Educational achievement in rural Montana high schools
by John Wesley Kimble

A thesis submitted in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE in Applied Economics
Montana State University

Abstract:
This study attempts to look at Montana's educational system and its impact on rural and urban students. It has two major objectives: first, to analyze the effects of school size on student achievement and, second, to analyze the factors determining achievement and their variation in different size schools. In order to accomplish this, a sample of sophomore and senior students was taken and they were administered an achievement test. The data collected was analyzed in light of project objectives. The study concluded that school size was not a significant factor in student achievement and that the factors that contribute to student achievement vary for schools of different sizes.

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Signature John W. Kimble

Date Nov. 19, 1974

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A thesis submitted in partial fulfillment
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ABSTRACT

This study attempts to look at Montana's educational system and its impact on rural and urban students. It has two major objectives: first, to analyze the effects of school size on student achievement and, second, to analyze the factors determining achievement and their variation in different size schools. In order to accomplish this, a sample of sophomore and senior students was taken and they were administered an achievement test. The data collected was analyzed in light of project objectives. The study concluded that school size was not a significant factor in student achievement and that the factors that contribute to student achievement vary for schools of different sizes.

Chapter I

INTRODUCTION

The purpose of this study is to analyze how the resources used by a school system relate to educational achievement. This research is especially relevant to Montana because of the problem caused both by the low population density and the rural nature of the state.

The Census of Population defines rural residents as those who live in the open country or in communities of less than 2,500 people. Montana is a large state which encompasses 147,138 square miles or more than 94 million acres. According to the 1970 census, its population numbers 694,409 people. The census lists 135 cities, of which 32 have a population of 2,500 or more and are considered urban. Slightly more than 53 percent of the population live in these 32 communities. The other 323,733 people or 47 percent of the population are rural. In 1960, 49 percent of the population was considered rural which shows a slight rural to urban migration.

Figures which represent the education of the population show that the urban population is better schooled than the rural portion, especially at the post secondary level. The 1970 Montana census showed the median number of school years completed for urban persons 25 years and older to 12.4 years, 12.1 years for the rural nonfarm

population, and 12.2 years for the rural farm population. Of the urban people, 13.6 percent have four years of college or more while only 6.4 percent of the rural farm population has four or more years of college. These figures compare favorably with the national medians. The national median of school years completed for persons over 25 are 12.2 years for the urban population and 11.1 years for the rural population. The percentage of persons with four years of college or more in the United States is 10.7 while nationally the rural percentage is 6.7 [Commerce, 1970].

The educational system has historically shortchanged rural people. Low levels of educational achievement by rural youth are indicative of the poor quality of education [Coleman, 1966]. While data indicates that rural youth are getting a better education than their parents it still lags behind that of their urban counterparts. Rural students drop out of school at an earlier age and fewer rural students go to college. Those who do go on to school have a hard time competing with the urban student [U.S. Commission on Rural Poverty, 1967: 41-44].

The various components of an educational system which include teachers, buildings, facilities, curriculum, and programs are usually of less quality in rural districts than in urban schools. Low teacher salaries in rural schools do not attract or retain the better

teachers. Poor facilities also contribute to the lack of better teachers. In general, small schools lack the equipment that the large urban schools can afford. Furthermore, students who live in rural areas are hampered by geographic isolation and what is called "small town milieu" [Sweeney, 1971: 4-8]. These limitations may inhibit them from learning new behaviors for coping with urban living. The Coleman Report (a recent study which hypothesizes that rural students are getting short-changed educationally) concluded that the low educational level of the parents and a combination of community factors place rural students at a disadvantage even when they enter school.

The majority of Montana's high schools, about 65 percent, have less than 180 students. These schools account for 20 percent of the total number of high school students in the state. Sixteen of Montana's largest urban high schools have approximately 50 percent of the student enrollment. In 1964 Montana's expenditures were about $570 per pupil in average daily attendance. In comparison, New York spent $790 per pupil in average daily attendance for the same period. In 1972, Montana spent 52.18 cents of every tax dollar on education [Montana, 1972: I,1,V.1]. In Fiscal Year 70-71, 73 percent of school funds came from the local level, 21 percent from the state, and 6 percent from the U. S. government [Montana Schools, 1972:I.1]. These figures have not varied by more than 2 percent in the past ten years.

This large tax burden carried by the local taxpayer can cause inequities in school quality. Because of the spillover of educational benefits to areas outside the local school district, emphasis has been placed on supporting school systems through a broader tax base.

The problems of rural schools, and the costs of schooling, have made the issues of school efficiency, school quality, and educational quality of interest to nearly every citizen. In the last decade, rising costs and increasing taxes have aroused the public's interest in the economics of schools. Accountability and efficiency have become key educational issues. The problems of education require much knowledge about the educational process and educational outcomes.

Economics is the science that deals with the allocation of scarce resources among unlimited wants. Education is not a free good and it does have a price. The resources used in its production could be used to produce other goods. Education must be considered an economic good. It is the efficiency in combining resources and comparing the benefits derived from education to alternative resources that interest the economist. Essentially, educational outcomes consist of two major economic components. The investment component refers to future years of increased earning power. The consumption component includes the immediate utility and long-run satisfaction of education for the individual. These are personal outcomes since the benefits are accrued directly by the student and his family. The

amount a student or his parents spend on education is determined by his estimated benefits from increased productivity and enjoyment. Thus, the student will spend an amount on education that will equate private marginal benefits to private marginal costs.

As an economic good education contributes to society as well as to those directly involved. This spillover effect has two important implications. One is that the costs should be borne by those who benefit from education; another is that efficiency in resource allocation suggests that the amount of education provided will be less than optimal if the external benefits are not considered. Making education socially efficient and equitable requires that the cost burden be adjusted. Expenditures must be extended beyond the point where private marginal costs equal private marginal benefits so that ultimately private marginal costs plus external marginal costs equal private marginal benefits plus external marginal benefits; also some means of allocating the costs to the proper private and public beneficiaries must be considered.

Educational costs can be further divided into private and public costs. Private or individual costs include indirect costs such as earnings foregone while in school and direct costs such as tuition, books, and supplies. Public cost includes the cost of building and operating schools.

The relationship that links educational achievement and educational

resources can be analyzed by using the logical constructs of economics. In this analysis, we can assume that the school functions somewhat like a firm in the sense that it tends to maximize output within its resource limitations. In order to accomplish this, it is necessary to consider an educational production function. Educational production can be depicted as a functional relationship which illustrates the maximum amount of educational output that could be produced by each and every set of inputs. In order to achieve the greatest output for a given budget restriction, the decision maker must determine the combination of resources that will maximize output within the budget constraint. This condition is satisfied by purchasing and utilizing each of the inputs in such a combination that the last dollar expended on each of the inputs yields the same effect on output. The flow then from budget to output is as follows: dollar budgets are used to purchase school inputs in resource markets (which include markets for personnel, equipment, and so on); these resources are combined by the school administrator in some fashion; finally, the relationship between input and output and how they are combined can be represented by a production function.

This study will consider two important areas in Montana's educational system. First, school quality and how it varies according to school size will be investigated. If the student in the larger, more urban schools is getting a better education than the rural student

then a possible shift of funding priorities may be in order. Second, those factors that determine educational achievement will be investigated. Determining factors in differently sized schools may well indicate where to place educational resources. The study then has two major objectives:

1) To analyze whether or not school size is important in determining student achievement, and

2) To analyze factors that affect student achievement and to determine whether or not these factors vary in different size schools.

The procedure followed for achieving these objectives is as follows:

1) A survey of the literature relevant to the subject area of the study to help give direction and purpose to the project,

2) Instruments were either identified or designed to collect the data,

3) A sample of schools was drawn and permission was obtained to perform the required testing and data collection,

4) Testing and data collection was accomplished by two data collectors who were hired to visit each school as scheduled. The time to collect the data took about three months.

5) The data was coded and verified and processed on the Sigma-7 computer at Montana State University to allow statistical interpretation of the data and a thorough examination of what had been collected,

and

6) The analysis of the data and the results are presented in Chapters IV and V.

Chapter II

REVIEW OF LITERATURE

Since nearly a quarter of this nation's population is enrolled in schools, it is important to determine what effect the schools have on what a student learns. Many educators, laymen, and researchers have contended that schools make little difference [Coleman, 1966]. Their contention is that academic performance is dependent on social and economic conditions outside the school. The impact of such thought, if true, would mean a great deal of tax money is being inefficiently used.

For many years, educators and the general public have endeavored to make education more efficient. Early studies were conducted for the most part by professional educators. The main idea of these studies was to use per pupil expenditures to measure school quality. Many determinants were used and they ranged from student performance measures to a measure of how well the administration adopted innovative procedures. A fairly consistent conclusion was reached: more money means more effective schools. These analyses provided a strong incentive to increase spending for better student performance, but one thing was lacking: a measurement of the student's capabilities upon entering school and the influence of extracurricular activities upon student achievement. More recent studies have emphasized the

importance of social environment and have discounted the effects of schooling. It seems that in order to assess achievement, adequate account must be taken of both the social and school services to which the student is exposed. In order to do this accurately, it must be known what the status of the student is upon entering school, upon completion of school, and then how much of his achievement is attributable to the school. The controls that would be necessary to complete such a study would make it impossible. Nevertheless, many studies (attempting to measure this achievement) have been undertaken. The Coleman Report mentioned in Chapter I best illustrates this new line of inquiry. It, like others, tends to emphasize the importance of the socio-economic environment of the student in determining his performance.

The Coleman Report

The Coleman Report (1966) has been the most widely discussed of all the studies. It was carried out as the result of the Civil Rights Act of 1964, Section 402, by the National Center for Educational Statistics of the U.S. Office of Education. James Coleman of Johns Hopkins University was responsible for the design, administration and analysis of the study. It is probably the most extensive attempt made to assess the quality of American education. Approximately 660,000 students, their teachers, and their schools were surveyed. Other

questions were also asked, including those on the diversity of the curricula and the qualifications of the administrators. The report reveals that several of those factors are positively correlated with the performance of the pupil.

The most significant school service variable in determining student achievement was the verbal ability of the teacher. This might be construed as a proxy of the teachers' intelligence and thus their ability to motivate and communicate in a manner that makes the subject understandable. The report showed a strong relationship of socio-economic status to student achievement and in fact stated that most achievement was related to socio-economic factors. The report also found that a pupil's achievement is strongly related to the educational backgrounds and aspirations of the other students in the school. Expenditures per student were not significantly related to school achievement.

The Coleman Report generated considerable criticism. Criticism by James W. Guthrie in Do Teachers Make A Difference [1970:25] challenges the statistical methodology and claims that the measurements utilized are inadequate. Bowles and Levin [Winter, 1968:3-24] criticize poor sample response. They suggest that a better measurement of facilities with less aggregation of data might show a better relationship between expenditures and student performance.

Summary of Other Research Studies

The results of other studies cannot be summarized concisely partly because of the large variety of measurements used and partly due to their diversity. The remainder of this survey provides a brief description of a selection of these studies and the conclusions that were drawn by each one.

A study by Kiesling [1967:356-357] sampled 97 high schools out of 1,400 in New York. The measure of output was an achievement test. The input variables used were: pupil intelligence, socio-economic attributes of the community, per student expenditures, school size, and school growth rate. Kiesling discovered that school size was negatively related to achievement if at all, and that high expenditure districts do a poorer job of educating pupils from low socio-economic backgrounds than do low expenditure districts.

A study in 1962 by Street, Hamblin and Powell [261-266], tried to relate school size to achievement. The study was done in East Kentucky and used the Stanford Achievement Test as a measure of school output. They classified the schools by categories of 0 to 100 students, 100 to 300 students, and 300 students and over. The conclusion reached was that the student in the larger school was likely to out-perform the student in the small school. They did warn, however, that factors other than size could have been responsible

for their findings.

In 1957, a study by Shelly [1957] attempted to correlate eight factors with the quality of 39 South Carolina secondary schools. The eight factors used were teacher salary, teacher certification, scope of educational program, school size, quality of administration, facilities, socio-economic status of the community, and the amount of money spent for instruction per teacher. These factors also accounted for 69 percent of the variation in quality. The scope of the educational program and the quality of administration seemed the most important factors. Little relationship between socio-economic status and quality was revealed, possibly because most of the school funding came from the state.

A study completed at the University of Arkansas in 1962 [Treadway, 1962:513] tried to link school quality to student achievement. Eight of the 39 factors used were deemed significant to student achievement. They were size of school district, financial support, supervisory services, class size, teacher turnover, high school expenditures, dual education programs, and teacher qualifications. A similar study by Simpson [1961:3499] found that six key factors explained student achievement. They were school size, rate of growth, expenditures, effort and capacity, program, and socio-economic status. It was not immediately clear what other variables he examined in his research.

A study by John Riew [1966:280-287] reviewed some works that showed variable results. In one study, he found that there was little or no relationship between quality and school size. Riew's own study chose Wisconsin high schools and used information from the State Department of Public Instruction. He found that per pupil expenditures decline as enrollment rises to 700 pupils. Expenditures rose when schools reached an enrollment of 701-900 pupils and then fell after that point. This fiscal study excluded capital expenditures. Riew concluded that a larger sample of schools should have been used to strengthen his results.

A study by J. Alan Thomas [1962] employed data from project TALENT at the University of Pittsburgh. Thomas used more than 20 variables to analyze student achievement. Even after home and community factors were taken into account, the variables that seemed most related to achievement were: teachers' salaries, teachers' experience, and the number of library books in the school. He used scores on 18 different achievement tests and his sample was composed of 206 high schools in communities of 2,500 to 250,000 in 46 states. Other variables he found significant in influencing test scores were the size of class the student was in and the number of days a student spent in school.

Samuel Bowles [1969] in a report to the U.S. Office of Education presented the econometric problems involved in estimating educational

production functions. Bowles focused on the meaning of such a function, output measurement, initial measurement, and the dimensions of the learning environment. He used data from the University of Pittsburgh's project TALENT and the Coleman Report to estimate educatonal production functions. He found that teacher quality was an important ingredient in student achievement. Bowles also explored four major characteristics of the home which affect achievement. The first factor was the verbal interaction and communication with adults. Secondly, he assessed the quality of such interaction and communication, using family size and education of the parents as criteria. Thirdly, Bowles looked at what motivates achievement, by examining the parents' attitude toward education. Fourth, he analyzed the degree of opportunity a student has to explore the physical environment in the home and measured it both by how often reading material was used in the home and by parents' income. The school environment was also measured by the educational level or verbal efficiency of teachers, school policies, extracurricular activities, class size, community support of education, and school facilities. Bowles found that in no instance was per pupil expenditure significantly related to achievement but found that most of the factors that were purchased by such expenditures showed a strong relationship. The results of his study showed several important factors including that parents' income better explained achievement than did parents' education.

There have been studies that measure educational quality through methods other than the use of achievement tests. One by Welch appeared in the American Economic Review [1966:379]. The basis of this study was that the quality of schooling was considered a principal contributor to productivity. The study excluded from its population those who had attended college. The sample population was rural farm males older than 25 years. The study compared the income of the schooled representative to the income of a representative with no schooling. The percentage of students who returned to school was estimated for each year. It appeared that teacher quality did enhance school productivity. The validity of this study might be questioned because that part of the population that was rural schooled but was forced to move to the city for employment was excluded. The study also aggregated data on a statewide basis, and less aggregation might have provided more explicit data.

The concept of investment in human capital set forth in the study by Welch has also been investigated by Theodore W. Schultz [1971]. The major economic benefit of education is the increased productivity of the person receiving it. The assumption that the wage a person is paid is equal to his contribution to output (marginal product) is important to this theory. It follows then that the increased productivity derived from investing in educational will have a positive effect on earnings. Schultz's studies conclude that education is an

important factor in influencing economic growth. The discrepancy between the growth rates of national income and national resources leave an unexplained area that might be explained in part by the increased investment in human capital.

Summary of Achievement Tests Used

Bowles [1969] chose three measures of output: reading comprehension, mathematics competence, and a composite score based on reasoning, creativity, vocabulary, and English. Each achievement test measured different levels of achievement. The Coleman Report [1966] used a test series designed and administered by Educational Testing Service, Princeton, New Jersey. Other studies used a variety of tests ranging from unspecified aptitude and achievement tests to specific tests. Some studies used complete batteries of achievement tests, others only an individual test. Those studies that were based on data collected by the Coleman Report or by project TALENT had specific tests. Street, Powell, and Hamblin [1962:261-266], in their study in Kentucky, used the Stanford Achievement Test. Nearly as many different achievement tests as studies were used. A few of the studies reviewed used whatever scores were available and then converted them to a standard norm for analysis. Administering a specific test is costly and time consuming but does allow for data control and for more convenient collection of other data on the social background of

the student.

The Seventh Mental Measurement Yearbook [Buros, 1972] lists 36 achievement batteries, plus various tests in specific areas. The choice of test or tests would depend on the areas to be tested. Measuring achievement is by no means an exact science, but there are at least six good general achievement tests that should be adequate.

Conclusion

Ten studies and their research techniques have been reviewed in this chapter. Nine of these used achievement tests as a measure of school output. Two looked at the productivity of the subject in determining the effects of schools. School size was a variable in seven of the ten studies and was not significant in four, possible significant in one, and significant in only two cases. The variable that seemed consistently significant in the studies that used it was socio-economic status. In no instance did per student expenditures show a positive relationship to achievement, yet the items that the money bought, such as facilities, teachers, and extracurricular activities, did show a relationship in some of the studies. Each study used some unique variable that showed a significant relationship to achievement.

Chapter III

ECONOMIC THEORY AND METHODOLOGY

The Economic Model

Production is the process of combining inputs to create outputs of a specified form. An input is simply anything which a firm buys for use in its production or other processes and an output is any commodity which a firm produces or processes for sale. Production is assumed to occur only if the outputs are of more value to society than the inputs. This relationship between the input and output variables is often referred to as a production function. The educational production function relates school and student inputs to a measure of school output. Representation of the educational production process in this form is of interest in studies of human capital formation as well as studies in optimum resource allocation in education. There are certain complexities in applying a production function to education. The most complex of these is the student. Each student is an individual with traits and characteristics not homogeneous to the group. The teacher, laws and regulations, and the community's educational concept add to the complexity of the situation.

The production function is based on the idea that output depends on the inputs used and that there is a unique output for each possible

combination of inputs. Symbolically, the production function can be represented by:

$$Y = f(X)$$

where output Y is dependent on the amount of input X used given the existing technology. In order to present a more accurate picture of the model, more than a single input is necessary. The production function would then take the form

$$Y = f(X_1, X_2, X_3, \ldots, X_n)$$

where Y again represents the output and the inputs are represented by $X_1, X_2, X_3, \ldots, X_n$. The output can be varied by using different amounts of X_1, X_2, etc. or by using a different quantity of one input and holding the others constant. This can also be stated in terms of obtaining a fixed output Y and by looking at the different possible combinations of the input variables that it would take to obtain a fixed output of Y [Doll, 1968: 39-60].

The optimum combination of the input factors can be determined by calculation of the marginal product of the input variables. The marginal product of an input factor can be defined as the addition to output of the last unit of the input factor added. If we assume that the primary objective of a firm is to produce as efficiently as possible then the cost outlay should be as low as possible for the determined level of output. In order to accomplish this the marginal

product of a dollar's worth of one output must equal the marginal product of a dollar's worth of every other input used.

The model in this particular application involves one dependent variable and several independent variables. The basic production function will take the form:

$$A_i = f_0 + f_1X_{2i} + f_2X_{2i} + \ldots + f_nX_{ni} + U_i$$

where: A_i = the achievement score (Dependent Variables);

f_0 through f_n = the parameters of the production function;

X_{ni} = the amount of input n devoted to observation of student i's education and n - 1 through n (Independent Variables); and

U_i = a disturbance term.

The school input factors are dependent on a system of simultaneous equations representing the school administrator's social welfare function, the budget constraints, and the educational production function. Because of this, any estimation of the parameters in this model will lead to inconsistencies. One way around this problem is to assume that school administrators probably do not select school inputs as if they were maximizing a well-defined production function. This assumption has some basis in actual practice as the administrator lacks perfect knowledge and is subject to political and legal constraints. This assumption causes another problem in that

if the school administrators do not conform to any systematic optimizing model, then the observations of the data are not technically efficient. Thus we get some sort of an average production function [Bowles, 1969: 10].

The knowledge available on learning relationships makes the specification of an educational production function difficult at best. The concept of the margin and diminishing return is not well established in the industry. Therefore, a linear function would seem somewhat superior for the purposes of this study. Possible positive interactions of our inputs would be another reason for using a linear form. The restrictions for a linear form are many and severe, but for reasons of simplicity, the linear additive form presented above will be used.

This study focuses primarily on the economic consequences of schooling. Ideally, the output measures would include income and social adjustments of the individual after schooling. Lacking the opportunity to measure post school adjustments, a proxy, in the form of an achievement test score, will be used. Policy making is primarily concerned with the parameters of the production function and the marginal products of the inputs for movement toward optimal input combinations. It is doubtful that the marginal product of the same input for different groups of students can be compared.

The score on an achievement test is an ordinal measurement. There is no zero point and no well-defined unit of measurement. This has implications in the area of the marginal rate of substitution. Although the marginal rate of substitution is valid theoretically, the absoluteness of the measure of marginal product is not. Among students scoring at different parts of the measurement scale, equal units of increase in scores are not comparable [Gardner, 1965: 24].

Some assumptions must be made before we can begin this analysis. First we must assume that the variables used represent quantities observed without error. Although the data are subject to some degree of error in measurement, it seems prudent to consider these errors negligible in light of the unobservable elements (the $U_i 1$ terms). The error term ($U_i 1$) must be assumed to be normally distributed with mean zero and variance sigma squared [Malinvaud, 1966: 172-175].

Another of the purposes of this study is to attempt to determine those factors that affect student achievement. After all the data are collected, a linear regression program [Nie, 1970: 174] will be used to obtain the necessary statistics. Four dependent variables and 18 independent variables will appear in the model. Table III-1 shows the variables to be used in the regression. A more definitive description of each variable will be included in Chapter IV.

For purposes of analysis, the sample will be examined in two

TABLE III-1. VARIABLES TO BE USED IN THE REGRESSION ANALYSIS.

Variable Description
Dependent Variables:
English test score - Standardized
Numberical competency score - Standardized
Reading test score - Standardized
Total test score
Independent Variables:
Student's view of school
Average daily preparation per teacher
Per student expenditure
Student-teacher ratio
Beginning teacher salary
Year school facility was built
School size
Father's highest grade level attained
Items in the home (TV, radio, phonograph, paper)
Number of yearly books and monthly magazines
Number of automobiles in the family
Student's own room and car
Student's college plans
Community size
Student's involvement in school activities
Hours student works outside school
Amount of travel the student has done
High school grade point average

different ways. First, each of the 27 schools will be placed in 1 of 4 categories, broken down according to student size. A description of these categories is shown in Table III-2 and the number of schools in each is indicated. This will isolate the effects the variables have on achievement in schools of a different size. Second, all students will be analyzed collectively. As mentioned, the production process of schools is complex. About the most that can be expected from estimation is a discovery of some of the relationships of the educational process.

The Variables

The intent of this study is to examine the effects of variables representing student socio-economic status and the school and their relationship to selected dependent variables represented by achievement test scores. Three sections, reading, English, numerical competency, of the Stanford Achievement Test, High School Battery will be used as dependent variables. There are several reasons for choosing a less extensive testing regimen: 1) The cost of administering the complete 6-hour battery would be prohibitive; 2) remaining sections of the test may have favored schools with broader curriculums; and 3) most cooperating schools would be disrupted less by an abbreviated testing program. The complete test battery was given in any school

TABLE III-2. SCHOOL SIZE BREAKDOWNS FOR ANALYSIS PURPOSES.

Size	Student Per School	No. of Schools
1	0 to 117	7
2	118 to 261	7
3	262 to 1,040	7
4	1,041 and Larger	6
TOTAL SCHOOLS		27

that requested it. The SAT Battery was chosen based on Buros [1972]. This review of the tests rates it of high quality overall. Both the numerical competency and reading tests ranked high. The English test was not well ranked but rated high enough for use in this study.

A number of independent variables were collected for the study. Since the projected model needed proxy values for student socio-economic status and school influence factors, the following information was collected by questionnaire for each twelfth grade student (see the appendix for a copy of the questionnaire):

1. Father's occupation;
2. Father's highest educational level;
3. Mother's occupation;
4. Mother's highest educational level;
5. Major provider;
6. Family size;
7. Number of cars in family;
8. Whether they have television, telephone, newspaper, and radio:
9. Number of magazine subscriptions;
10. Number of books purchased per year;
11. Whether the student has their own room and car;
12. Location of residence;

13. Part-time work;

14. Hours per week spent on studies outside school;

15. Travel in Montana, U.S., world;

16. School activities;

17. Favorite subject;

18. After school plans;

19. Time in community;

20. High school grade point average.

The data used to represent school inputs were collected at the school site and from the trustees' report to the Superintendent of Public Instruction. The expenditures and revenues for each school district were also collected from the State Superintendent's Office. In multi-school districts, the chief accounting officer of the district aided in determining the funds allocated to each school. Other school data included information on teachers and school facilities. Data on the teachers in the system included degree level, experience, and daily preparations. Data on the school facilities including building age, number of classrooms, full-time non-teaching staff, starting salary level for teachers, students bussed daily, and community population was gathered. All of these data were added to the information on each student. Data was also collected on student attitudes. One of the questions asked, for example, was whether the

student liked school. Another question asked the student was who had influenced their plans greatest after schooling was completed.

The Student Sample

The process below describes how the schools and the individual students were chosen. All public high schools in Montana were listed from largest to smallest according to size of the school. Statistics [Montana, 1972] from the Office of the Superintendent of Public Instruction for 1972 showed 47,045 high school students in 167 operating high schools. These students were then broken into 10 groups with 10 percent of the total students in each. Then the list of schools was broken into 10 groups each containing about 10 percent of the students. Table III-3 shows the final groups and the sizes of the schools included. Five percent of all high school students were to be tested. The method of selection varied because of the number of schools in each of the size categories. Schools that fell in the first three size categories were chosen at random until the approximate predetermined number of sample students was obtained. In size categories four, five, six, seven, and eight, not only were the sample schools chosen at random but in most cases the sample of students within schools were picked at random. In the largest categories, a sample of students was taken from all the schools to obtain the

TABLE III-3. SAMPLING BREAKDOWN OF MONTANA SCHOOLS BY SIZE.

	Size	No. of Schools	No. of Students	Approx. No. of Students to Test	No. of Schools	% of School to test
1.	0- 117	74	4,952	260	7	100
2.	119- 180	33	4,867	270	4	100
3.	181- 261	23	4,890	340	3	100
4.	272- 470	12	4,373	300	3	50
5.	473- 621	9	4,694	260	3	30
6.	639-1,040	6	4,748	260	2	30
7.	1,207-1,677	3	4,452	260	2	16
8.	1,815-1,905	3	5,575	240	2	9
9.	1,936-2,271	2	3,976	300	2	12
10.	2,247-2,271	2	4,518	330	3	11
		167	47,045	2,820	30	

desired number of students. This procedure left 30 schools. Three of the 30 schools would not participate in this survey. The size of these schools placed them in a category which allowed no substitutes so 27 schools were used in the project.

Testing dates were set with each of the schools. Table III-4 shows a breakdown of students tested. Discrepancies appear because in some cases the total population, rather than a sample, were tested upon request. Absences and limitations set by the school administrators also contributed to the discrepancies. Other schools asked that the total school population (grades nine and eleven) be tested at the same time as the tenth and twelfth grades. The figures of the ninth and eleventh grades tested were not included in Table III-4. Table III-4 shows the total number tested in the school as well as the breakdown for the sophomores (grade 10) and the seniors (grade 12).

The protection of student anonymity was a slight problem during data collection. In order to return the test results to the schools, the project agreed to supply to each school a label with student identification and the test scores. Each test answer sheet was pre-numbered before the project began. The respondents in grade twelve transferred this number to the questionnaire and it was the only item entered into the project data files as a means of student identification.

TABLE III-4. ACTUAL STUDENT SAMPLE FOR GRADES 10 AND 12.

	Size	Total No. Tested	Grade 10 Tested	Grade 12 Tested
1.	0- 117	356	132	124
2.	119- 180	193	127	66
3.	181- 261	237	138	99
4.	272- 470	548	348	200
5.	473- 621[a]	182	104	78
6.	639-1,040	240	132	108
7.	1,207-1,677	197	128	69
8.	1,815-1,905	164	97	67
9.	1,936-2,040	169	105	64
10.	2,247-2,271[b]			
	TOTALS	2,186	1,311	875

[a] One school declined to participate.

[b] Both schools declined to participate.

The method of selecting a sample of students in individual schools varied. In some cases, particular classes thought to be representative of the students were chosen. In some schools, the sample was taken from alphabetical lists or by random selection from another file source. Two schools utilized a computer to draw their sample. One school agreed to participate in the project on the condition that student participation be on a volunteer basis. In this instance, project personnel met with the students, explained the project and asked for their participation. Another school agreed to participate only on the condition that school personnel administer the test. In addition, a small part of the student data had to be eliminated becasue of responses that did not make sense. These responses numbered less than 10.

Standardizing the Test Score

Each student was given three tests from the Stanford Achievement Test, High School Battery. The result was a raw score for each student and each test. The raw score alone does not have much meaning and must usually be related to other scores achieved. In order to make this kind of comparison, the scores must be translated to means and standard deviations of a standard value. The conversion formula used for this process was:

$$\text{Standard Score} = 50 + 10\left[\frac{\text{raw score} - \text{mean raw score}}{\text{standard deviation}}\right].$$

This resulted in a standard score with a mean of 50 and a standard deviation of 10 [Roscoe, 1969: 53-57]. The mean raw score and the standard deviation were obtained from the Stanford Achievement Test Manual [Gardner, 1965: 13-14]. The specific formulas used for each test for each senior tested were as follows:

$$\text{standard reading score} = 50 + 10\left[\frac{\text{raw score} - 41.8}{11.18}\right]$$

$$\text{standard numerical competency score} = 50 + 10\left[\frac{\text{raw score} - 30.2}{8.88}\right]$$

$$\text{standard English score} = 50 + 10\left[\frac{\text{raw score} - 59.5}{14.25}\right].$$

The specific formulas used in the case of the sophomores tested were as follows:

$$\text{standard reading score} = 50 + 10\left[\frac{\text{raw score} - 35.7}{11.39}\right]$$

$$\text{standard numerical competency score} = 50 + 10\left[\frac{\text{raw score} - 26.8}{8.66}\right]$$

$$\text{standard English score} = 50 + 10\left[\frac{\text{raw score} - 51.5}{14.25}\right].$$

The score transformation does not change the shape of the distribution of the raw scores, it changes only the mean and standard deviation. The scores received on tests from different subject areas are not comparable and cannot be combined. Standard scores have the same mean and standard deviation and can usually be combined without objection.

Chapter IV

DATA DESCRIPTION

The results of the data collection and a discussion of the dependent and independent variables used in the regression analysis are contained in this chapter. The results of the test scores for the sophomores and seniors are presented and then analyzed separately. Each of the independent variables are briefly described.

Overview of Testing

The achievement test used in the study was the Stanford Achievement Test (SAT), High School Battery. Three of the tests were used--English, numerical competency, and reading. Two individuals were hired to administer the tests. One was certified to teach mathematics at the secondary school level but had no teaching experience. The second was a certified elementary teacher with eight years teaching experience and a master's degree in education. The tests were administered according to the instructions provided by the test company and were scored by the Test Scoring Service Department at Montana State University.

The tests are designed to measure the educational achievement of students in school. It takes 40 minutes to administer each of the three tests. The English test consisted of three parts; the numerical

competence and reading tests were a single section each. In order to establish norms and a basis for standardization, the test was administered to 22,699 students on a regional basis. For each student the raw scores must be converted to a standard score which can in turn be translated to either a percentile rank or stanine or both. The Stanford Achievement Test people provide the necessary information for this process of standardization. The standard score they provide has a median of 50 and a standard deviation of 10 with a normal distribution. This standardization process is different for each grade, or class. Percentile rank allows the student's performance to be compared with the norm group. For example, a percentile score of 60 would mean the student was equal to or greater than 60 percent of the other students in his group. The stanine is a value which is represented on a simple nine-point scale of normalized scores. The scores range from a low of 1 to a high of 9 with the value 5 always representing the average performance for students in the norm group. Specific information on the tests may be obtained from the SAT manual [Gardner, 1965].

Summary of Test Results for Seniors and Sophomores

Tables IV-1 and IV-2 show by school the mean scores which sophomores and seniors achieved for each test. The scores are standardized by the process presented in Chapter III of this study and not according to the description in the SAT manual. The means are listed in four