarence M. Williams, "An Exploratory Investigation of the Effects of Class Size and Scheduling Related to Achievement and Motivational Outcomes" (unpublished Doctor's thesis, Michigan State University, East Lansing, 1962), pp. 16-53.

state education department. Pre-achievement measures were obtained for all three subjects. For chemistry, a state education score in biology was available; for physics, a Grade X maths test score was available; in senior English, the results of a junior English test were used. (It would have been desirable to have had pre-achievement measures in the appropriate subjects, but this was impossible.) Post-achievement scores were obtained by the use of another English test and a Word Rating List which measures "Academic Self-Concept".

Using analysis of covariance to control intelligence, pre-achievement, and motivation in each of the three subject areas, Williams tested nine specific statistical null hypotheses. He found significant differences in statistically adjusted achievement outcomes in English and chemistry, but none in physics. In English the results favored the experimental conditions (large classes), while in chemistry the results favored the control conditions (small classes).

The major conclusion reached by Williams was that class size, as a variable, does affect the teaching and learning situation. He did, however, qualify this by stating:

Due to certain concessions necessary to experiment in a field setting and necessary assumptions regarding achievement measures, it was impossible to separate sufficiently the full effects of class size on instruction and learning and motivational outcomes. However, awareness of the importance to teaching of manipulation of class size (with the attendant schedule shifts) was increased.<sup>17</sup>

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<sup>17</sup>Ibid., p. 55.

## VII. THE MENNITI STUDY

Menniti of the Catholic University of America made a study in 1964 of the relationship between class size and pupil achievement in the eighth grade classes in the school systems of the Dioceses of Harrisburg, Pennsylvania, and of Evansville, Indiana.<sup>18</sup> Menniti used supervisory reports to eliminate overcrowded classes and classes with inferior physical conditions. Using similar reports he also omitted classes with teachers of superior or inferior ratings, to equalize as much as possible the important variable of teacher ability. Large classes were defined as those having 40 or more students per class, while small classes were defined as those having 35 or fewer students.

Classes of each diocese were paired separately, and members of the selected classes were grouped according to ability levels through the use of scores obtained in intelligence tests. Raw scores on achievement tests in mathematics and reading were used to determine achievement levels. After analyzing the data obtained from these tests, Menniti compared the results from the two dioceses. He then reached the following conclusions:

(1) In the areas of reading and arithmetic, there was a significant difference favoring the pupils in small classes,

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<sup>18</sup>Daniel J. Menniti, "A Study of the Relationship Between Class Size and Pupil Achievement in the Catholic Elementary School" (unpublished Doctor's thesis, Catholic University of America, Washington, D.C., 1964)

taken as a group.

(2) In the area of arithmetic, there were significant differences favoring the below-average pupils (I.Q. of 89 and below) in small classes. When class size exceeds 45, achievement in science also appears to be affected.

(3) In the areas of reading and arithmetic, there were significant differences favoring the average pupils (I.Q. of 90 to 109) in small classes. In arithmetic this was more true when the class size exceeded 45.

(4) The achievement of the above-average pupils (I.Q. of 110 and above), taken as a group, does not appear to be different in small or large classes.

(5) The achievement of pupils with I.Q.'s ranging from 110 to 119 did not appear to be different in small classes or large classes except when the size of the class exceeded 45. In the latter case, there were significant differences favoring the pupils in small classes in the area of reading.

(6) No significant differences were found in the achievement of the pupils with an I.Q. of 120 and above.<sup>19</sup>

#### VIII. THE MADDEN STUDY

In 1966, a study was conducted by Madden<sup>20</sup> of Arizona

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<sup>19</sup>Ibid., pp. 75-77.

<sup>20</sup>Joseph V. Madden, "An Experimental Study of Student Achievement in General Mathematics in Relation to Class Size" (unpublished Doctor's thesis, Arizona State University, Tucson, 1966)

State University into the relationship between class size and student achievement in general mathematics at the ninth grade level. For his study Madden used as his experimental group large classes of seventy to eighty-five students; the regular or control group consisted of classes of twenty-five to forty students.

Madden divided his students into three ability levels, and gave tests at the beginning and at the end of a semester to obtain the data for determining the significance of class size in achievement. An intelligence test was administered to obtain data for ability grouping.

Before analyzing his data Madden stratified the Population by method, ability level, and sex. Using analysis of variance to determine significance, he formulated and tested seven null hypotheses.

Madden found that both the control group and the experimental group were statistically equivalent at the beginning of his study. The analysis of variance of the post-test results led to the following conclusions:

(1) There was a significant difference in the achievement of pupils in the experimental (large) group as compared with the achievement of pupils in the control (small) group.

(2) There was a significant difference in the achievement of pupils in the mean ability level in favor of the experimental (large) group.

## IX. SUMMARY OF THE CHAPTER

The consensus of researchers into studies concerning the relationship between academic achievement and class size that were completed before 1960 is that such studies have either shown no statistically significant relationship or have proven contradictory. These studies have taken place at all grade levels, but mostly at the elementary and at the junior high school levels. They have been based on a variety of subjects, but especially on English and mathematics. Experimental groups have varied in size from as few as one hundred students to several thousand. Achievement instruments have varied from regular school examinations to tests standardized on a state-wide or larger basis. Class sizes have varied greatly, with no definite agreement on what constitutes a small class or a large class. Students have been classified in a variety of ways using such bases as past performance, ability rating, and educational background of parents. The data obtained have been treated in various ways, from using raw scores and converting improvements into grade levels to a simple comparison of test results. In spite of all this variation there was a remarkable similarity in conclusions -- that the results were negative or inconclusive.

Since 1960 the results of such studies have changed. Mostly they seem to indicate that there is a statistical significance between academic achievement and class size.

It is possible that more scientific methods of controlling variables and more modern methods of data processing such as the analysis of covariance made it possible to find a significance which was not noticed before.



## CHAPTER III

### COLLECTION AND ORGANIZATION OF DATA

This chapter gives details about the collection of the data. It also gives information about the organization of the data in preparation for the analysis to follow.

#### I. COLLECTION OF THE DATA

When the thesis topic and method of operation had been approved by the committee, permission was requested from the Department of Education of the Province of Manitoba to use the records of the Department. The use of two sets of records was requested: (1) the spring half-yearly reports for 1965, and (2) the score sheets for the Grade IX Departmental Examinations of June, 1965.

After permission was granted by the Department of Education to use the records requested, the half-yearly reports were used to determine the number of Grade IX classes in each school included in this study and the number of students enrolled in each class. The score sheets were used to obtain the examination results of each pupil as well as the Intelligence Quotient (I.Q.) of the pupil as determined from the mental ability test written by the pupil at the same time as he wrote the examinations in English, social studies, mathematics and science.

## II. ORGANIZATION OF THE DATA

The data obtained from the half-yearly reports were used to group the schools as follows: Category A, schools having one Grade IX class; Category B, schools having two Grade IX classes; Category C, schools having three Grade IX classes; and Category D, schools having four or more Grade IX classes.

The classes were then grouped as follows: Category I, classes having twenty or fewer students; Category II, classes having twenty-one to twenty-nine students; and Category III, classes having thirty or more students.

One hundred forty schools came within the limitations of this study. The number of Grade IX classes varied from one to ten a school, with over half the schools having only one Grade IX class and over one quarter having two Grade IX classes.

In the two hundred sixty-four classes for which data were recorded class size varied from ten students to forty-two. In schools having more than one Grade IX class, the tendency was towards medium-sized classes except in Category D schools, where the number of medium-sized and large classes was almost equal.

When the examination results of the students were examined, it was found necessary to omit three classes of

students for the following reasons:

(1) One class in Category A-II was omitted because only two out of the twenty-two students had complete records, and these could not be considered representative of the whole class.

(2) One class in Category B-II was omitted because there were no examination results available for that class.

(3) One class in Category C-III was omitted because no students in the class had complete examination results.

Thus the actual number of classes in each category which formed part of this study was as shown in Table I.

TABLE I  
CLASSIFICATION OF RESPONDENT CLASSES  
BY CATEGORY AND SCHOOL SIZE

School Size	Category			Total
	I	II	III	
A	19	28	27	74
B	12	53	16	81
C	5	20	4	29
D	5	38	34	77
Totals	41	139	81	261

After the classes had been grouped as previously described, the I.Q.'s of the pupils who had complete results were tabulated. The median I.Q. and the range of I.Q.'s were established, and the pupils were divided into ability levels (quartiles) according to their I.Q. The median I.Q. was found to be 103. The ability-level grouping resulted as follows:

(1) The above-average ability level (first quartile) contained all pupils having an I.Q. of from 111 to 143.

(2) The high-average ability level (second quartile) contained all pupils having an I.Q. of from 104 to 110.

(3) The low-average ability level (third quartile) contained all pupils having an I.Q. of from 97 to 103.

(4) The below-average ability level (fourth quartile) contained all pupils having an I.Q. of from 70 to 96.

In order to be able to determine the quality of the students in each class size and each school size so that the ability of the students could enter into a comparison of examination results, a final re-sorting of the pupils took place after the quartiles were established. Each category from A-1 through D-III was subdivided into four sections, each containing the students from one of the four quartiles. These divisions and the number of students in each are given in Tables II to V.

TABLE II

NUMBER OF PUPILS FOR EACH QUARTILE IN CATEGORY A SCHOOLS  
ACCORDING TO SIZE OF CLASS

Categories	I	II	III	Total
Q <sub>1</sub>	84	131	214	429
Q <sub>2</sub>	66	155	210	431
Q <sub>3</sub>	70	165	219	454
Q <sub>4</sub>	77	208	216	501
Totals	297	659	859	1,815

TABLE III

NUMBER OF PUPILS FOR EACH QUARTILE IN CATEGORY B SCHOOLS  
ACCORDING TO SIZE OF CLASS

Categories	I	II	III	Total
Q <sub>1</sub>	32	316	90	438
Q <sub>2</sub>	57	285	108	450
Q <sub>3</sub>	51	331	140	522
Q <sub>4</sub>	70	343	148	561
Totals	210	1,275	486	1,971

TABLE IV

NUMBER OF PUPILS FOR EACH QUARTILE IN CATEGORY C SCHOOLS  
ACCORDING TO SIZE OF CLASS

Categories	I	II	III	Total
Q <sub>1</sub>	13	166	44	223
Q <sub>2</sub>	13	120	34	167
Q <sub>3</sub>	23	103	24	150
Q <sub>4</sub>	33	109	24	166
Totals	82	498	126	706

TABLE V

NUMBER OF PUPILS FOR EACH QUARTILE IN CATEGORY D SCHOOLS  
ACCORDING TO SIZE OF CLASS

Categories	I	II	III	Total
Q <sub>1</sub>	4	244	308	556
Q <sub>2</sub>	17	241	270	528
Q <sub>3</sub>	27	214	268	509
Q <sub>4</sub>	26	246	228	500
Totals	74	945	1,074	2,093

As can be seen from these tables there were 1,815 pupils from schools having one Grade IX class, 1,971 from schools having two Grade IX classes, 706 from schools having three Grade IX classes, and 2,093 from schools having four or more Grade IX classes. The number of pupils from each category of school, except for Category C, is quite similar, so these school types have nearly equal numbers of classes. Thus a comparison of the data for these three categories (A, B, and D) should be especially valuable, since a comparison of nearly equal samples should be more valid than a comparison of samples of vastly different sizes.

According to the half-yearly reports, the total number of pupils registered in the Grade IX classes of the schools used in this study was 7,007. However, there were complete data for only 6,587 pupils, and incomplete data for a further 112 pupils. There were no examination results for 287 pupils, who might therefore be considered as drop-outs. However, because these pupils were registered for the second term, they had had some influence on the classes in which they were registered; these pupils were therefore included in the class enrolment for the purpose of grouping the classes according to size.

Table II shows that Category A schools had more pupils in large classes than in small or medium-sized classes. Tables III and IV show that Category B and Category C schools were

composed predominantly of medium-sized classes. Table V shows that Category D schools were composed of a nearly equal division of medium-sized and large classes. What these tables do not show is that in schools where there was more than one Grade IX class there was a variety of ways of dividing the pupils into their classes. Division by sex was practised in four schools. In eight schools pupils were divided into classes alphabetically. In many schools there was considerable evidence of ability grouping, with both slow-learner and advanced-performance classes in evidence. While division by sex or alphabetically might not affect the results of a study such as this one materially, ability grouping could make a considerable difference in the achievement of a class and thus affect the result of the study.

Finally, a ten-percent random sample was taken from the body of students used in this study for the purpose of making an analysis of covariance. The sample consisted of 66 students from small classes, 335 students from medium-sized classes, and 256 students from large classes. The examination results of these students were tabulated on I.B.M. cards so that they could be processed, using a covariance program.



## CHAPTER IV

### ANALYSIS OF THE DATA

The purpose of this chapter is to present an analysis of the data and to report the significance, if any, of the relationship between academic achievement and class size based on the number of students who passed their examinations. Comparisons are made on the basis of: (1) school categories -- to determine whether results in one size of school were significantly higher than in another; (2) all students -- to determine whether one class size achieved significantly higher than another in the sample as a whole; and (3) intelligence -- to determine whether the academic achievement of students of one ability level is affected significantly more by class size than the academic achievement of students of another ability level.

This chapter also reports the significance, if any, of the relationship between class size and academic achievement in language (English), social studies, mathematics, and science. Here, too, comparisons are made on the same three bases as above to determine whether one size of class achieved significantly higher than another in any of the four subject areas examined, and to determine whether students of any ability level achieved significantly higher in a particular size of class in any of these four subjects.

Finally, this chapter presents the results of the analysis of covariance of a ten-percent random sample to determine the significance, if any, of the relationship between academic achievement and class size. The basis is the aggregate of marks obtained when ability based on a measure of intelligence is controlled.

#### I. COMPARISON BY NUMBER OF FAILURES

Percentages of students in each class size of each school category who had no failures were calculated. Percentages were also calculated for students in each class size of each school category who had one failure, two failures, three failures, and four failures. Table VI contains the results of these calculations.

Table VI shows that C-III classes had the highest percentage of students having no failures (67.46 percent), while D-I classes had the lowest (31.08 percent) -- a difference of 36.38 percent. However, if these two class types and C-I classes with a percentage of 35.37 percent are omitted, the difference in percentages decreases to only 4.16 percent. This decreased percentage seems to indicate that, with the above exceptions, there is little difference in the achievement of students on the basis of class size in any school category.

The range in percentages of students having one

TABLE VI  
 PERCENTAGES OF FAILURES ACCORDING TO SCHOOL SIZE  
 AND CLASS SIZE

School Category	Class Size	Number of Failures				Total	
		0	1	2	3		4
A	Small (I)	56.90	21.21	11.11	5.06	5.72	100.00
A	Medium (II)	54.32	16.84	13.81	9.10	5.93	100.00
A	Large (III)	55.30	18.98	11.29	8.96	5.47	100.00
B	Small (I)	56.67	17.62	11.43	9.05	5.23	100.00
B	Medium (II)	57.57	19.06	11.84	7.14	4.39	100.00
B	Large (III)	57.20	17.28	10.08	9.88	5.56	100.00
C	Small (I)	35.37	21.95	14.63	12.20	15.85	100.00
C	Medium (II)	56.43	18.27	13.05	6.02	6.23	100.00
C	Large (III)	67.46	10.32	11.11	4.76	6.35	100.00
D	Small (I)	31.08	28.38	25.68	6.76	8.10	100.00
D	Medium (II)	54.13	21.61	13.24	6.46	4.56	100.00
D	Large (III)	58.29	20.20	10.34	6.52	4.65	100.00

- A -- Schools having one Grade IX class.
- B -- Schools having two Grade IX classes.
- C -- Schools having three Grade IX classes.
- D -- Schools having four or more Grade IX classes.

failure is from 10.32 percent to 28.38 percent -- a difference of 18.06 percent. The large classes in the Category C schools, which had the largest percentage of students with no failures, had the smallest percentage of students with one failure. If this category is omitted, the maximum difference in percentages decreases to 11.54 percent.

The range in percentages of students having two failures is from 10.08 percent to 25.68 percent -- a difference of 15.60 percent. Omitting the small classes in the Category D schools, which have the highest percentage of students with two failures, as well as the large classes in the Category C schools, the maximum difference decreases to 4.55 percent.

Small classes in the Category C schools had the largest percentage of students having three or four failures. If this category is omitted, the maximum differences in percentages of students having three or four failures are 5.12 percent and 3.72 percent respectively.

Table VI indicates that, except for the high percentage of large classes in the Category C schools which had no failures, the high percentage of small classes in the Category D schools which had one or two failures, and the high percentage of small classes in the Category C schools which had three or four failures, there appears to be little variation in the results achieved by any class size in any category of school.

Percentages of Passes

For the purpose of this study it was assumed that students having no failures or only one failure have passed their examinations, while those who have two or more failures have failed their examinations. Using this definition of passing and failing, the percentages of pupils in each class size of each school category who passed their examinations were calculated. Table VII contains the data obtained from these calculations.

TABLE VII

PERCENTAGES OF STUDENTS WHO PASSED THEIR EXAMINATIONS  
ACCORDING TO SCHOOL SIZE AND CLASS SIZE

Category of School	Number of Grade Nine Classes	Class Size		
		Small	Medium	Large
A	1	78.11	71.16	74.28
B	2	74.29	76.63	74.48
C	3	57.32	74.70	77.78
D	4 or more	59.46	75.74	78.49

Table VII shows that the percentages of students who passed their examinations varies from a low of 57.32 percent for small classes in Category C schools to a high of 78.49 percent for large classes in Category D schools -- a difference of 27.17 percent. However, if the small classes in the

Category C and Category D schools are omitted, the maximum variation decreases to 7.33 percent.

In the Category A schools small classes have the highest pass rate, 78.11 percent; in the Category B schools medium-sized classes have the highest pass rate, 76.63 percent; and in Category C and Category D schools large classes have the highest pass rates, 77.78 percent and 78.49 percent respectively.

From this table it would appear that in the Category A schools, small classes produced higher results than did medium-sized or large classes; in the Category B schools medium-sized classes seem to have a small advantage over the small and the large classes; and in the Categories C and D schools, large classes seem to have a small advantage over medium-sized classes and a large advantage over small classes.

#### Pass-Fail Relationships

Contingency tables were constructed using the pass-fail data and the class size variable. Five tables were constructed, one for each school category and one for all students. The chi-square values were calculated and reported, together with the probability levels, in Tables XXIII to XXVII. (See Appendix.) For the purpose of this study, a probability level of .05 or less was considered to be statistically significant. Table VIII is a summary of the findings reported in Tables XXIII to XXVII.

TABLE VIII

SUMMARY OF RELATIONSHIPS BETWEEN CLASS SIZE AND STUDENT  
ACHIEVEMENT USING A PASS-FAIL CRITERION BASED ON  
THE NUMBER OF EXAMINATIONS PASSED

Category	Chi-square	df	p
A	5.314	2	.075
B	1.196	2	.056
C	12.473	2	.003
D	14.645	2	.001
All Students	4.703	2	.097

Results of the analysis show that only in the Category C and Category D schools did the students in any class size achieve a significantly higher pass rate. In both school categories students in large classes achieved higher pass rates. (See Tables XXV and XXVI.)

The difficulty of grouping students on the basis of ability in Category A and Category B schools may have been, to some extent, responsible for the lack of statistical significance in these categories when the pass-fail criterion was tested. In the larger Category C and Category D schools slow learners were likely placed in small classes so that the teacher could provide more individual attention, or for reasons of discipline. This grouping of lower-ability students into small classes could account for the relatively low pass rate of the small classes in the Category C and Category D

schools. When the results of all students were tested, no significant differences in achievement were indicated for different class sizes. This could be accounted for by the fact that the number of students in the small classes in the Category C and Category D schools was relatively small, 156 out of a total of 663. Thus the effect of their low pass rate was not sufficient to produce statistical significance in the combined pass rate in small classes.

#### Ability and Student Achievement

To test the validity of the idea that ability grouping significantly affected pass rates, it was decided to relate the performance of the students in the various class sizes in the various school categories to the ability (intelligence) level of the students in them. For this analysis, the percentages of students in the upper two quartiles of intelligence rating -- that is, having an I.Q. greater than the median I.Q. -- was determined for each class size in each school category. Table IX shows a comparison of the percentage pass rates of the students in the various class sizes in the various school categories with the percentages of students having above-median ability found in each.

The data in Table IX support the impression that the small classes in the Category C and Category D schools had such low pass rates because the students in these classes were of a lower ability level. Small classes in Category C



TABLE IX

PERCENTAGES OF PUPILS PASSED AND PERCENTAGES OF PUPILS HAVING ABOVE-MEDIAN ABILITY ACCORDING TO SCHOOL AND CLASS SIZE

School Category	Number of Grade Nine Classes	Class Size	Percent Passed	Percent Having Above Median Ability
A	1	Small (I)	78.11	50.50
A	1	Medium (II)	71.16	43.40
A	1	Large (III)	74.28	49.36
B	2	Small (I)	74.29	42.18
B	2	Medium (II)	76.63	47.17
B	2	Large (III)	74.48	40.83
C	3	Small (I)	57.32	31.70
C	3	Medium (II)	74.70	57.43
C	3	Large (III)	77.78	61.91
D	4 or more	Small (I)	59.46	28.38
D	4 or more	Medium (II)	75.74	51.38
D	4 or more	Large (III)	78.48	53.82

schools, which produced a pass rate of 57.32 percent, had only 31.70 percent of their students of above-median ability; small classes in the Category D schools had a pass rate of 59.46 percent, and had only 28.38 percent of their students of above-median ability. In no other category was the pass rate lower than 71.16 percent or the percentage of higher-ability students lower than 40.83 percent; thus it would be expected that the small classes in the Category C and Category D schools would not produce pass rates as high as those of the other class categories.

Table IX shows that the higher the percentage of students having above-median ability, the higher the percentage of passes -- a result which was to be expected. There is, of course, some variation, both among and within school categories. Among school categories, for example, the C-III classes achieved a 77.78 percent pass rate with 61.91 percent of their students of above-median ability, while D-III classes achieved a pass rate of 78.49 percent with 53.82 percent of their students of above-median ability. A-I classes achieved a pass rate of 78.11 percent with 50.50 percent of their students of above-median ability, and B-II classes had a pass rate of 76.63 percent with 47.14 percent of their students of above-median ability.

Within school categories, for example, D-I classes had a pass rate of 59.46 percent compared with 75.94 percent

for D-II classes and 78.49 percent for D-III classes while having only 28.38 percent of their students of above-median ability compared with 51.38 percent and 53.82 percent respectively for the D-II and D-III classes.

To test the significance of the variations within and among school categories that appear in Table IX, contingency tables were constructed using the pass-fail data and the class size variable. Four tables were constructed, one for each ability level, and the chi-square test was applied to the distribution. (See Tables XXVIII to XXXI in the Appendix.) Table X summarizes the results of the application of the chi-square test. The results of the analysis show that none of the relationships tested was significantly different.

TABLE X

SUMMARY OF RELATIONSHIPS BETWEEN CLASS SIZE AND STUDENT  
ACHIEVEMENT FOR STUDENTS IN DIFFERENT ABILITY LEVELS  
BASED ON THE COMPLETE SET OF EXAMINATIONS

Ability Level	Chi-square	df	p
Above-average (1st quartile)	0.470	2	.788
High-average (2nd quartile)	4.413	2	.114
Low-average (3rd quartile)	0.221	2	.895
Below-average (4th quartile)	0.474	2	.785

### Summary

Using the pass-fail criterion, the differences in the pass rates achieved by the students in the various class sizes in the Category C and Category D schools proved to be statistically significant. In both cases the large classes achieved the highest pass rates.

When all students' results were tested, no significant differences in achievement were indicated for different class sizes.

To determine whether the significant differences observed in the pass rates achieved by the students in the various class sizes of the Category C and Category D schools were present because students of different ability levels were being compared, the students were divided into ability levels (quartiles) on the basis of their intelligence quotient. Class size was then tested against achievement for each ability level. It was found that for no ability level did the students in any class size achieve a pass rate sufficiently higher to be statistically significant.

## II. COMPARISON OF AGGREGATES

Another method of comparison was based on the aggregate of the marks obtained by the students. Results of the comparison were used to confirm or to negate any trends noticed in the comparison based on the number of examinations passed.

In the set of examinations written by the students, a maximum of 100 marks per subject was possible. The pass mark was 50, or 50 percent of the possible mark. Since there were four examinations, the maximum possible mark was 400. Therefore an aggregate of 200 marks, one-half of the maximum, was considered to be a passing aggregate.

In this section comparisons were made on the basis of school categories, for all students, and on the basis of ability levels (quartiles). The percentages of students in each class size of each school category who had a minimum aggregate of 200 marks was calculated. Table XI presents the results of these calculations.

TABLE XI

PERCENTAGES OF PUPILS HAVING A MINIMUM AGGREGATE MARK OF 200  
ACCORDING TO SCHOOL SIZE AND CLASS SIZE

School Category	Number of Grade Nine Classes		Class Size		
			Small	Medium	Large
A	1		83.84	78.60	79.86
B	2		79.05	82.27	79.42
C	3		64.63	80.92	81.75
D	4 or more		71.62	81.69	83.15

Table XI shows that the percentages of students who passed their examinations varied from 64.63 percent to 83.84

percent -- a difference of 19.21 percent. Small classes in the Category C schools had the lowest pass rate, as they did in the comparison based on the number of examinations passed. The rank of the percentages of the remaining classes is also much the same as before.

In the Category A schools small classes had the highest pass rate, 83.84 percent; in the Category B schools medium-sized classes achieved the highest pass rate, 82.27 percent; and in the Category C and Category D schools, large classes achieved the highest pass rates, 81.75 percent and 83.15 percent respectively. Thus no one class size can be said to predominate in producing higher pass rates, though the tendency appears to be that, when the aggregate criterion is used, students in larger schools and larger classes have a higher achievement rate. This tendency was also found when the pass-fail criterion based on the number of examinations passed was used.

#### Pass-Fail Relationships

To test the significance of the differences in pass rates found in Table XI, contingency tables were constructed using the aggregate data and the class size variable. Five tables were constructed, one for each school category and one for all students, and the chi-square test applied to the distribution. (See Tables XXXII to XXXVI in the Appendix.) Table XII summarizes the results of the application of the

chi-square test.

TABLE XII

SUMMARY OF RELATIONSHIPS BETWEEN CLASS SIZE AND STUDENT  
ACHIEVEMENT USING A PASS-FAIL CRITERION BASED ON  
A MINIMUM AGGREGATE MARK OF 200

Category	Chi-square	df	p
A	3.552	2	.176
B	2.606	2	.275
C	11.951	2	.009
D	6.431	2	.043
All Students	2.699	2	.264

Results of the analysis show that only in the Category C and Category D schools did the students in any class size achieve a pass rate sufficiently higher to be statistically significant. In both Category C and Category D schools students in large classes achieved higher pass rates. (See Tables XXXIV and XXXV.)

#### Ability and Student Achievement

Contingency tables were constructed using the aggregate data and the class size variable. Four tables were constructed, one for each ability level, and the chi-square test applied to the distribution. (See Tables XXXVII to XL in the Appendix.) Table XIII is a summary of the findings reported in Tables XXXVII to XL.

TABLE XIII

SUMMARY OF RELATIONSHIPS BETWEEN CLASS SIZE AND STUDENT  
ACHIEVEMENT FOR STUDENTS IN DIFFERENT ABILITY LEVELS  
BASED ON A MINIMUM AGGREGATE MARK OF 200

Ability Level	Chi-square	df	p
Above-average (1st quartile)	2.384	2	.305
High-average (2nd quartile)	3.292	2	.148
Low-average (3rd quartile)	1.976	2	.385
Below-average (4th quartile)	2.734	2	.276

Results of the analysis show that none of the relationships tested was significantly different.

#### Summary

When the percentages of students who obtained a minimum aggregate mark of 200 in four examinations were used as the criterion, it was found that, when comparison was made by school categories, the observed differences in pass rates were statistically significant in the Category C and Category D schools. In both cases the significance favored the large classes.

When all students' results were tested, no significant differences in achievement were indicated for different class sizes.

When the achievement of students in the various class sizes was tested and student ability controlled, no statis-



tically significant difference existed in any of the relationships tested.

The results obtained in Section II support results obtained in Section I.

### III. COMPARISONS IN LANGUAGE (ENGLISH)

The purpose of this portion of the study was to determine: (a) whether class size is related to student achievement in language, and (b) whether a relationship existed between class size and student achievement in language when the effects of ability were controlled.

#### Pass-Fail Relationships

To analyze the data to discover whether a relationship existed between class size and student achievement in language, contingency tables were constructed using the language pass-fail data and the class size variable. Five tables were constructed, one for each school category and one for all students. The chi-square values were computed and reported, together with the probability levels, in Tables XLI to XLV. (See Appendix.) Table XIV is a summary of the findings reported in Tables XLI to XLV.

Results of the analysis show that only in the Category C and Category D schools did the students in any class size achieve a pass rate sufficiently higher to be statistically significant. In both Category C and Category D schools

TABLE XIV

SUMMARY OF RELATIONSHIPS BETWEEN CLASS SIZE AND STUDENT  
ACHIEVEMENT IN LANGUAGE FOR EACH SCHOOL CATEGORY  
AND FOR ALL STUDENTS

Category	Chi-square	df	p
A	5.531	2	.067
B	5.274	2	.076
C	16.425	2	.001
D	11.907	2	.005
All Students	31.703	2	.000

students in large classes achieved higher pass rates. (See Tables XLIII and XLIV.) The analysis also shows that, for all students, there was a significantly higher pass rate in large classes (Table XLV).

Ability and Student Achievement in Language

To test the significance of the differences in the pass rates achieved in language by all students according to class size and student ability, contingency tables were constructed using the language pass-fail data and the class size variable. Four tables were constructed, one for each ability level. The chi-square values were calculated and reported, together with the probability levels, in Tables XLVI to XLIX. (See Appendix.) Table XV is a summary of the findings reported in Tables XLVI to XLIX.

TABLE XV

SUMMARY OF RELATIONSHIPS BETWEEN CLASS SIZE AND STUDENT  
ACHIEVEMENT IN LANGUAGE FOR STUDENTS  
IN DIFFERENT ABILITY LEVELS

Ability Level	Chi-square	df	p
Above-average (1st quartile)	7.934	2	.019
High-average (2nd quartile)	9.627	2	.009
Low-average (3rd quartile)	4.801	2	.093
Below-average (4th quartile)	6.076	2	.049

The summary shows that there was a statistically significant difference in language pass rates for students in the first, second, and fourth quartiles. In the first and second quartiles students in large classes achieved higher pass rates. (See Tables XLVI and XLVII.) In the fourth quartile (Table XLIX) students in medium-sized classes achieved a significantly higher pass rate. Students of lower ability seem to achieve higher pass rates in smaller classes.

Summary

When the differences in the results of the examination in language were tested on the basis of school categories, no statistical significance resulted from the differences in the pass rates achieved by the students in the various class sizes of the Category A or Category B schools. In the Category C and Category D schools, however, a statis-

tically significant difference was found. This significance was in favor of the large classes.

When the differences in the results of the examination in language were tested for all students, a statistically significant difference was found. Here, also, the significance favored the large classes.

When the differences in the results of the examination in language were tested and student ability controlled, a statistically significant difference existed in three of the four relationships tested. In the first and second quartiles students in large classes achieved significantly higher pass rates, while in the fourth quartile students in medium-sized classes produced a significantly higher pass rate.

From the results of these quartile tests it is apparent that students with above-median ability achieve higher results in language in large classes, while the achievement of students with below-median ability may not be related to class size. The tendency appears to exist for students in the fourth quartile to achieve higher in language in classes not larger than thirty.

#### IV. COMPARISONS IN SOCIAL STUDIES

The purpose of this portion of the study was to determine: (a) whether student achievement in social studies was related to class size, and (b) whether a relationship existed

between class size and student achievement in social studies when the effects of ability were controlled.

#### Pass-Fail Relationships

Contingency tables were constructed using the social studies pass-fail data and the class size variable. Five tables were constructed, one for each school category and one for all students. The chi-square values were calculated and reported, together with the probability levels, in Tables L to LIV. (See Appendix.) Table XVI is a summary of the findings reported in Tables L to LIV.

TABLE XVI

SUMMARY OF RELATIONSHIPS BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT IN SOCIAL STUDIES FOR EACH SCHOOL CATEGORY AND FOR ALL STUDENTS

Category	Chi-square	df	p
A	5.045	2	.084
B	9.395	2	.009
C	13.914	2	.001
D	21.820	2	.000
All Students	0.485	2	.787

The summary shows that, when the results of the examination in social studies were compared by school categories, the observed differences in the pass rates achieved by the students in the various class sizes were statistically signi-

ficant in the Categories B, C, and D schools. Students in small classes, Category B schools achieved a significantly higher pass rate (Table LI), while students in large classes achieved significantly higher pass rates in Categories C and D schools (Tables LII and LIII).

Table XVI also shows that, for all students, there was no significance in the relationship between class size and achievement in social studies.

#### Ability and Student Achievement in Social Studies

To test the significance of the differences in the pass rates achieved in social studies by all students according to class size and student ability, contingency tables were constructed using the social studies pass-fail data and the class size variable. Four tables were constructed, one for each ability level. The chi-square values were calculated and reported, together with the probability levels, in Tables LV to LVIII. (See Appendix.) Table XVII is a summary of the findings reported in Tables LV to LVIII.

The summary shows that none of the relationships tested was significantly different.

#### Summary

When the percentages of students who passed their examination in social studies was used as the criterion, it was found, when comparison was made on the basis of school categories, that a statistically significant difference

TABLE XVII

SUMMARY OF RELATIONSHIPS BETWEEN CLASS SIZE AND STUDENT  
ACHIEVEMENT IN SOCIAL STUDIES FOR STUDENTS  
IN DIFFERENT ABILITY LEVELS

Ability Level	Chi-square	df	p
Above-average (1st quartile)	1.543	2	.470
High-average (2nd quartile)	4.102	2	.136
Low-average (3rd quartile)	2.752	2	.258
Below-average (4th quartile)	1.026	2	.607

existed in three of the four relationships tested. In the Category B schools students in small classes achieved a significantly higher pass rate, while in the Category C and Category D schools students in large classes achieved significantly higher pass rates.

When all students' results were tested, there was no significance in the relationship between class size and achievement in social studies.

When the differences in the results of the examination in social studies were tested and student ability controlled, no statistically significant difference existed in any of the four relationships tested. From these quartile tests it is apparent that students of any ability level achieve equally well in social studies in any size of class.

Since the students of every ability level achieved

equally well in social studies in any class size, it is likely that the statistically significant differences found in the achievement of students in the various class sizes in the Categories B, C, and D schools occurred because results achieved by students of different abilities were being compared.

## V. COMPARISONS IN MATHEMATICS

The purpose of this portion of the study was to determine: (a) whether student achievement in mathematics was related to class size, and (b) whether a relationship existed between class size and student achievement in mathematics when the effects of ability were controlled.

### Pass-Fail Relationships

Contingency tables were constructed using the mathematics pass-fail data and the class size variable. Five tables were constructed, one for each school category and one for all students. The chi-square values were calculated and reported, together with the probability levels, in Tables LIX to LXIII. (See Appendix.) Table XVIII is a summary of the findings reported in Tables LIX to LXIII.

Table XVIII shows that, when the results of the examination in mathematics were compared by school categories, the observed differences in the pass rates achieved by the students in the various class sizes were statistically significant only in the Categories B and C schools. Students in



TABLE XVIII

SUMMARY OF RELATIONSHIPS BETWEEN CLASS SIZE AND STUDENT  
ACHIEVEMENT IN MATHEMATICS FOR EACH SCHOOL  
CATEGORY AND FOR ALL STUDENTS

Category	Chi-square	df	p
A	3.952	2	.147
B	11.003	2	.006
C	15.416	2	.001
D	4.818	2	.092
All Students	3.785	2	.158

medium-sized classes, Category B schools, achieved a higher pass rate (Table LX), while students in large classes, Category C schools, achieved a higher pass rate (Table LXI).

The summary also shows that, when the results of all students were tested, there was no significance in the relationship between class size and achievement in mathematics.

Ability and Student Achievement in Mathematics

To test the significance of the differences observed in the pass rates achieved in mathematics by all students according to class size and student ability, contingency tables were constructed using the mathematics pass-fail data and the class size variable. Four tables were constructed, one for each ability level. The chi-square values were calculated and reported, together with the probability levels,

in Tables LXIV to LXVII. (See Appendix.) Table XIX is a summary of the findings reported in Tables LXIV to LXVII.

TABLE XIX

SUMMARY OF RELATIONSHIPS BETWEEN CLASS SIZE AND STUDENT  
ACHIEVEMENT IN MATHEMATICS FOR STUDENTS  
IN DIFFERENT ABILITY LEVELS

Ability Level	Chi-square	df	p
Above-average (1st quartile)	5.575	2	.065
High-average (2nd quartile)	0.648	2	.724
Low-average (3rd quartile)	1.581	2	.463
Below-average (4th quartile)	11.288	2	.006

Results of the analysis show that only in the fourth quartile was there a statistically significant difference in the pass rates in mathematics for all students in the various class sizes. Table LXVII shows that the students in the medium-sized classes achieved a significantly higher pass rate.

Summary

When the percentages of students who passed their examination in mathematics were used as the criterion, it was found that, when comparison was made by school categories, a statistically significant difference existed in the Categories B and C schools. In the Category B schools students in medium-sized classes achieved a significantly higher pass

rate, while in the Category C schools students in large classes achieved a significantly higher pass rate.

When all students' results were tested, there was no significance in the relationship between class size and achievement in mathematics.

When the differences in the results of the examination in mathematics were tested and student ability controlled, only in the fourth quartile were the differences in pass rates statistically significant. These students of below-average ability achieved a significantly higher pass rate in mathematics in medium-sized classes.

From these quartile tests it is apparent that students of above-median ability achieve equally well in mathematics in any size of class, while students of below-average ability achieve higher in classes that do not exceed thirty students in size. Students with lower ability appear to achieve better when they receive more individualized instruction. Since the students in three of the four ability levels achieved equally well in mathematics in any class size, it is likely that the statistically significant differences found in the achievement of students in the Categories B and C schools occurred because the results achieved by students of different ability levels were being compared.

## VI. COMPARISONS IN SCIENCE

The purpose of this portion of the study was to determine: (a) whether student achievement in science was related to class size, and (b) whether a relationship existed between class size and student achievement in science when the effects of ability were controlled.

Pass-Fail Relationships

Contingency tables were constructed using the science pass-fail data and the class size variable. Five tables were constructed, one for each school category and one for all students. The chi-square values were calculated and reported, together with the probability levels, in Tables LXVIII to LXXII. (See Appendix.) Table XX is a summary of the findings reported in Tables LXVIII to LXXII.

TABLE XX

SUMMARY OF RELATIONSHIPS BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT IN SCIENCE FOR EACH SCHOOL CATEGORY AND FOR ALL STUDENTS

Category	Chi-square	df	p
A	8.964	2	.012
B	3.707	2	.165
C	5.449	2	.069
D	7.164	2	.031
All Students	3.698	2	.165

The results of the analysis show that only in the Categories A and D schools did the students in any class size achieve a pass rate in science sufficiently higher to be statistically significant. Students in small classes of Category A schools achieved a significantly higher pass rate (Table LXVIII), while students in large classes, Category D schools, achieved a significantly higher pass rate (Table LXXI). The summary also shows that, when all students' results were tested, there was no significance in the relationship between class size and achievement in science.

#### Ability and Student Achievement in Science

To test the differences observed in the pass rates achieved in science by all students according to class size and student ability, contingency tables were constructed using the science pass-fail data and the class size variable. Four tables were constructed, one for each ability level. The chi-square values were calculated and reported, together with the probability levels, in Tables LXXIII to LXXVI. (See appendix.) Table XXI is a summary of the findings reported in Tables LXXIII to LXXVI.

Results of the analysis show that only in the third quartile was there a statistically significant difference in the pass rates achieved by students in any class size in science. Students in small classes achieved a significantly higher pass rate. (See Table LXXV.)

TABLE XXI

SUMMARY OF RELATIONSHIPS BETWEEN CLASS SIZE AND STUDENT  
ACHIEVEMENT IN SCIENCE FOR STUDENTS  
IN DIFFERENT ABILITY LEVELS

Ability Level	Chi-square	df	p
Above-average (1st quartile)	1.663	2	.446
High-average (2nd quartile)	2.648	2	.271
Low-average (3rd quartile)	7.521	2	.024
Below-average (4th quartile)	0.871	2	.653

Summary

When the percentages of students who passed their examination in science were used as the criterion, it was found that, when comparison was made by school categories, the observed differences in pass rates were statistically significant in the Categories A and D schools. In Category A schools students in small classes achieved a significantly higher pass rate, while in Category D schools students in large classes achieved a significantly higher pass rate. When all students' results were tested, there was no significance in the relationship between class size and achievement in science.

When the differences in the results of the examination in science were tested and student ability controlled, it was found that only in the third quartile were the differ-

ences in pass rates statistically significant. These students of low-average ability achieved higher pass rates in small classes.

From these quartile tests it is apparent that students of above-median ability achieve equally well in science in any size of class, while students of low-average ability have higher achievement in smaller classes. The achievement of students of below-average ability does not seem to be related to class size.

#### VII. ANALYSIS OF COVARIANCE

As a final test to determine whether the findings obtained in the previous comparisons were valid, a ten-percent random sample was taken from the body of students used in this study. The sample consisted of 66 students from small classes, 335 students from medium-sized classes, and 256 students from large classes. The examination results of these students were processed, using a covariance program. In this comparison, ability as measured by I.Q. was controlled, and the significance of the differences in the aggregates of marks obtained by the students in the four examinations was tested. Table XXII contains the results of the analysis of covariance.

TABLE XXII

ANALYSIS OF COVARIANCE USING FINAL EXAMINATION RESULTS  
AS THE DEPENDENT VARIABLE WITH ABILITY SCORES  
USED AS A COVARIABLE

Source of Variation	Sums of Squares	df	F
Between	367.25	2	
Within	1036894.50	653	0.116*
Total	1037261.75	655	

\* not significant

The data in Table XXII indicate that, when adjusted for ability, no statistically significant difference existed in the aggregates of marks obtained by the students in any class size. This result corresponds with those found in Section I and Section II where no statistical significance was found when comparisons were made which took the ability of the students into consideration. The analysis of covariance can therefore be said to validate the findings reported in the various comparisons made in this chapter.



## CHAPTER V

### SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

#### I. SUMMARY OF THE INVESTIGATION

The purposes of this study were to determine: (1) the relationship between class size and academic achievement in the Grade IX classes in the high schools of Manitoba; (2) whether there is an optimum size of class in which students can achieve better results in external examinations; and (3) the best size of class for each of the four subjects used as the basis of this study. The study was confined to those high schools in Manitoba which had at least one Grade IX class except those in Metropolitan Winnipeg, Brandon, and north of the Swan River Valley. Special schools such as Indian schools and private schools were also omitted.

In the related literature, studies reported prior to World War II were discounted because of the contradictory or inconclusive results obtained. Many were not scientifically conducted, and sophisticated methods of determining significance were not available at that time.

The results of the Department of Education Grade IX examinations of June, 1965 were obtained, also the half-yearly reports for the 1965 spring term. Using the data from these reports, the schools used in the study were classified

as: Category A, those schools having one Grade IX class; Category B, those schools having two Grade IX classes; Category C, those schools having three Grade IX classes; and Category D, those schools having four or more Grade IX classes. The classes were classified as: Category I (small), having 20 students or fewer; Category II (medium-sized), having from 21 to 29 students; and Category III (large), having 30 students or more. The students were classified according to their ability level (intelligence quotient) into above-average (first quartile), high-average (second quartile), low-average (third quartile), and below-average (fourth quartile). The results of the set of examinations were tabulated for each student, together with his I.Q., the aggregate of marks obtained, and the number of examinations passed. Results from 6,585 students in 261 classes of 140 schools were used in the study.

Comparisons were made of the pass rates of students in each class size using the pass-fail criterion and the aggregate mark criterion. These comparisons were made on the basis of: (1) school categories, to determine whether students in any size of class achieved higher pass rates in any size of school; (2) all students, to determine whether any differences noted in the first comparison carried over into the whole sample; and (3) the quartile distribution of ability, to determine whether students of any ability level

achieved significantly higher pass rates in one class size than in another. In each comparison a chi-square test of significance was made to determine whether the observed differences were statistically significant.

Comparisons were made in each of the four subjects in which examinations were written, language (English), social studies, mathematics, and science to determine whether students in any class size achieved significantly higher pass rates in any of them. These comparisons were made according to school categories as well as for all students. Comparisons were also made using the quartile distribution of ability. The significance of the observed differences was tested by the chi-square test of significance.

Finally, a ten-percent random sample was taken from each class size in each school category and an analysis of covariance performed to determine whether there was any significant difference in achievement when ability as determined by intelligence was controlled. This comparison was to serve as a test of the validity of the results previously obtained.

## II. SUMMARY OF RESULTS

(1) Both comparisons based on the pass-fail criterion showed that in schools where there were three or more Grade IX classes the students in the large classes achieved pass rates which were significantly higher. When the ability of

the students was taken into consideration, however, there was no significance in the differences in pass rates. Class size, therefore, was not a significant factor in determining the pass rate of the students where the whole set of examinations was concerned.

(2) Differences in pass rates in language were statistically significant in schools having three or more Grade IX classes and for all students. In each case students in large classes achieved significantly higher pass rates. Students in three ability levels achieved higher pass rates in language in large classes. In the first and second quartiles students in large classes achieved significantly higher pass rates, while in the fourth quartile students in medium-sized classes achieved a significantly higher pass rate. Within the limits of this study, therefore, class size was a significant factor in the achievement of students in language.

(3) Students in small classes achieved a significantly higher pass rate in social studies in schools having two Grade IX classes, while students in large classes achieved significantly higher pass rates in schools having three or more Grade IX classes. When student ability was taken into consideration, however, there was no significance in the differences in pass rates in social studies. Therefore, within the limits of this study, class size was not a significant factor in the achievement of students in social studies.

(4) Students in medium-sized classes achieved a significantly higher pass rate in mathematics in schools having two Grade IX classes, and students in large classes achieved a significantly higher pass rate in schools having three Grade IX classes. When student ability was considered, students in the below-average ability level (fourth quartile) achieved a significantly higher pass rate in medium-sized classes. Therefore, within the limits of this study, class size was not a significant factor in achievement in mathematics for students of above-median ability, while students of below-average ability achieve significantly higher pass rates in classes that are not over thirty students in size.

(5) Students in small classes achieved a significantly higher pass rate in science in schools having one Grade IX class, while students in large classes achieved a significantly higher pass rate in schools having four or more Grade IX classes. Students of low-average ability (third quartile) achieved a significantly higher pass rate in small classes. Class size is therefore not a significant factor in achievement in science for students of above-median ability, while students of low-average ability achieve significantly higher pass rates in small classes. The achievement in science of students of below-average ability does not seem to be related to class size.

(6) The results of the comparisons on a subject basis

provide one reason why there was no significance in the differences in pass rates when comparisons were on the basis of the whole set of examinations. It is that the tendency towards higher pass rates in large classes observed in the comparisons in language were balanced by the tendency towards higher pass rates in small classes in the other three subjects.

(7) The analysis of covariance with ability as determined by I.Q. controlled indicated that there was no statistically significant difference in the aggregates of marks obtained by the students of any class size. Since this finding is similar to those found when the results of the set of examinations were compared by other means, the analysis of covariance reinforces previous conclusions.

### III. CONCLUSIONS AND IMPLICATIONS

#### Conclusions

From this study, there are strong indications that in some subjects achievement is not affected significantly in large classes. For these subjects, the retention of large classes would seem practical. In large schools, moreover, it would seem possible to take into account different achievement rates in different ability levels by grouping students having above-median ability in large classes and those having below-median ability in smaller classes. Further re-arranging might even be possible, with the same students attending a

large class for one subject and a small one for another.

Students with above-median ability achieved significantly higher pass rates in language in large classes. There was no statistical significance in the differences in the achievement of these students in social studies, mathematics, or science in any class size. Logically, therefore, students with above-median ability should be placed in classes of not fewer than thirty.

Students of low-average ability achieved significantly higher pass rates in science in small classes, while their achievement in language, social studies, and mathematics was not significantly affected by class size. Students of below-average ability achieved significantly higher pass rates in language and in mathematics in medium-sized classes. Logically, therefore, students of below-median ability should be placed in small classes for science and medium-sized classes for language and mathematics.

Another important factor pointed out by this study is the danger of taking the results of a set of examinations at face value. While most administrators are probably fully aware of this, many people (including many parents) are not. In this study there were twenty-four comparisons involving school categories, and the differences in pass rates achieved by the students in the different class sizes turned out to be statistically significant in thirteen of them -- over fifty

percent. When the results of all students were tested, however, in only one comparison out of six were the observed differences in pass rates statistically significant. Comparison of pass rates cannot therefore be said to be valid unless the ability of the students in question is taken into consideration. The teachers of small classes, for example, should not be expected to obtain a high pass rate from their students just because the classes are small.

#### Implications for Administrators

The school administrator has a dual task to perform. On the one hand students must be grouped into classes in such a manner as to obtain for these students the maximum possibility of high academic achievement from the staff and the facilities available. This could involve: (1) testing students to determine their level of ability; (2) class size arrangements and the attendant schedule shifts necessary to enable students to attend the size of class in which they achieve highest in each subject; (3) adjusting teacher workload to enable teachers of lower-ability pupils to give more individual instruction; (4) the provision of adequate classroom space and teaching staff to ensure that optimum learning conditions are present for students of all ability levels in every subject. Conversely, the school administrator must convince people such as parents and some school board members that while a high pass rate may be tangible evidence of high



academic achievement, a lower pass rate at times is not infallible proof that all is not well in the school system.

#### IV. RECOMMENDATIONS FOR FUTURE RESEARCH

In this study one important variable, teacher characteristics, was considered to be controlled because of the large number of teachers involved. Another study might be undertaken in which classes selected have been taught by teachers having approximately the same training and experience in order to equalize this variable more completely. This would necessitate a knowledge of teacher qualifications not available for this study.

In this study three class sizes were used, small, medium-sized, and large. Although this had the advantage of permitting a study over a range of sizes of class, it also made comparisons more difficult and complicated. To simplify procedure, and to provide a smaller break between small and large classes, it might be advisable in future studies to use only two class sizes, with the small classes containing perhaps 25 students or fewer, and the large classes containing perhaps 30 students or more.

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APPENDIX

TABLE XXIII

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN CATEGORY A SCHOOLS BASED ON NUMBER  
OF EXAMINATIONS PASSED

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	232	78.11	65	21.89	297
Medium Classes (II)	469	71.16	190	28.84	659
Large Classes (III)	638	74.28	221	25.72	859
Totals	1,339	73.77	476	26.23	1,815

$$\chi^2 = 5.314, df = 2, p = .075$$

TABLE XXIV

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN CATEGORY B SCHOOLS BASED ON NUMBER  
OF EXAMINATIONS PASSED

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	156	74.29	54	25.71	210
Medium Classes (II)	977	76.63	298	23.37	1,275
Large Classes (III)	362	74.48	124	25.52	486
Totals	1,495	75.85	476	24.15	1,971

$$\chi^2 = 1.196, df = 2, p = .545$$

TABLE XXV

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN CATEGORY C SCHOOLS BASED ON NUMBER  
OF EXAMINATIONS PASSED

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	47	57.32	35	42.68	82
Medium Classes (II)	372	74.70	126	25.30	498
Large Classes (III)	98	77.78	28	22.22	126
Totals	517	73.23	189	26.77	706

$$\chi^2 = 12.473, df = 2, p = .003$$

TABLE XXVI

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN CATEGORY D SCHOOLS BASED ON NUMBER  
OF EXAMINATIONS PASSED

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	44	59.46	30	40.54	74
Medium Classes (II)	716	75.74	229	24.26	945
Large Classes (III)	843	78.49	231	21.51	1,074
Totals	1,603	76.59	490	23.41	2,093

$$\chi^2 = 14.645, df = 2, p = .001$$

TABLE XXVII

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
FOR ALL STUDENTS BASED ON NUMBER  
OF EXAMINATIONS PASSED

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	479	72.25	184	27.75	663
Medium Classes (II)	2,534	75.04	843	24.96	3,377
Large Classes (III)	1,941	76.27	604	23.73	2,545
Totals	4,954	75.23	1,631	24.77	6,585

$$\chi^2 = 4.703, df = 2, p = .097$$

TABLE XXVIII

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
FOR FIRST QUARTILE STUDENTS BASED ON NUMBER  
OF EXAMINATIONS PASSED

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	130	99.25	3	0.75	133
Medium Classes (II)	828	96.62	29	3.38	857
Large Classes (III)	635	96.80	21	3.20	656
Totals	1,593	96.78	53	3.22	1,646

$$\chi^2 = 0.470, df = 2, p = .788$$



TABLE XXIX

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
FOR SECOND QUARTILE STUDENTS BASED ON NUMBER  
OF EXAMINATIONS PASSED

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	123	80.39	30	19.61	153
Medium Classes (II)	672	83.90	129	16.10	801
Large Classes (III)	539	86.66	83	13.34	622
Totals	1,334	84.64	243	15.36	1,576

$$\chi^2 = 4.413, df = 2, p = .114$$

TABLE XXX

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
FOR THIRD QUARTILE STUDENTS BASED ON NUMBER  
OF EXAMINATIONS PASSED

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	125	73.10	46	26.90	171
Medium Classes (II)	585	71.96	228	28.04	813
Large Classes (III)	475	72.96	176	27.04	651
Totals	1,185	72.48	450	27.52	1,635

$$\chi^2 = 0.221, df = 2, p = .895$$

TABLE XXXI

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
FOR FOURTH QUARTILE STUDENTS BASED ON NUMBER  
OF EXAMINATIONS PASSED

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	102	49.51	104	50.59	206
Medium Classes (II)	446	49.23	460	50.77	906
Large Classes (III)	293	47.56	323	52.44	616
Totals	841	48.66	887	51.34	1,728

$$\chi^2 = 0.474, df = 2, p = .785$$

TABLE XXXII

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN CATEGORY A SCHOOLS BASED ON MINIMUM  
AGGREGATE MARK OF 200

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	249	83.84	48	16.16	297
Medium Classes (II)	518	78.60	141	21.40	659
Large Classes (III)	686	79.86	173	20.14	859
Totals	1,453	80.06	362	19.94	1,815

$$\chi^2 = 3.552, df = 2, p = .176$$

TABLE XXXIII

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN CATEGORY B SCHOOLS BASED ON MINIMUM  
AGGREGATE MARK OF 200

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	166	79.05	44	20.95	210
Medium Classes (II)	1,049	82.27	226	17.73	1,275
Large Classes (III)	386	79.42	100	20.58	486
Totals	1,601	81.23	370	18.77	1,971

$$\chi^2 = 2.606, df = 2, p = .275$$

TABLE XXXIV

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN CATEGORY C SCHOOLS BASED ON MINIMUM  
AGGREGATE MARK OF 200

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	53	64.63	29	35.37	82
Medium Classes (II)	403	80.92	95	19.08	498
Large Classes (III)	103	81.75	23	18.25	126
Totals	559	79.18	147	20.82	706

$$\chi^2 = 11.951, df = 2, p = .004$$

TABLE XXXV

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN CATEGORY D SCHOOLS BASED ON MINIMUM  
AGGREGATE MARK OF 200

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	53	71.62	21	28.38	74
Medium Classes (II)	772	81.69	173	18.11	945
Large Classes (III)	893	83.15	181	16.85	1,074
Totals	1,718	82.08	375	17.92	2,093

$$\chi^2 = 6.431, df = 2, p = .043$$

TABLE XXXVI

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
FOR ALL STUDENTS BASED ON MINIMUM  
AGGREGATE MARK OF 200

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	521	78.58	142	21.42	663
Medium Classes (II)	2,742	81.20	635	18.80	3,377
Large Classes (III)	2,068	81.26	477	18.74	2,545
Totals	5,331	80.96	1,254	19.04	6,585

$$\chi^2 = 2.699, df = 2, p = .264$$

TABLE XXXVII

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
FOR FIRST QUARTILE STUDENTS BASED ON MINIMUM  
AGGREGATE MARK OF 200

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	133	100.00	0	0.00	133
Medium Classes (II)	846	98.72	11	1.28	857
Large Classes (III)	645	98.32	11	1.68	656
Totals	1,624	98.66	22	1.34	1,646

$$\chi^2 = 2.384, df = 2, p = .305$$

TABLE XXXVIII

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
FOR SECOND QUARTILE STUDENTS BASED ON MINIMUM  
AGGREGATE MARK OF 200

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	132	86.27	21	13.73	153
Medium Classes (II)	726	90.64	75	9.36	801
Large Classes (III)	566	91.00	56	9.00	622
Totals	1,424	90.36	152	9.64	1,576

$$\chi^2 = 3.292, df = 2, p = .148$$

TABLE XXXIX

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
FOR THIRD QUARTILE STUDENTS BASED ON MINIMUM  
AGGREGATE MARK OF 200

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	144	84.21	27	15.79	171
Medium Classes (II)	647	79.58	166	20.42	813
Large Classes (III)	526	80.80	125	19.20	651
Totals	1,317	80.55	318	19.45	1,635

$$\chi^2 = 1.976, df = 2, p = .385$$

TABLE XL

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
FOR FOURTH QUARTILE STUDENTS BASED ON MINIMUM  
AGGREGATE MARK OF 200

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	111	53.88	95	46.12	206
Medium Classes (II)	523	57.73	383	42.27	906
Large Classes (III)	331	53.73	285	46.27	616
Totals	965	55.84	763	44.16	1,728

$$\chi^2 = 2.734, df = 2, p = .276$$

TABLE XLI

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN LANGUAGE IN CATEGORY A SCHOOLS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	206	69.36	91	30.64	297
Medium Classes (II)	496	75.27	163	24.73	659
Large Classes (III)	654	76.14	205	23.86	859
Totals	1,356	74.71	459	25.29	1,815

$$\chi^2 = 5.531, df = 2, p = .067$$

TABLE XLII

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN LANGUAGE IN CATEGORY B SCHOOLS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	153	72.86	57	27.14	210
Medium Classes (II)	999	78.35	276	21.65	1,275
Large Classes (III)	392	80.65	94	19.35	486
Totals	1,544	78.34	427	21.66	1,971

$$\chi^2 = 5.274, df = 2, p = .076$$

TABLE XLIII

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN LANGUAGE IN CATEGORY C SCHOOLS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	51	62.20	31	37.80	82
Medium Classes (II)	400	80.34	98	19.66	498
Large Classes (III)	106	84.13	20	15.87	126
Totals	557	78.90	149	21.10	706

$$\chi^2 = 16.425, df = 2, p = .001$$

TABLE XLIV

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN LANGUAGE IN CATEGORY D SCHOOLS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	51	68.92	23	31.08	74
Medium Classes (II)	747	79.05	198	20.95	945
Large Classes (III)	875	81.47	199	18.53	1,074
Totals	1,673	79.93	420	20.07	2,093

$$\chi^2 = 11.907, df = 2, p = .005$$



TABLE XLV

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN LANGUAGE FOR ALL STUDENTS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	461	69.53	202	30.47	663
Medium Classes (II)	2,642	78.24	735	21.76	3,377
Large Classes (III)	2,027	79.65	518	20.35	2,545
Totals	5,130	77.90	1,455	22.10	6,585

$$\chi^2 = 31.703, df = 2, p = .001$$

TABLE XLVI

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN LANGUAGE FOR FIRST QUARTILE STUDENTS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	121	90.98	12	9.02	133
Medium Classes (II)	819	95.57	38	4.43	857
Large Classes (III)	633	96.49	23	3.51	656
Totals	1,573	95.57	73	4.43	1,646

$$\chi^2 = 7.934, df = 2, p = .019$$

TABLE XLVII

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN LANGUAGE FOR SECOND QUARTILE STUDENTS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	119	77.78	34	22.22	153
Medium Classes (II)	673	84.02	128	15.98	801
Large Classes (III)	544	87.46	78	12.54	622
Totals	1,336	84.77	240	15.23	1,576

$$\chi^2 = 9.627, df = 2, p = .009$$

TABLE XLVIII

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN LANGUAGE FOR THIRD QUARTILE STUDENTS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	118	69.01	53	30.99	171
Medium Classes (II)	613	75.40	200	24.60	813
Large Classes (III)	502	77.11	149	22.89	651
Totals	1,233	75.41	402	24.59	1,635

$$\chi^2 = 4.801, df = 2, p = .093$$

TABLE XLIX

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN LANGUAGE FOR FOURTH QUARTILE STUDENTS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	103	50.00	103	50.00	206
Medium Classes (II)	537	59.27	369	40.73	906
Large Classes (III)	348	56.49	268	43.51	616
Totals	988	57.18	740	42.82	1,728

$$\chi^2 = 6.076, df = 2, p = .049$$

TABLE L

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN SOCIAL STUDIES IN CATEGORY A SCHOOLS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	240	80.81	57	19.19	297
Medium Classes (II)	489	74.20	170	25.80	659
Large Classes (III)	648	75.44	211	24.56	859
Totals	1,377	75.87	438	24.13	1,815

$$\chi^2 = 5.045, df = 2, p = .084$$

TABLE LI

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN SOCIAL STUDIES IN CATEGORY B SCHOOLS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	168	80.00	42	20.00	210
Medium Classes (II)	1,006	78.91	269	21.09	1,275
Large Classes (III)	351	72.22	135	27.78	486
Totals	1,525	77.37	446	22.63	1,971

$$\chi^2 = 9.395, df = 2, p = .009$$

TABLE LII

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN SOCIAL STUDIES IN CATEGORY C SCHOOLS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	46	56.10	36	43.90	82
Medium Classes (II)	368	73.90	130	26.10	498
Large Classes (III)	99	78.57	27	21.43	126
Totals	513	72.66	193	27.34	706

$$\chi^2 = 13.914, df = 2, p = .001$$

TABLE LIII

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN SOCIAL STUDIES IN CATEGORY D SCHOOLS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	40	54.05	34	45.95	74
Medium Classes (II)	692	73.23	253	26.77	945
Large Classes (III)	831	77.37	243	22.63	1,074
Totals	1,563	74.68	530	25.32	2,093

$$\chi^2 = 21.820, df = 2, p = .001$$

TABLE LIV

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN SOCIAL STUDIES FOR ALL STUDENTS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	494	74.51	169	25.49	663
Medium Classes (II)	2,555	75.66	822	24.34	3,377
Large Classes (III)	1,929	75.80	616	24.20	2,545
Totals	4,978	75.60	1,607	24.40	6,585

$$\chi^2 = 0.485, df = 2, p = .787$$

TABLE LV

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN SOCIAL STUDIES FOR FIRST QUARTILE STUDENTS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	125	93.98	08	6.02	133
Medium Classes (II)	805	93.70	52	6.30	857
Large Classes (III)	606	92.38	50	7.62	656
Totals	1,536	93.32	110	6.68	1,646

$$\chi^2 = 1.543, df = 2, p = .470$$

TABLE LVI

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN SOCIAL STUDIES FOR SECOND QUARTILE STUDENTS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	117	76.47	36	23.53	153
Medium Classes (II)	647	80.77	154	19.23	801
Large Classes (III)	518	83.28	104	16.72	622
Totals	1,282	81.35	294	18.65	1,576

$$\chi^2 = 4.102, df = 2, p = .136$$

TABLE LVII

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN SOCIAL STUDIES FOR THIRD QUARTILE STUDENTS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	133	77.78	38	22.22	171
Medium Classes (II)	584	71.83	229	28.17	813
Large Classes (III)	467	71.74	184	28.26	651
Totals	1,184	72.42	451	27.58	1,635

$$\chi^2 = 2.752, df = 2, p = .258$$

TABLE LVIII

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN SOCIAL STUDIES FOR FOURTH QUARTILE STUDENTS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	119	57.77	87	42.23	206
Medium Classes (II)	516	57.28	387	42.72	906
Large Classes (III)	338	54.87	278	45.13	616
Totals	976	56.48	752	43.52	1,728

$$\chi^2 = 1.026, df = 2, p = .607$$

TABLE LIX

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN MATHEMATICS IN CATEGORY A SCHOOLS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	244	82.15	53	17.85	297
Medium Classes (II)	509	77.23	150	22.77	659
Large Classes (III)	692	80.56	167	19.44	859
Totals	1,445	79.61	370	20.39	1,815

$$\chi^2 = 3.952, df = 2, p = .147$$

TABLE LX

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN MATHEMATICS IN CATEGORY B SCHOOLS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	162	77.14	48	22.86	210
Medium Classes (II)	1,026	80.47	249	19.53	1,275
Large Classes (III)	356	73.27	130	26.73	486
Totals	1,544	78.34	427	21.66	1,971

$$\chi^2 = 11.003, df = 2, p = .006$$



TABLE LXI

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN MATHEMATICS IN CATEGORY C SCHOOLS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	48	58.54	34	41.46	82
Medium Classes (II)	386	77.51	112	22.49	498
Large Classes (III)	101	80.16	25	19.84	126
Totals	535	75.78	171	24.22	706

$$\chi^2 = 15.416, df = 2, p = .001$$

TABLE LXII

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN MATHEMATICS IN CATEGORY D SCHOOLS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	53	71.62	21	28.38	74
Medium Classes (II)	762	80.63	183	19.37	945
Large Classes (III)	836	77.84	238	22.16	1,074
Totals	1,651	78.88	442	21.12	2,093

$$\chi^2 = 4.818, df = 2, p = .092$$

TABLE LXIII

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN MATHEMATICS FOR ALL STUDENTS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	507	76.47	156	23.53	663
Medium Classes (II)	2,683	79.45	694	20.55	3,377
Large Classes (III)	1,985	77.80	560	22.20	2,545
Totals	5,175	78.59	1,410	21.41	6,585

$$\chi^2 = 3.785, df = 2, p = .158$$

TABLE LXIV

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN MATHEMATICS FOR FIRST QUARTILE STUDENTS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	133	100.00	00	0.00	133
Medium Classes (II)	824	96.38	33	3.62	857
Large Classes (III)	636	96.95	20	3.05	656
Totals	1,593	96.78	53	3.22	1,646

$$\chi^2 = 5.575, df = 2, p = .065$$

TABLE LXV

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN MATHEMATICS FOR SECOND QUARTILE STUDENTS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	139	90.85	14	9.15	153
Medium Classes (II)	710	88.64	91	11.36	801
Large Classes (III)	554	89.07	68	10.93	622
Totals	1,403	89.06	173	10.94	1,576

$$\chi^2 = 0.648, df = 2, p = .724$$

TABLE LXVI

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN MATHEMATICS FOR THIRD QUARTILE STUDENTS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	125	73.10	46	26.90	171
Medium Classes (II)	630	77.49	183	22.51	813
Large Classes (III)	496	76.19	155	23.81	651
Totals	1,251	76.51	384	23.49	1,635

$$\chi^2 = 1.581, df = 2, p = .463$$

TABLE LXVII

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN MATHEMATICS FOR FOURTH QUARTILE STUDENTS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	110	53.40	96	46.60	206
Medium Classes (II)	519	57.28	387	42.72	906
Large Classes (III)	299	48.54	317	51.46	616
Totals	928	53.70	800	46.30	1,728

$$\chi^2 = 11.288, df = 2, p = .006$$

TABLE LXVIII

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN SCIENCE IN CATEGORY A SCHOOLS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	253	85.19	44	14.81	297
Medium Classes (II)	510	77.39	149	22.61	659
Large Classes (III)	665	77.42	194	22.58	859
Totals	1,428	78.68	387	21.32	1,815

$$\chi^2 = 8.964, df = 2, p = .012$$

TABLE LXIX

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN SCIENCE IN CATEGORY B SCHOOLS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	173	82.38	37	17.62	210
Medium Classes (II)	1,016	79.69	259	20.31	1,275
Large Classes (III)	406	83.54	80	16.46	486
Totals	1,595	80.92	376	19.08	1,971

$$\chi^2 = 3.707, df = 2, p = .165$$

TABLE LXX

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN SCIENCE IN CATEGORY C SCHOOLS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	57	69.51	25	30.49	82
Medium Classes (II)	396	79.52	102	20.48	498
Large Classes (III)	104	82.54	22	17.46	126
Totals	557	78.90	149	21.10	706

$$\chi^2 = 5.449, df = 2, p = .069$$

TABLE LXXI

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN SCIENCE IN CATEGORY D SCHOOLS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	54	72.97	20	27.03	74
Medium Classes (II)	765	80.95	180	19.05	945
Large Classes (III)	900	83.80	174	16.20	1,074
Totals	1,719	82.13	374	17.87	2,093

$$\chi^2 = 7.164, df = 2, p = .031$$

TABLE LXXII

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN SCIENCE FOR ALL STUDENTS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	537	81.00	126	19.00	663
Medium Classes (II)	2,687	79.51	690	20.49	3,377
Large Classes (III)	2,075	81.53	470	18.47	2,545
Totals	5,299	80.47	1,286	19.53	6,585

$$\chi^2 = 3.698, df = 2, p = .165$$

TABLE LXXIII

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN SCIENCE FOR FIRST QUARTILE STUDENTS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	131	98.50	02	1.50	133
Medium Classes (II)	826	96.38	31	3.62	857
Large Classes (III)	632	96.34	24	3.66	656
Totals	1,589	96.54	57	3.46	1,646

$$\chi^2 = 1.663, df = 2, p = .446$$

TABLE LXXIV

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN SCIENCE FOR SECOND QUARTILE STUDENTS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	129	84.31	24	15.69	153
Medium Classes (II)	698	87.14	103	12.86	801
Large Classes (III)	553	88.94	69	11.06	622
Totals	1,380	87.56	196	12.44	1,576

$$\chi^2 = 2.648, df = 2, p = .271$$

TABLE LXXV

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN SCIENCE FOR THIRD QUARTILE STUDENTS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	145	84.80	26	15.20	171
Medium Classes (II)	611	75.15	202	24.85	813
Large Classes (III)	505	77.57	146	22.43	651
Totals	1,261	77.13	374	22.87	1,635

$$\chi^2 = 7.521, df = 2, p = .024$$

TABLE LXXVI

RELATIONSHIP BETWEEN CLASS SIZE AND STUDENT ACHIEVEMENT  
IN SCIENCE FOR FOURTH QUARTILE STUDENTS

SIZE OF CLASS	PASS		FAIL		TOTAL
	N	%	N	%	
Small Classes (I)	132	64.08	74	35.92	206
Medium Classes (II)	552	60.94	354	39.06	906
Large Classes (III)	385	62.50	231	37.50	616
Totals	1,069	61.86	659	38.14	1,728

$$\chi^2 = 0.871, df = 2, p = .653$$