SEMESTER PLAN PROGNOSIS: THE INFLUENCE OF THE SEMESTER PLAN ON SCIENCE AND MATHEMATICS ACHIEVEMENT

A Thesis

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ABSTRACT

The study investigated the relationship between student achievement under the semester plan and student achievement under the ten-month school year plan to ascertain whether the semester plan influenced students' academic achievement. For this purpose, student schievement in two subject areas was analyzed, namely General Science 100, and Mathematics 100.

The empirical data consisted of students' achievement in grade IX science and mathematics, General Science 100 and Mathematics 100, the raw score of the Sub-tests, Numerical Ability and Numerical Ability plus Verbal Reasoning of the Differential Aptitude Test, sex difference, age difference expressed in months, and the raw score of the Gough Socio-Economic Scale. The analysis of covariance was subsequently performed for each of two subject areas.

The interpretations of the coefficient correlations, original and adjusted dependent means, and the F ratio, indicated that students' achievement in General Science 100 under the two different types of school organization differed significantly. The null hypothesis was rejected. Consequently, it was concluded that under the semester plan, students' achievement in General Science 100 at Silver Heights Collegiate was better than the students' achievement under the ten-month school year. Similarly for Mathematics 100, achievement under the semester plan at Silver Heights Collegiate was found to be superior to the achievement under the non-semester plan.

On the basis of this evidence, the conclusion was made that students under the semester plan at Silver Heights Collegiate achieved

better results in General Science 100 and Mathematics 100 if achievement is used as the criterion.

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CHAPTER I

THE PROBLEM AND ITS IMPORTANCE

INTRODUCTION

One of the most significant educational trends in Manitoba is toward the introduction of the semester system at the secondary level. Three of the five secondary schools in St. James-Assiniboia operated on the semester plan during the 1971-72 school year. The semester system appears to be gathering support from other school divisions in Manitoba. Both teachers and students who have had an opportunity to work on a semester plan tend to support it.

In the semester system, the regular ten-month school year is divided into two five-month semesters. A student's regular seven or eight course load is distributed between the two semesters. He takes half his year's work in one semester, and the remainder in the other. A course remains the same in content, and approximately the same amount of time is devoted to it, but this time is compressed into a five month period instead of a ten month period. As a result, the student has to contend with only three or four courses at a time.

The semester approach provides both an increase in the frequency and in the concentration of instruction. In the semester system the student sees his teachers every school day, and the course moves along quickly without any slack periods. The increased pace, together with the concentration of the course, conveys a sense of urgency to the student.

Most schools operating on a semester system offer their core courses in both semesters. Students who are successful can continue

studying in the same subject-matter field during the next term. Alternatively students can work toward completing requirements in other subject matter fields for a particular grade level. Students who are not successful on the examinations can repeat the course the next term, or they can proceed with some other course and make up the deficiency during some future term or during summer school.

Even though the semester system is still in its infancy in Manitoba, many schools in the next year or two will be faced with the decision of whether or not to adopt the semester system. Since changes in our schools should offer an opportunity to improve the quality of instruction and learning, this study attempted to show that the inception of the semester plan had pedagogical soundness.

Statement of the Problem

The purpose of this study was to ascertain whether the semester plan influenced students' academic achievement in Mathematics 100 and General Science 100 at Silver Heights Collegiate. More specifically, this study attempted to determine statistically whether the student learned less, as much, or more, as indicated by school grades under the semester plan of school-term organization.

To this end, this study involved two separate studies which investigated:

(a) the relationship between the dependent variable, Mathematics 100 instructed under the semester and non-semestered plan. The analysis of covariance attempted to eliminate differences in the groups due to different Mathematics IX marks, Differential Aptitude Sub-test Numerical Ability, Differential Aptitude Sub-test Numerical Ability

plus Verbal Reasoning, sex, ages, and socio-economic conditions as measured on the Gough Socio-Economic Scale.

(b) the relationship between the dependent variable, General Science 100 instructed under the semester and non-semestered plans. The analysis of covariance attempted to eliminate differences in the groups due to different Science IX marks, Differential Aptitude Sub-test Numerical Ability, Differential Aptitude Sub-test Numerical Ability plus Verbal Reasoning, sex ages, and socio-economic conditions as measured on the Gough Socio-Economic Scale.

The Null Hypotheses

The following hypotheses were tested:

1. There will be no significant difference in Mathematics 100 achievement for students taught under the semester or non-semestered system, when the initial differences between the two groups have been adjusted with respect to Mathematics IX Differential Aptitude Sub-test Numerical Ability, Differential Aptitude Sub-test Numerical Ability plus Verbal Reasoning, Sex Difference, Age Difference, and the Gough Socio-Economic Scale.
2. There will be no significant difference in General Science 100 achievement for students taught under the semester or non-semestered system, when the initial differences between the two groups have been adjusted with respect to Science IX, Differential Aptitude Sub-test Numerical Ability, Differential Aptitude Sub-test Numerical Ability plus Verbal Reasoning Sex Difference, Age Difference and the Gough Socio-Economic Scale.

Limitations of the Study

This writer acknowledged the following problems which set limits on the study:

(1) As mentioned by Popham[1], analysis of covariance cannot completely overcome the basic danger of dealing with intact groups. The possibility of an unknown confounding variable's existence always haunts the researcher.

(2) Even though "intact" population at grade ten level was considered, students who undertook Mathematics 101 and Physical Science 101 were eliminated from this study.

(3) Students who transferred to Silver Heights Collegiate at the grade ten level and did not take the Differential Aptitude Test, Form L, were excluded from this study.

(4) Students who missed the Gough Socio-Economic Scale were excluded from this study.

(5) The sample was drawn from students attending Silver Heights Collegiate.

(6) The study considered only the following control variables: Mathematics IX and Science IX, Differential Aptitude Test, Form L, Sex Difference, Age Difference and Gough's Socio-Economic Scale. The data for these control variables was available either from cumulative record folders in the school, from tests conducted annually by the School Division, or from the test which was conducted by this writer. The reasons for the selection of the control variables will be discussed in greater detail in Chapter III (Design of the Study).

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[1] Popham, James W. Educational Statistics, Use and Interpretation, Harper and Row, New York, 1967.

Basic Assumptions

The following were assumed to be true:

(1) That cultural backgrounds of students attending Silver Heights Collegiate were similar.

(2) That the quality of instruction was the same for students taught under the semester system and the non-semester system.

(3) That the academic results were valid and represented true measures of academic achievement.

(4) That the Gough Socio-Economic Scale and Differential Aptitude Test, Form L, used were reliable measures of the socio-economic level and aptitude of students involved in this study.

THE SIGNIFICANCE OF THE STUDY

A Need for Investigation

Even though innovation is a key word in education today, modern educators must learn to define, investigate, document and implement scientifically new educational programs. It is essential that any plan for reorganizing the school year be supported by sound reasons. No system, whether it be the non-semester or the semester plan, will ever be the final solution to the ever-changing problems that face us in education. However, we do have serious needs now and we forsee even greater problems in the future. We must act not only for these present needs but also for the predictable needs of the future.

Education today, as never before, is being pressed to a place

of accountability. The semester plan is no exception. Timmerman[1] quotes Johnson[2], "We teach probability and statistics, game theory and problem solving, the tools of the research worker. Isn't it strange that at the same time we have not made intensive and organized use of the tools - - -". The fact that the semester plan has been widely adopted in Alberta, British Columbia and Saskatchewan and that its advocates conclude that the semester plan has specific advantages does not necessarily guarantee that the semester plan will ameliorate the academic achievement at Silver Heights Collegiate. This study proposes to investigate the semester plan in order to discover that if it is as a school term organization, superior to the ten-month school term organization, then its application to other schools should be considered. On the other hand if the semester plan has inherent weaknesses seriously affecting learning, perhaps the plan should be abandoned.

Statement of Importance

Even though Ellwood[3] maintains that the major advantage of the semester plan is that "more effective learning and mastery plus higher student achievement should result from increased frequency of instruction and concentration of instruction", it was the primary concern of this study to:

(1) ascertain that the Semester Plan influenced the student academic

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1 Timmerman, D. "Predicting First Year Algebra Achievement in the St. James-Assiniboia School Division No. 2, St. James-Assiniboia, University of Manitoba, 1971, 99p.

2 Johnson, D.A. "A Pattern for Research in the Mathematics Classroom, The Mathematics Teacher, 59: 418 - 425, 1966.

3 Ellwood, T.G. "The Challenge of Semesters", British Columbia Teacher, November, 1970.

achievement in Mathematics 100 and General Science 100 at Silver Heights Collegiate.

(2) provide the writer with factual material upon which to base or justify future considerations as to whether the semester plan should be continued or discontinued.

(3) account for the writer's decision of implementing the semester plan to the Superintendent and School Board.

(4) provide other administrators with factual material upon which to base their final decision to adopt or not to adopt the semester plan.

(5) add to the total knowledge of educational research in the field of the Semester Plan.

SUMMARY

This study attempted to ascertain whether or not the semester plan influenced student achievement in Mathematics 100 and General Science 100 at Silver Heights Collegiate. To this end, the study investigated two different groups of students, semestered and non-semestered, who attended Silver Heights Collegiate. In Chapter III, the writer will explain how it was possible, with the use of definite control variables and a statistical program,to study two different groups as though they were equal.

As previously stated, it is hoped that this study provided the writer, and other administrators with information upon which to base the decision of continuing or adopting the semester plan. No matter how attractive its administrative properties may be, the semester plan should perhaps be rejected if student achievement is adversely affected.

CHAPTER II

THE REVIEW OF THE LITERATURE

INTRODUCTION

The unit of instructional time in use in the majority of Canadian schools is a school-year commencing in September and ending in June. Programs of studies are adapted to this unit and a subject-year contains sufficient material to be covered in somewhat less than two hundred days.

The evolution of such a time unit seems to have been haphazard. Phillips[1] stated that in the early nineteenth century Canadian Schools operated for a winter or spring term of six months. Central authorities subsequently felt it was desirable to lengthen the school year to ten months or more. During the latter half of the nineteenth century a trend developed toward a five-day week with schools in session all year except for a two-week vacation at Christmas and a four-week vacation during the summer.

Early in the twentieth century the modern pattern of a school-year extending from September to June, with short vacation periods at Christmas and Easter, emerged. Phillips[2] attributed the development to this pattern to three factors: prosperity, consideration for the children and establishment of summer schools for the professional improvement of teachers.

In 1959 a royal commission in Manitoba[3] mentioned that it was

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[1] Phillips, C.E., The Development of Education in Canada, W.J. Gage and Company, Toronto, p. 243.

[2] Ibid p. 243

[3] Report of the Manitoba Royal Commission on Education 1959, The Queen's Printer, Winnipeg, 1959, p. 264.

generally satisfied with the school-year organization in the province. It did feel that the division of the school-year into three regular periods would eliminate "the annual irregularity occasioned by the variability of Easter". The Commission also recommended that the required number of teaching days be set at 195, as opposed to the present number of 200 days.

Girard[1] reported that, similarly in 1959, a royal commission in Alberta[2] made the content of its findings known to the public. The Commission displayed interest in the possibilities of a divided-school for instruction in Alberta secondary schools. Girard mentioned that the interest may have been due, in part, to the actual operation of the divided school year in Red Deer and, in part, to the briefs submitted to the Commission relating to semester of school-year operation. The Alberta Teachers' Association[3], in their brief submitted to the Commission, maintained that students were encouraged by the advantages of short-term instruction to return to school. Drop-outs were fewer and more economical use could be made of the school plant. The Association recommended that a study be made of the optimum length of class period, the relative merits of two terms over three, the retention of subject matter by pupils and their subsequent success at the university.

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1 Girard, D. "Learning Effectiveness Under the Trimester System of School-Year Organization at the Lindsay Thurber Composite High School", Red Deer, Alberta, University of Alberta, 1962, p. 70.

2 Report of the Royal Commission on Education in Alberta 1959, The Queen's Printer, Edmonton, 1959, Chapter 29.

3 Alberta Teachers' Association Brief to Alberta Royal Commission in Education, 1958.

Girard[1] stated that the Commission realized that the divided school year would provide greater flexibility in taking care of differences in speed of learning and of mental capacity. Furthermore, the divided school year would make it possible to enrich and accelerate the high school program for the gifted and provide more challenge to all. Thus, the Commission recommended that a committee representing the University and the Department of Education and including qualified representatives of the public, be convened to study the divided school year and its implementation in the whole educational system.

Since the early sixties Western Canada has witnessed a gradual acceptance of the semester plan. Alberta, British Columbia, Saskatchewan, and now a few school divisions in Manitoba have adopted and are operating under the semester plan. There has been much talk about the need to provide for individual differences at the secondary level. Many curriculum changes, program changes, and examinations, have been adopted with this end in view. These changes, however, are still not sufficient to provide adequate flexibility for students. The semester plan has been accepted because, the added flexibility allows students more opportunities to reassess and re-route, if necessary, their academic program.

The Semester

Ellwood[2] mentioned in an article entitled the "Challenge of Semesters" that "the controlled study in Red Deer, Alberta, which was

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[1] Girard, D. "Learning Effectiveness Under the Trimester System of School-Year Organization at the Lindsay Thurber Composite High School", Red Deer, Alberta, University of Alberta, 1962, p. 70.

[2] Ellwood, T.G., "The Challenge of Semesters", The British Columbia Teacher, November 1970.

initiated in 1949 and still continuing, was reported on in 1964. At that time the semester system had resulted in a substantial increase in student achievement. This was determined by examining the work of the same students taught by the same teachers before and after the school introduced the semester plan. The number of "B" grades in the school involved increased by 15% in one year, and the gain has been maintained ever since". Ellwood mentioned that the semester plan is not perfect, but it offers a unique situation. It offers an opportunity to make student learning more effective, and at the same time offers the paying public some economy of operation and greater use of school facilities.

In his report to the trustees in Red Deer, Alberta, Dawe[1] said that "after two years of semester teaching the first concrete evidence of success was the results attained in Grade XII departmental examinations. The passes (50% or better) for the first two years of operation under the 10 month plan and for the first two years under semesters are illustrated in Table 1. It should be kept in mind that there was no change in the teaching staff".

Dawe[2] mentioned that the test of the Grade XII results has remained consistent throughout the years. The over-all "B" or better for the school under semesters is 75% for 39 semesters. In June, 1969, the composite results, including appeals and supplementals written for their semester subjects were 80.4% or some 20% above the provincial range of 60%. Ignoring the appeals and supplementals the results were 78.4%. Dawe asserted that there is little evidence either to support or refute that the semester

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1 Dawe, W.B. "An Examination of the Semester System", Red Deer, Alberta, 1969.

2 Ibid

TABLE 1

DAWE'S REPORT

Subject	Ten-Month Plan	Semester System
English 3	56.7%	61.5%
Social Studies 3	52.9%	82.5%
Algebra 2	74.1%	78.3%
Trigonometry	78.9%	76%
Biology 2	51.6%	84%
Chemistry 2	54%	84%
Physics 2	75.9%	83.5%
French	82.9%	83%

handicaps the slow learner. He maintained that "students in a split class, that is one in which instruction is given for one hour per day for $6\frac{1}{2}$ months, do not appear to do either appreciably better or worse than students of the same ability in a two-hour class. Records of students who have gone to 10-month systems after attending here do not indicate any improvement".

An article written by Kowalski[1] demonstrated that the benefits accrued to students under the semester plan were encouraging. "Sixty-two percent of the teachers surveyed believed that the students were better able to acquire skills, fifty-seven percent thought that the understanding of concepts was facilitated and sixty-two percent believed that students were better able to master factual materials. Language Arts, Mathematics and Science teachers in particular (77%) expressed the belief that student learning in the affective domain was enhanced".

The Forest Lawn High School in Calgary, Alberta conducted a survey in order to give the School Board some ideas of the reactions of staff and students to the semester plan. This was done after their first year in the semester plan. Even though the survey was not too comprehensive, it did indicate that more than half the teaching staff thought the semester plan was educationally superior to the traditional system. Only eleven percent of the teachers felt the semester plan was educationally inferior to the traditional system. Fifty-two teachers thought that a 3/3 teaching assignment on semesters was educationally superior to a 6-period assignment on a 7-period day. The 3/3 teaching assignment means that a teacher teaches three different groups of students in one semester and three different groups of students in the other semester. The 6-period assignment on a 7-period day implies that in a non-semestered plan, a teacher teaches

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1 Kowalski, A.E. "Calgary Pilot Project Proves Successful", Alberta School Trustee, 1970

every day six periods out of 7 periods for the complete ten month school year. However, thirty-three teachers felt that a 7-period teaching assignment on an 8-period day was educationally superior to a 4/3 teaching assignment on semesters. Twenty-three teachers chose the 4/3 assignment on semesters as being educationally superior to the 7/8 assignment on a traditional program.

On October 6th, 1971, Larson[1], Superintendent for the Lethbridge Schools submitted a brief to the Minister of Education requesting the authority to allow his school district to continue with the semester plan. Larson maintained that the common procedures employed by the public and separate districts during the past two years have produced student scores which it is believed are "just as valid and reliable as those resulting from departmental examinations". Larson's table, Table II, comparing the examination results obtained prior to the introduction of the divided school year (1968-1969) with those obtained after the semester plan was introduced (1969-1970) indicate that the percentage distribution seems to be somewhat similar.

Larson's findings are relevant to this study because they point out by the students' numerical and percentage distribution of papers that there was no deterioration of academic performance. In support that the high standard of evaluation was maintained, he stated in his brief that the three Alberta universities had agreed to continue accepting the Lethbridge high school students based upon the results obtained through local evaluation procedures. Larson's brief and in particular his request to the Department of Education to continue the semester plan for another

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[1] Larson, O.P., "Brief Submitted by the Lethbridge Public and Separate School Boards to the Minister of Education Requesting Authority to Continue with the Divided Year Plan and Local Evaluation Procedures"., Lethbridge, 1971.

TABLE II

TABLE COMPARING THE EXAMINATION RESULTS OBTAINED PRIOR TO THE INTRODUCTION OF THE DIVIDED SCHOOL YEAR (68-69) WITH THOSE OBTAINED AFTER THE DIVIDED YEAR WAS INTRODUCED (69-70)

		LETHBRIDGE COLLEGIATE		WINSTON CHURCHILL		CATHOLIC CENTRAL	
		68-69 Prior	69-70 After	68-69 Prior	69-70 After	68-69 Prior	69-70 After
H (80-100)	Papers	197	207	52	67	37	34
	Percent	13.9	16.4	11.1	12.5	10.6	8.5
A (65-79)	Papers	479	402	131	170	153	146
	Percent	33.8	31.5	28.5	31.7	44	36.3
B (50-64)	Papers	542	486	209	243	110	191
	Percent	38.3	38.1	45.4	45.3	31.5	47.5
C (40-49)	Papers	153	154	51	49	39	28
	Percent	10.8	12.1	11.1	9.2	11.3	7.0
D (0-40)	Papers	44	24	18	7	9	3
	Percent	3.1	1.9	3.9	1.3	2.6	0.7
Totals	Papers	1415	1273	460	536	348	402
	Percent	100	100	100	100	100	100
Percent with B or Higher Grade . . .		86.1	86	85	89.5	86.1	92.3

three years, are cogent examples in support of the semester plan school organization.

Fehlberg's[1] study tested the hypothesis as to whether the over-all achievement in English 30 of students enrolled under the semester system was better than under the ten month school year organization. He found that the F value was not sufficiently large to support the rejection of the null hypothesis. The data thereby supported the interpretation that for English 30, neither system of school-term organization was to be considered superior to the other if achievement was used as the criterion. Similarly the Social Studies 30 over all achievement for the two types of school-term organization did not differ significantly. Statistical analysis revealed that the F value was not large enough to support the rejection of the null hypothesis. The rejection of the null hypothesis for Mathematics 30 was also not warranted and it was thus proper to conclude that for Mathematics 30 neither system of school-term organization was related to superior results in achievement.

Fehlberg[2] concluded that the results of the analyses did not support the hypothesis that students enrolled under the semester system of school-term organization obtained lower achievement scores than students enrolled under the conventional type of school-term organization. Fehlberg further added that no evidence was found to support the rejection of the semester plan as well as evidence to support the introduction of the semester plan into a given institution. The implications of this study for educators

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1 Fehlberg, Dieter August. "Student Achievement Under Alberta's Semester System", University of Alberta, Edmonton, Alberta, 1968, p. 52.

2 Ibid

are surely dependent upon their needs and frame of reference and are left for individual interpretations. Thus the treatment and control of variables affecting students' achievement appear to be the key to permit a causal difference in evaluating the effects of the semester plan on student achievement.

The Extended School Year

After an intensive review of the literature on the rescheduling of the school year, the writer realized that a great deal had been written on the extended school year. The term extended school year may mean the operation of the schools on a four quarter system with rotating attendance, the operation of the schools throughout the year, summer school to supplement the regular school year for make up work, acceleration, enrichment, and extended service term for teachers with emphasis on inservice growth and school improvement activities. This study concerned itself with the more frequently used terminology, the extended school year plan, without referring specifically to any particular way of rescheduling the school year under the extended school year.

The extended school year and the semester plans provide greater flexibility than the conventional ten-month school year plan. The structured, specialized curriculum of our modern secondary school, when combined with the ten-month school year, can become a discouraging trap for many students. One or two course failures can put a student a year behind and encourage him to quit. Some senior students find out too late that they have embarked on the wrong program. Some are not prepared to pay this price and drop out of school, seldom to return. Other students find, after twelve years of school, that they are just one or two courses short

of graduation and are discouraged by the prospect of another year in school. But with the semester plan and more frequently with the extended school year plan, the student can re-assess and re-route his courses at definite periods during the year. Furthermore, a student is able to repeat a failure in the next semester rather than wait for the next year. Besides, the extended school year plan and the semester plan make it more possible for teachers to get to know their students. Under both plans there is a definite reduced pupil load.

Because the immediacy of students' goals are in sight from the beginning, many drop-outs find it easier to return to school. Combined with policies of subject promotion as opposed to grade promotion, both plans move one step closer in practice to the concept of continuous progress. Although the extended school year and semester plans can accelerate the graduation of some students it is possible for a student to take more courses and obtain a broader background during his stay at the secondary level.

The extended school year achieved some popularity in the United States during the first three decades of this century. Bluffton, Indiana, was the first district to organize schools on the plan, in 1904. By 1925 thirteen American cities had some or all of their schools so organized.

In 1928 Aliguippa, Pennsylvania tried the extended school year plan. Its purpose was to ameliorate the overcrowded conditions in schools, resulting from a sudden increase in population. The population in this area subsequently declined during the depression years and the plan was dropped in 1938. Vanderslice[1], the Superintendent of Schools at Aliguippa

[1] Vanderslice, H.R., "What One Town Learned in 10 Years of Year-Round School", U.S. News and World Report, August 2, 1957, pp. 48-51.

during this period, felt that the plan had no adverse effect on pupil growth. He stated that attendance and achievement in the summer quarters surpassed that of the winter ones. Most arguments against the plan, according to him, had little or no validity.

The Cato-Meridian's elementary school carried an extensive experiment to find out the academic growth of children prior and after the introduction of the extended school year program. Allen[1] mentioned that "The academic growth of children prior to the project (1961-1964) was compared with that of the pupils in the experimental category (1964-1967) through the Iowa Test of Basic Skills.

The experimental group made its greatest gain in work study skills, i.e., map reading, reading of graphs and tables plus knowledge and use of reference materials. The gain was significant at the 1 percent level which means that the results could not have been attained through chance. Since the only known variable not controlled was the extended school year, the achievement is attributed to the plan. The experimental group (1964-1967) made larger academic gains than its control (1961-1964) on the total or composite of the Iowa Basic Tests. Statistically, the difference was not great, but it indicated a trend towards significance at the 10 percent level. The possibility of this achievement difference occurring by chance alone is only one out of ten times.

Similarly the Stanford Achievement Test was used to compare achievement of students having two years of extended school year experience with students having one year. Allen[2] stated that "Fifth grade experimental

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[1] Allen, James E., "Setting the Stage for Lengthened School Year Programs", University of the State of New York, New York, 1968, 113 p.

[2] Ibid

group achievement on the arithmetic computation sub-test was higher than the achievement of the fifth grade control group". This difference in achievement was considered statistically significant at the 1 percent level. The experimental group made a greater gain than the control group on the following sub-tests: word meaning, paragraph meaning, spelling, language and arithmetic concepts.

The purpose of the study in Syosset[1], New York was to examine the effects of an extended school year at the secondary level. Teacher grades, Regents test scores and achievement test scores showed the experimental students as high, if not higher scores as students in the comparison and control groups. Since the intent of the study was to demonstrate that the experimental group could do as well, not necessarily exceed the achievement of those not in the experimental program, the objectives have been realized. But differences in achievement on the part of one group or the other were never statistically significant.

A similar study was done in Horvell[2]. As in the Syosset's study, the Horvell study showed that the student achievement was equal to and sometimes higher than that of comparable students taking similar courses. Students in the Extended School Year plan took regular and special Regents Examinations. Regents Biology Examination scores obtained by 61 students in the summer were compared with those obtained by 123 students who took Biology during the regular school year. The mean performance of the summer segment students was 78.16 compared to the mean performance of 70.42 for the regular students. A statistical analysis of the Biology Regents test

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1 Ibid

2 Ibid

reports the mean score of the modified summer segment group was significant at the 1 percent level. These results cannot be attributed to chance.

In Commack, New York[1], a modified extended school year plan was implemented in the Grade L. Hubbs Elementary School. The subjects were 216 pupils in grades 1 - 4 at the beginning of the experiment, selected from 14 widely scattered elementary schools among 500 volunteers. The matching control group, which remained in the traditional 180-day program, was known to have slightly higher average mental ability than the experimental group. Pupils were taught in eight self-contained, heterogeneous classrooms, which averaged 27 pupils per class. The measured achievement of experimental pupils and control pupils was compared both by grade level and by ability level. The experimental primary-grade grouping scored higher than the control group on all seven sub-tests of the Metropolitan Achievement Test. After 25 months in the pilot project, third grade experimental pupils scored greater mean and median gains in reading comprehension as measured by the Metropolitan Reading Test, than did control pupils. The experimental group mean and median gains were statistically significant at the 1% level of confidence.

Since the extended school year is a further refinement of the semester plan, it is not surprising to realize that the two plans have a great deal in common. Thus, this writer established their philosophical similarities and then used the extended school year plan to reaffirm the pedagogical potency of the semester plan.

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[1] Ibid

SUMMARY

The material presented in this chapter strongly suggested that the semester plan can be justified as an educational procedure of reconstructing the school-term organization in order to improve a child's education. The semester plan, if proven as a benefit to pupils' individual needs, should be the strongest argument for its introduction.

CHAPTER III

THE DESIGN OF THE STUDY

INTRODUCTION

The purpose of this chapter was to describe the collection of the data and the special adaptations needed to consolidate the data for statistical treatment.

The Setting

The study was carried out in Silver Heights Collegiate, a 900 student secondary high school, located in St. James-Assiniboia, in an area generally considered socio-economically privileged.

The grade X students attending Silver Heights Collegiate in 1970-1971 came from Golden Gate and Bruce Junior Highs. The total grade X enrolment was 369 pupils grouped heterogeneously into 14 different grade X rooms. Students were assigned randomly to subject teachers with the aid of a computer.

In 1971-1972, the grade X students attending Silver Heights Collegiate came mostly from Golden Gate Junior High. In this school year, a new school boundary was implemented and Bruce Jumior High students went to another secondary school. The 204 students enrolled were grouped heterogeneously into nine different rooms. Students were assigned randomly to subject teachers with the aid of a computer.

THE VARIABLES USED IN THE STUDY

In this study, ten variables were selected for use. There were

seven control variables, two dependent variables and one independent variable. The variables are described in the following three sections of this chapter.

Control Variables

After reviewing the relevant literature, seven control variables were selected for use in this study. The selection of the method of acquiring the empirical data was to some extent influenced by the testing services carried out by the St. James-Assiniboia School Division, by the resources available to this writer and by the need to administer one appropriate test to quantify the variables.

As stated previously, the purpose of this study was to establish whether students taught under the semester plan achieve better than students taught under the ten-month school year in Mathematics 100 and General Science 100 at Silver Heights Collegiate. The comparison was based on the achievement of students at Silver Heights Collegiate who studied the above subjects under the ten-month school year in 1970-71 versus the achievement of those who studied the above subjects under the semester plan in 1971-72. The two groups involved different students.

Since the groups consisted of different students, it was necessary to examine these groups to ensure that the possible improvement or deterioration in achievement was not due to inherent differences in the groups such as past school marks, aptitudes, age, sex, or socio-economic conditions.

The comparison of achievement was made through a statistical analysis of covariance. The use of this technique first assumed the groups above to be identical with regard to past achievement in Mathematics,

past achievement in Science, age, aptitude, sex, and socio-economic conditions. These control variables were measured by (1) grade IX mathematics marks, (2) grade IX science marks, (3) Differential Aptitude Sub-test Numerical Ability raw scores, (4) Differential Aptitude Sub-test Numerical Ability plus Verbal Reasoning raw scores, (5) age in months, (6) sex, (7) socio-economic conditions on the Gough Socio-Economic scale. Each variable was compared for each group and if a significant difference was found, the group means for Mathematics 100 and General Science 100 were adjusted for each control variable considered. Once the final adjustments based on the control variables were made, the groups were considered identical when all known possible areas of difference were taken into consideration.

This permitted unbiased comparison between the two treatments to be made and enabled the writer to assume that any significant difference in achievement was attributed to the semester or ten-month plan.

(a) School Marks, Mathematics IX and Science IX

Lother[1] in his major thesis, submitted to the Faculty of Graduate Studies and Research using term and final examination scores and intelligence tests results on the Co-operative School and College Ability Tests, Form 3A, and the Otis Quick-Scoring Gamma Test, Form Am, showed that a significant relationship existed between grade nine term results and final grade ten results, as well as between grade nine and grade ten final results. Lother stated that "the coefficients of correlation between grade IX subjects and grade X results - - - except for the score in Social Studies,

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1 Lother, H.E., "The effectiveness of selected variables for predicting Grade IX and Grade X achievement, as measured by final marks in these grades". 1967, p. 46.

are in no case less than .65".

According to Fishman and Pasanella[1], the most obvious intellective predictor was the high school record. On the basis of 263 studies the correlation coefficient was roughly .50 with freshman grades and achievement. Similarly, Berdie[2] claimed that both achievment tests and high school records should be used for predicting future attainment. Scannell[3] also studied the prediction of college success from elementary and high school performance. He found that the accuracy with which general academic success was predicted from achievement test scores increased year by year from grade four through high school and that the high school grade point average was the best single predictor of college success. Marks and Murray[4] found that the high school average provided the most information about future academic performance at the college level as measured by college point average.

This study did not try to predict student achievement from a ten-month school year to a semester plan. The aforementioned studies were mentioned because without considering Mathematics IX and Science IX as control variables, the validity of the difference in means for the

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[1] Fishman, Joshua A. and Pasanella, Anne K., "College Admission Selection Studies", Review of Educational Research, Vol. XXX, No. 4, 1960.

[2] Berdie, Ralph, "Testing Programs and Counselling in the Schools", National Society for the Study of Education, Sixty-second Year Book, Part II, 1963.

[3] Scannell, D.P., "Prediction of College Success from Elementary and Secondary School Performance", Journal of Educational Psychology, 1960.

[4] Marks, E. and Murray, J.E., "Non Additive Effects in the Prediction of Academic Achievement", Educational and Psychological Measurement, 25: 1097 - 1104, 1965.

dependent variables between the two groups could be affected. Often the means for the dependent variables which appear to be highly significant when considered alone, will be adjusted to virtual equivalence through analysis of covariance. Sometimes the reverse is also seen, that is, small unadjusted mean differences between groups may end up being extremely large adjusted differences after each group's performance on control variables is taken into account.

(b) Differential Aptitude Test Sub-tests, Numerical Ability, and Numerical Ability plus Verbal Reasoning

Guilford, Hoefner, and Peterson[1] found that in predicting success in algebra and mathematics, the Differential Aptitude Tests were better than any other aptitude tests, and about equal to standardized achievement tests.

In her thesis, Lacerte[2] mentioned that the Differential Aptitude Test may be characterized as currently the best battery for use in educational guidance in high school. She stated that Erwald[3] found that the Differential Aptitude Test scores offered significant prediction of sophomore students' tendency to remain in high school until graduation.

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[1] Guilford, J.P., Ralph Hoefner, and Hugh Peterson, "Predicting in Ninth Grade Mathematics from Measures of Intellectual Aptitude Factors", Educational and Psychological Measurement, Vol. XXV, No. 3 (1965) p. 659 - 681.

[2] Lacerte, Chrislaine L., "An investigation of the relative effectiveness of three methods of interpreting D.A.T. scores to grade nine students".

[3] Erwald, H.H., "The Relationship of scores in the D.A.T. to Scholarship in High School and Freshmen College", Dissertation Abstracts, 1961, 22 800.

Berg's[1] research revealed that ninth grade Differential Aptitude Test scores on the sub-tests for Verbal Reasoning (V.R.), Numerical Ability (N.R.), Spelling (S.P.) and Sentences (Sent.) and the combination of Verbal Reasoning and Numerical Ability scores were about as predictive of future success as are most college entrance tests administered before entering College.

Timmerman[2] reported in his thesis that Layton and Swanson[3] tried to show the regression of grade nine Differential Aptitude Test scores to the grade XI test scores and the high school rank of students. They hypothesized that the Differential Aptitude Test scores were most suitable as a measure of both academic ability and special aptitudes, and that these tests would show to what degree the student possessed special aptitudes which he may capitalize upon in making vocational choice other than college. They found that the Verbal Reasoning test was the best single predictor of grade XI test scores. They also discovered that high school rank and the combination of Verbal Reasoning with Numerical Ability Tests were closely correlated with the grade XI scores.

Since the Differential Aptitude Test was administered to every grade nine student in the St. James-Assiniboia School Division, the test

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1 Berg, O.D., "Prediction of College Achievement on the basis of ninth grade Differential Aptitude Test Scores", Dissertation Abstracts, 1965, 26, 3147.

2 Timmerman, D., "Predicting First Year Algebra Achievement in the St. James-Assiniboia School Division No. 2, St. James-Assiniboia, University of Manitoba, 71, 99 p.

3 Layton, W.L. and E.O. Swanson, "Relationship of Ninth Grade Differential Aptitude Test Scores to Eleventh Grade Test Scores and High School Rank", Journal of Educational Psychology, 49: 133 - 155, 1968.

seemed appropriate as a source of data for this study. More important was that the battery of tests had received considerable use in prediction studies as described above. Bennett, Seashore, and Wesman[1] maintain that the Differential Aptitude Sub-test Numerical Ability is a measure of the student's ability to reason with numbers, to manipulate numerical relationships, and to deal intelligently with quantitative materials. Similarly, Bennett, Seashore and Wesman[2] support that Differential Aptitude Sub-test Numerical Ability plus Verbal Reasoning, "will tap the same general area as most intelligence or general mental ability tests".

The above reports gave support for the inclusion of the Differential Aptitude Sub-tests, Numerical Ability, and Verbal Reasoning plus Verbal Reasoning as test instruments to quantify the scholastic aptitude of students in this study.

(c) Sex Difference and Age Difference

Minor differences between groups with respect to the dependent variables achievement in Mathematics 100 and achievement in General Science 100 can be extremely influential. If this study had analyzed only group differences with respect to the dependent variable(s), without taking into consideration some important control variables, a misleading picture of the true difference between the two groups could have been obtained.

Because this study used "intact" groups, it is assumed that differences existed between the two groups under investigation. One group,

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1 Bennett, K., Seashore, Harold G., Wesman, Alexander G., Fourth Edition Manual, Psychological Corporation, New York, 1966.

2 Ibid

for example, could have had more boys while the other group could have had older students because several were repeating Mathematics 100 or General Science 100. Such discrepancies were assumed important and this study used sex and age as two control variables so that if a significant difference was found the group means for achievement in Mathematics 100 and achievement in General Science 100 were adjusted to permit an unbiased comparison between the two treatments.

(d) Gough Socio-Economic Scale

This study tried to determine if other control variables were related, perhaps casually, to the dependent variables under study. Even though it was mentioned in the setting section of this chapter that Silver Heights Collegiate was located in an area generally considered socio-economically privileged, some students directly involved in this study came from homes that were not as privileged as the majority. To avoid the chance of having socio-economic factors distort the significant difference between the semestered group and the non-semestered group, this writer applied the Gough Socio-Economic Scale to all students participating in this study in order to eliminate the bias.

The Gough Socio-Economic Scale has been used widely in Alberta. This writer will use the revised version of the Gough Socio-Economic Scale. It contains twenty questions. The Gough Scale was developed in 1949 as reported in an article by Gough[1]. A revised form was developed by W.B. Elley and the development of the revised form was reported by

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1 Gough, H. "A Short Social Status Inventory", Journal of Educational Research, V. 40, pp. 52 - 56, 1949.

Elley[1]. Elley's study was designed to investigate the extent of the socio-economic bias in selected intelligence tests with a view to identifying instruments which measure general intelligence with a minimum of such bias. Benoit[2], used this socio-economic scale in his thesis that he submitted to the Department of Educational Administration, University of Alberta.

Dependent Variables

Consideration was given to setting the dependent variables. This writer contemplated using all the compulsory courses at the grade ten level. They were English 100 or 101, Geography 100 or 101, Mathematics 100 or 101, and General Science 100 or Physical Science 101.

English 100 or 101 was not used because the English department had serious reservations about teaching English under the semester plan. The department felt that the English program was too heavy to be taught adequately in five months.

The courses Geography 100 and 101 were not used because there was not a full geography course taught at the grade IX level. Students were exposed to a half course in Geography and the mark was combined with History. The final geography and history mark was reported under Social Studies on the students' official mark recorders.

Mathematics 101 and Physical Science 101 were not considered because the total enrolment for each course was too low. It was assumed that if those two subjects were used, the dependent group means would not

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1 Elley, Warwick B., "A Comparative Analysis of the Socio-Economic Bias in Selected Intelligence Tests", Ph.D thesis, University of Alberta, 1961.

2 Benoit, Lionel C., "An Analysis of Political Attitudes of High School Students", M.Ed. thesis, University of Alberta, 1967.

have been a true representation of the real difference between the semestered and non-semestered groups. Furthermore one of the basic requisites of analysis of covariance technique is that the population be large.

Mathematics 100 and General Science 100 were used as the two dependent variables because the enrolment was large enough to give a realistic picture of the semestered and non-semestered groups. To further assume a true difference between the two groups under investigation, the analysis of covariance was used to adjust the means of the two dependent variables with respect to the control variables.

Independent Variable

As previously stated in Chapter I, the purpose of this study was to discover to what extent the semester plan affected students' academic achievement. Thus, the independent variable in this study was the semester plan.

Summary

The variables of the investigation are summarized as follows:

Control Variables	Unit of Measure
(a) Previous Achievement	
(1) Mathematics IX final mark	Percent
(2) Science IX final mark	Percent
(b) Differential Aptitude Test	
(1) Numerical Ability	Raw Score
(2) Numerical Ability plus Verbal Reasoning	Raw Score
(c) Sex Difference	_____

(d) Age . . . . . Months

(e) Gough Socio-Economic Scale . . . . . Sum of "yes" answers.

Dependent Variable

(a) Mathematics 100 final mark . . . . . Percent

(b) General Science 100 final mark . . . . . Percent

Independent Variable

Semester Plan

POPULATION AND THE POPULATION SAMPLE

The population is defined as all students enrolled in Mathematics 100 and General Science 100 in Silver Heights Collegiate from September 1970 to June, 1971 and from September, 1971 to June, 1972. All students in the population are used in this study and so no sampling will be necessary. Any student who missed the Differential Aptitude Test in grade IX and failed to do the Gough Socio-Economic Scale were not considered. This eliminated several students from this study.

(a) Ten Month School Year Group, 1970-1971

The study considered all those students who obtained a final mark in Mathematics IX and Science IX in the non-semestered junior highs, Bruce and Golden Gate, and who subsequently attended Silver Heights Collegiate in 1970-1971. Silver Heights Collegiate was not on the semester plan at that time. Table III indicates the number of students who participated in this study.

TABLE III

TEN MONTH SCHOOL YEAR POPULATION SAMPLE

School	Total Grade X Enrolment	Number in this Study	Description of Class Structure
Silver Heights Collegiate	369	Mathematics 100 214	Heterogeneous
		Gen. Science 100 220	Heterogeneous

(b) Semester Group 1971-1972

This study considered all those students who obtained a final mark in Mathematics IX and Science IX in a non-semestered junior high, Golden Gate, and who attended Silver Heights Collegiate in 1971-1972. Silver Heights Collegiate operated under the semester plan except for the English course in grades X, XI and XII. Table IV indicates the number of students who participated in this study.

DATA SOURCES AND COLLECTION

Once the students to be involved in the study were selected, the collecting of the data was carried out. The Gough Socio-Economic Scale was administered to the population during the early part of April, 1972. The scores for the above socio-economic scale were recorded as raw scores since no local norm was available. This test had not been administered previously in Silver Heights Collegiate nor in the St. James-Assiniboia School Division. The Gough Socio-Economic Scale was administered by the guidance counsellors in each homeroom. The instructions were explained and distributed to the counsellors and each was asked to adhere strictly to the instructions. A copy of the test is included in the appendix.

The St. James-Assiniboia School Division annually administers the complete battery of the Differential Aptitude Test to all grade nine students in the division. This was done during the month of November, 1970, and November, 1971. This test was administered in the gymnasium of Bruce and Golden Gate junior highs to all students in each school and at the same time. This operation was supervised by the guidance counsellor

TABLE IV

SEMESTER POPULATION SAMPLE

School	Total Grade X Enrolment	Number in this Study	Description of Class Structure
Silver Heights Collegiate	209	Mathematics 100 114	Heterogeneous
		Gen. Science 100 120	Heterogeneous

of each school. Each guidance counsellor received the same instructions for administering the tests from the supervisor of guidance for the school division. The tests were scored by the computer and then returned to the schools. The raw scores were used as the measures of control variables, Numerical Ability and Numerical Ability plus Verbal Reasoning.

The grade nine Mathematics and Science final marks for each student in the population were taken from the student's record file. The raw score was recorded. Similarly, the raw score for Mathematics 100 and General Science 100 final mark was taken from the student's record file.

This data along with a coded school, student number, sex and age, socio-economic scale differences were then punched into computer cards.

DESCRIPTION OF THE ANALYSIS

Analysis of Covariance

If this writer had had all the freedom he might have wished, he could have manipulated the groups, semestered and non-semestered, composing his population by sampling procedures so that all representing the dependent variables were equivalent with respect to possible confounding control variables. This, however, was impossible to do in most on-going school programs.

Popham[1] maintains that the analysis of covariance may be used when a relationship is being studied between a dependent variable and

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[1] Popham, James W., Educational Statistics - Use and Interpretation, Harper and Row, New York, 1967, 419 p.

two or more control variables. This powerful technique allows the researcher to statistically equate the dependent variables with respect to one or more control variables which are relevant to the dependent variable. Obviously, such a tool has important implications for educational researchers since it permits within limits the use of intact student groups while still controlling variables which might otherwise confound the results of the investigation.

As explained by Popham[1], the analysis of covariance involves a combination of the analysis of variance concept and the regression concept. In its most basic form, we might think of analysis of covariance first determining the magnitude of the relationship between the control variables and the dependent variable. Having determined this, the procedure then statistically readjusts each dependent score, through a regression prediction technique, so that the scores compensate for whatever control variable disparity exists between the independent groups. The adjusted scores are then subjected to an analysis of variance which tests for mean differences by identifying the amount of variation resulting from differences between groups. Finally the F value is obtained and it is compared with the critical F value at the 0.05 significance level.

SUMMARY

In attempting to ascertain whether the semester plan influenced the students' academic achievement in Mathematics 100 and General Science 100, two separate studies were conducted. The first study used the dependent variable, Mathematics 100 and six control variables:

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[1] Ibid

Mathematics IX, Differential Aptitude Sub-tests Numerical Ability and Numerical Ability plus Verbal Reasoning, Age Difference, Sex Difference and the Gough Socio-Economic Scale. The second study utilized the dependent variable, General Science 100 and six control variables, Science IX, Differential Aptitude Sub-tests Numerical Ability and Numerical Ability plus Verbal Reasoning, Age Difference, Sex Difference and the Gough Socio-Economic Scale. For both studies the independent variable was the semester plan. The descriptions of the population were followed by an outline of the data sources and then the method of collecting the data.

The analysis of covariance procedure was described. It explained that the means for the semestered and non-semestered groups were calculated along with the means of the control variables for the two groups. Furthermore it was stated that the means for the dependent variables of the two groups were then adjusted for the effect of the control variables. Finally at the end of the computation, the covariance procedure produced an F value which was then tested for significance at the 0.05 level.

CHAPTER IV

ANALYSIS OF THE DATA

INTRODUCTION

The major purpose of this study was to determine whether students learned less, as much or more when taught under the semester plan as compared to the conventional ten month plan.

In this chapter the results of the analysis of covariance are presented for the two dependent variables, General Science 100 and Mathematics 100. These include the correlation coefficients, original and adjusted means, and the F ratio.

The following abbreviations will be used throughout the remainder of this thesis:

DAT-NA -- Differential Aptitude Test, Sub-test Numerical Ability

DAT-NA+VR -- Differential Aptitude Test, Sub-test Numerical Ability plus Verbal Reasoning

THE FINDINGS FOR GENERAL SCIENCE 100

Correlation Coefficients -- Between Control Variables

Table V presents the correlation coefficients for all the variables, General Science 100, grade IX science, DAT-NA, DAT-NA+VR, sex, age and the socio-economic condition as measured by the Gough Socio-Economic Scale.

Six of the correlation coefficients were significant at the .05 level. These were the control variables, grade IX science, DAT-NA, DAT-NA+VR in the dependent variable, General Science 100. Similarly the DAT-NA and the DAT-NA+VR were significant to the control variable, grade IX science.

TABLE V

GENERAL SCIENCE 100 - CORRELATION COEFFICIENTS BETWEEN ALL VARIABLES

	Y	1	2	3	4	5	6
0	0.999999						
1	0.528092	1.000000					
2	0.427070	0.494096	1.000000				
3	0.470138	0.539146	0.795863	1.000000			
4	-0.039168	0.123699	-0.034618	0.056725	1.000000		
5	-0.095389	0.020783	0.016948	0.028113	0.072039	1.000000	
6	0.123593	0.082532	0.091973	0.100143	0.026525	0.229440	1.000000

The abbreviations used represent:

Y - Dependent Variable, General Science 100

1 - Control Variable, Grade IX Science

2 - Control Variable, Differential Aptitude Sub-test Numerical Ability

3 - Control Variable, Differential Aptitude Sub-test, Numerical Ability plus Verbal Reasoning

4 - Control Variable, Sex

5 - Control Variable, Age

6 - Control Variable, Gough Socio-Economic Scale

The control variable, DAT-NA, was significant to the control variable, DAT-NA+VR.

Of these control variables, the highest correlation, +0.795863, existed between the DAT-NA and the DAT-NA+VR. This, however, should be expected since the DAT-NA score comprised the DAT-NA+VR score. The remaining five significant correlation coefficients ranged in magnitude from +0.427070 to +0.539146. The results indicated a relatively strong correlation, 0.539146, between the grade IX science scores and the DAT-NA+VR.

Percentage Variance - Between Control Variables

In Table VI, the results are presented to illustrate the percentage variance accounted for by each of the control variables to one another.

As would be expected from the correlation coefficient given in Table V, the highest percentage variance was accounted for between the DAT-NA and the DAT-NA+VR. Also both of the DAT-NA and the DAT-NA+VR accounted for 24.4% and 29.05% respectively of the variability in the grade IX science scores. The DAT-NA+VR accounted for 63.202% of the variability in the DAT-NA. The remaining control variables, sex, age, and socio-economic condition had an insignificant percentage variance between each other.

Correlation Coefficient - Dependent Variable and the Control Variables

Table VII summarizes the data presented in Tables V and VI and presents only the correlation coefficients and the percentage variance between the dependent variable, General Science 100, and the control variables, grade IX science, DAT-NA, DAT-NA+VR, sex, age, socio-economic condition as measured by the Gough Socio-Economic Scale.

The control variables, grade IX science, DAT-NA, and DAT-NA+VR

TABLE VI

GENERAL SCIENCE 100 - PERCENTAGE VARIANCE ACCOUNTED FOR ALL VARIABLES

	Y	1	2	3	4	5	6
0	---						
1	27.878						
2	18.232	24.403					
3	19.129	29.052	63.202				
4	.00151	.0151	.0011	.0037			
5	.00901	.0004	.0002	.00004	.0011		
6	.0151	.0067	.0082	.0106	.0010	.0353	---

The abbreviations used represent:

Y - Dependent Variable, General Science 100

1 - Control Variable, Grade IX science

2 - Control Variable, Differential Aptitude Sub-test, Numerical Ability

3 - Control Variable, Differential Aptitude Sub-test, Numerical Ability plus Verbal Reasoning

4 - Control Variable, Sex

5 - Control Variable, Age

6 - Control Variable, Gough Socio-Economic Scale

TABLE VII

CORRELATION COEFFICIENTS AND PERCENTAGE VARIANCE BETWEEN GENERAL SCIENCE 100 AND THE CONTROL VARIABLES

Y

	Correlation Coefficient	Percentage Variance
0	0.99999	-------
1	0.528092	27.878
2	0.427070	18.232
3	0.470138	19.129
4	- 0.039168	.0015
5	- 0.095389	.0090
6	0.123593	.0151

The abbreviations used represent:

Y - Dependent Variable, General Science 100

1 - Control Variable, Grade IX science

2 - Control Variable, Differential Aptitude Sub-test, Numerical Ability

3 - Control Variable, Differential Aptitude Sub-test, Numerical Ability plus Verbal Reasoning

4 - Control Variable, Sex

5 - Control Variable, Age

6 - Control Variable, Gough Socio-Economic Scale

had a significant correlation to the dependent variable, General Science 100 at .05 level. A strong intercorrelation, +0.528092, existed between the General Science 100 scores and the control variable, grade IX science scores.

The correlation coefficients between the control variables, sex, age and the socio-economic condition and the dependent variable, General Science 100, were non-significant and the coefficients approached zero correlation.

Percentage Variance - Dependent Variable and the Control Variables

Table VII summarizes the data presented in Tables V and VI and presents only the correlation coefficients and the percentage variance between the dependent variable, General Science 100, and the control variables, grade IX science, DAT-NA, DAT-NA+VR, sex, age and the socio-economic condition.

In regards to the dependent variable, General Science 100, the percentage variability accounted for by the three control variables, grade IX science, DAT-NA and the DAT-NA+VR, was in approximately the same percentage range. Of these, the data indicated that grade IX science scores accounted for the highest percentage, 27.878%, of the variance in the dependent variable, General Science 100.

The control variables, sex, age, and the socio-economic condition each explained less than .05 of the variance in the dependent variable, General Science 100 achievement.

Original and Adjusted Means

For the educational researcher, analysis of covariance is an extremely appropriate statistical technique, in situations where the re-

searcher needs to test for mean differences between two or more intact groups while compensating for initial differences between the groups with respect to relevant variables.

The inspection of the dependent means as shown in Table VIII indicates the group which was significantly superior. The original dependent means for the groups were adjusted to compensate for initial differences between the grours on the control variables, it was these adjusted means that were inspected.

Table VIII showed that the adjustment made to the dependent means, semestered and non-semestered, were relatively small. The control group's, non-semester, unadjusted original mean was increased slightly while the experimental group's, semester, original mean was adjusted downward. The reason for these particular adjustments can be inferred from the differences between the semester and non-semester groups on the control variables. The semester group's mean was adjusted downward because of that group's initial superiority over the control variables in the DAT-NA and DAT-NA+VR, and the Gough Socio-Economic Scale. There were also slightly more girls than boys. The contribution to the mean adjustment made by each control variable was determined primarily by the magnitude of the initial difference between the semestered and non-semestered groups and the strength of the relationship between the dependent variable and the control variable as seen through the correlation coefficients found on Table V.

Once the adjustment on the dependent means for the semestered and non-semestered group was made, one could see by inspecting the adjusted means, that the semestered group performed significantly better than the

TABLE VIII

ORIGINAL AND ADJUSTED MEANS FOR GENERAL SCIENCE 100

Groups	Y Mean	Adjusted Y Mean	1	2	3	4	5	6
Semester	67.123	66.214	68.75	24.62	52.97	1.56	190.46	15.18
Non-Semester	59.617	60.084	70.01	23.45	51.49	1.46	200.42	14.78

The abbreviations used represent:

Y - Dependent Variable, General Science 100

1 - Control Variable, Grade IX science

2 - Control Variable, Differential Aptitude Sub-test Numerical Ability

3 - Control Variable, Differential Aptitude Sub-test, Numerical Ability plus Verbal Reasoning

4 - Control Variable, Sex

5 - Control Variable, Age

6 - Control Variable, Gough Socio-Economic Scale

non-semestered counterpart. The difference in means was 6.130 points favoring the semestered group.

F ratio to Test the Null Hypothesis

To test the null hypothesis that there was no significant difference in the General Science 100 achievement for students taught under the semestered or non-semestered system, the data were tested by an analysis of covariance. Data basic to the F ratio are summarized in Table IX.

The computed F ratio, 11.25, for General Science 100 in Table IX was significant at the .05 level. The critical $F_{.05}$ for this test was 3.87 and hence the null hypothesis of no difference between the semestered and non-semestered group was rejected.

Therefore, it can be concluded on the basis of the analysis of the data that students on the semestered system in this experiment achieved significantly higher results in General Science 100 than non-semestered students achieved in General Science 100.

TABLE IX

F RATIO FOR GENERAL SCIENCE 100

Source	D.F.	S.S.	M.S.	F.
Sem - Non (Between)	1	3433.805	3433.805	11.25
Error (Within)	328	100110.688	305.215	
Total	329	104354.000		

The abbreviations used represent:

Sem - Non - Semestered - Non-Semestered

D.F. - Degree of Freedom

S.S. - Sum of Squares

M.S. - Means Square

F - F ratio

THE FINDINGS FOR MATHEMATICS 100

Correlation Coefficients - Between Control Variables

Table X presents the correlation coefficients for all the variables in this study. These were, Mathematics 100, grade IX mathematics, DAT-NA, DAT-NA+VR, sex, age and the socio-economic condition as measured by the Gough Socio-Economic Scale.

Similar to the previous study, six control variables were significant at the .05 level. The control variables, grade IX mathematics, DAT-NA, DAT-NA+VR were significant to the dependent variable, Mathematics 100. The control variables, DAT-NA and the DAT-NA+VR were significant to the control variable, grade IX mathematics. The DAT-NA+VR was significant to the DAT-NA.

Of these controls, an identical high correlation, +0.795863, existed between the DAT-NA and DAT-NA+VR as it was the case in the previous study for General Science 100. The remaining five significant correlation coefficients ranged in magnitude from +0.477762 to +0.691986. A strong intercorrelation, +0.600131, existed between the control variable, DAT-NA and the control variable, grade IX mathematics. This correlation was stronger than the correlation that existed in the previous study between the control variable, DAT-NA and the control variable, General Science 100. The higher correlation between the DAT-NA and grade IX mathematics could be attributed to the similar quantities being measured. An analogous observation was made between the control variables, DAT-NA+VR and grade IX mathematics, and the control variables of the previous study, DAT-NA+VR and the General Science 100.

TABLE X

MATHEMATICS 100 - CORRELATION COEFFICIENTS BETWEEN ALL VARIABLES

	Y	1	2	3	4	5	6
0	1.000000						
1	0.691986	1.000000					
2	0.477762	0.600131	1.000000				
3	0.498574	0.591872	0.795863	1.000000			
4	0.055263	0.070849	-0.034618	0.061429	1.000000		
5	-0.145857	0.001831	0.016948	0.007101	0.035459	1.000000	
6	0.040349	0.107006	0.091973	0.103792	0.033085	0.188695	1.000000

The abbreviations used represent:

Y - Dependent Variable, Mathematics 100

1 - Control Variable, Grade IX Mathematics

2 - Control Variable, Differential Aptitude Sub-test, Numerical Ability

3 - Control Variable, Differential Aptitude Sub-test, Numerical Ability plus Verbal Reasoning

4 - Control Variable, Sex

5 - Control Variable, Age

6 - Control Variable, Gough Socio-Economic Scale

Percentage Variance - Between Control Variable

Table XI is an illustration of the percentage variance accounted for by each of the control variables.

Both of the control variables, DAT-NA and the DAT-NA+VR accounted for 36.00% and 34.928 % respectively of the variability in the control variable, grad IX mathematics. The percentage variance between the control variables, DAT-NA and DAT-NA+VR was 57.102%. The percentage variance between each of the remaining control variables, sex, age and the socio-economic condition as measured by the Gough Socio-Economic Scale was insignificant.

Correlation Coefficient - Dependent Variable and the Control Variables

Table XII summarizes the data presented in Tables X and XI and presents only the correlation coefficients and the percentage variance between the dependent variable, Mathematics 100 and the control variables, grade IX mathematics, DAT-NA, DAT-NA+VR, sex, age, and the socio-economic condition as measured by the Gough Socio-Economic Scale.

The control variables, grade IX mathematics, DAT-NA, and the DAT-NA+VR, were significant at the .05 level to the dependent variable, Mathematics 100. Of these controls, the correlation coefficient, +0.691936 which existed between the control variable, grade IX mathematics and the dependent variable, Mathematics 100 was the strongest correlation. The DAT-NA and the DAT-NA+VR had a similar correlation to the dependent variable, Mathematics 100.

The correlation coefficients between the control variables, sex, age, and the socio-economic condition, and the dependent variable, Mathematics 100 were non-significant and the coefficients approached zero

TABLE XI

MATHEMATICS 100 - PERCENTAGE VARIANCE ACCOUNTED FOR ALL VARIABLES

	Y	1	2	3	4	5	6
0	---						
1	38.316						
2	22.752	36.000					
3	24.802	34.928	57.102				
4	.3025	.0490	.1156	.3721			
5	-2.102	.0001	.0256	.0049	.1225		
6	.0160	1.544	.8281	1.060	.1089	3.534	---

The abbreviations used represent:

Y - Dependent Variable, Mathematics 100

1 - Control Variable, Grade IX Mathematics

2 - Control Variable, Differential Aptitude Sub-test, Numerical Ability

3 - Control Variable, Differential Aptitude Sub-test, Numerical Ability plus Verbal Reasoning

4 - Control Variable, Sex

5 - Control Variable, Age

6 - Control Variable, Gough Socio-Economic Scale

TABLE XII

CORRELATION COEFFICIENTS AND PERCENTAGE VARIANCE BETWEEN MATHEMATICS 100 AND THE CONTROL VARIABLES

Y

	Correlation Coefficient	Percentage Variance
0	1.000000	---------
1	0.691986	38.316
2	0.477762	22.752
3	0.498574	24.802
4	0.055263	.3025
5	-0.145857	2.102
6	0.040349	.0160

The abbreviations used represent:

Y - Dependent Variable, Mathematics 100

1 - Control Variable, Grade IX Mathematics

2 - Control Variable, Differential Aptitude Sub-test, Numerical Ability

3 - Control Variable, Differential Aptitude Sub-test, Numerical Ability plus Verbal Reasoning

4 - Control Variable, Sex

5 - Control Variable, Age

6 - Control Variable, Gough Socio-Economic Scale

correlation.

Percentage Variance - Dependent Variable and the Control Variables

Table XII summarizes the data presented in Tables X and XI and presents only the correlation coefficients and the percentage variance between the dependent variable, Mathematics 100 and the control variables, grade IX mathematics, DAT-NA, DAT-NA+VR, sex, age and the socio-economic condition.

The control variable that accounted for the highest percentage variance in the dependent variable, Mathematics 100, was grade IX mathematics. The percent variance was 38.316%. The control variables, DAT-NA and DAT-NA+VR accounted for 22.752% and 24.802% respectively of the variability in the dependent variable, Mathematics 100.

Except for the control variable, age, the remaining control variables, sex and the socio-economic condition explained less than .05 of the variance in the dependent variable, Mathematics 100 achievement. The control variable, age, accounted for 2.102% of the variability in the dependent variable, Mathematics 100.

Original and Adjusted Means

In order to determine whether the semester plan influenced students' academic achievement in Mathematics 100 at Silver Heights Collegiate, an investigation of Table XIII was made. Since this study attempted, to ascertain whether the student learned less, as much, or more, as indicated by school grades under the semester, it was necessary to compare the original and the adjusted means of the semestered and non-semestered groups in order to establish which group was superior.

TABLE XIII

ORIGINAL AND ADJUSTED MEANS FOR MATHEMATICS 100

Groups	Y Mean	Adjusted Y Mean	1	2	3	4	5	6
Semester	66.430	64.701	71.04	24.62	52.97	1.56	190.46	15.18
Non-Semester	58.090	58.978	71.31	23.45	51.49	1.46	200.42	14.78

The abbreviations used represent:

Y - Dependent Variable, Mathematics 100

1 - Control Variable, Grade IX Mathematics

2 - Control Variable, Differential Aptitude Sub-test Numerical Ability

3 - Control Variable, Differential Aptitude Sub-test, Numerical Ability plus Verbal Reasoning

4 - Control Variable, Sex

5 - Control Variable, Age

6 - Control Variable, Gough Socio-Economic Scale

The original means for the semestered and non-semestered were 66.430 and 59.090 respectively. Until then, no control variables had been considered to eliminate the biases that could have existed. The information so far considered, was not to be conclusive except that it established the magnitude of the differences between the two groups. Once the controls were introduced and the means computed, the original dependent mean for the semestered group was adjusted downward because of that group's superiority in the control variables, DAT-NA, DAT-NA+VR and the socio-economic conditions as measured by the Gough Socio-Economic Scale. The original dependent mean for the non-semestered group was adjusted slightly upward because of that group's superiority in the control variables, grade IX mathematics and age differences did not warrant any further adjustment.

The adjusted mean for the semestered group was 64.701 while the adjusted mean for the non-semestered group was 58.978.

F ratio to Test the Null Hypothesis

To test the null hypothesis that there was no significant difference in Mathematics 100 achievement for students taught under the semestered or non-semestered system, the data were tested by an analysis of covariance.

Table XIV show that the computed F ratio was 5.64. The critical F .05 in this study was 3.87. The difference was sufficiently large enough to be considered significant and to reject the null hypothesis as originally stated in chapter I.

Thus, it can be concluded on the basis of the analysis of the data

TABLE XIV

F RATIO FOR MATHEMATICS 100

Source	D.F.	S.S.	M.S.	F.
Sem - Non (Between)	1	2978.250	2978.250	5.64
Error (Within)	328	173100.125	527.744	
Total	329	178338.813		

The abbreviations used represent:

Sem - Non - Semestered - Non-Semestered

D.F. - Degree of Freedom

S.S. - Sum of Squares

M.S. - Means Square

F. - F ratio

that students on the semestered system in this experiment achieved significantly higher results in Mathematics than non-semestered students achieved in Mathematics 100.

SUMMARY

In this chapter, the findings of the investigation were reported. First, the findings of the correlation coefficients and percentage variance between all control variables used in this study were reported. Similarly, the findings of the correlation coefficients and percentage variance between the dependent variables, General Science 100 and Mathematics 100 to the controls used in this study were reported. Second, the findings of the investigation of the original and adjusted means were reported. This chapter was concluded with a comparison of the calculated F ratio for General Science 100 and Mathematics 100 to the $F_{.05}$ value with 1 and 328 degrees of freedom, in order to accept or reject the null hypotheses as stated in chapter I.

CHAPTER V

SUMMARY AND CONCLUSIONS

INTRODUCTION

This chapter contains a synopsis of the study which is followed by a presentation of the major findings. To compliment the purposes and major findings of the study, the conclusions based on the data are presented. Finally, recommendations are made for future study.

REVIEW OF THE STUDY

This study was designed to ascertain whether the students' academic achievements in General Science 100 and Mathematics 100 were less, as much or greater under the semester plan as compared to the regular ten month school year. Since the study used intact groups to represent the semester and the non-semester, it was necessary to use the analysis of covariance. This statistical program allowed the study to review the performance of the two groups by equating the dependent variable group means with respect to the variables used in this investigation.

Once the data, as explained in chapter III, for approximately 120 semestered students and 222 non-semestered students had been compiled and computed, the study interpretated the correlation coefficient, percentage variance, original and adjusted dependent means and the F ratio. The purpose of analyzing the findings was to discover if the semester plan had influenced students' academic performance in Mathematics 100 and General Science 100 at Silver Heights Collegiate.

MAJOR FINDINGS

The major findings of the study will be presented according to the correlation coefficient, the percentage variance, the original and adjusted dependent means, and the F ratio.

General Science 100

The major findings are outlined as follows:

(1) the correlation coefficient between the control variables grade IX science achievement and the DAT-NA was +.494096. The percentage variance between the control variables grade IX science achievement and the DAT-NA was 24.403%.

(2) the correlation coefficient between the control variables, grade IX science and the DAT-NA+VR was +.0539146 and thus 29.052 percent variance could be explained by the DAT-NA+VR in grade IX science.

(3) the highest percentage variance accounted for was between the DAT-NA and DAT-NA+VR. The percentage variance was 57.102%.

(4) the control variables, DAT-NA and DAT-NA+VR accounted for 24.4% and 29.05% respectively of the variability in the grade IX science scores.

(5) the DAT-NA and the DAT-NA+VR accounted for 18.232% and 19.129% respectively of the variance in the dependent variable, General Science 100.

(6) grade IX science had an intercorrelation of +.528092, and accounted for 27.87 of the percentage variance in the dependent variable, General Science 100.

(7) the control variables, sex difference, age difference and the socio-economic conditions accounted for an insignificant variance in the

other control variables used in this study as well as in the dependent variable, General Science 100.

(8) the original means for the semester and non-semester groups were 67.123 and 59.617 respectively while the semester adjusted mean was 66.214 and the non-semester adjusted mean was 60.084.

(9) the critical value for $F_{.05}$ with 1 and 328 degrees of freedom was 3.87 while the computed F value was 11.25. Since the significant difference was large enough, the null hypothesis was rejected.

(10) the semestered students' achievement in General Science 100 was greater than the non-semestered students' achievements. The semester plan was considered superior to the ten month school year plan in General Science 100 at Silver Heights Collegiate.

Mathematics 100

The major findings are summarized as follows:

(1) the correlation coefficient between the control variables, grade IX mathematics and the DAT-NA was +.600131. This implied that the DAT-NA accounted for 36.000 percent of the variance in grade IX mathematics.

(2) the intercorrelation between the DAT-NA+VR and grade IX Mathematics was +.591872. The DAT-NA+VR accounted for 34.928 percent of the variability in grade IX Mathematics.

(3) except for the correlation coefficient between the control variables, DAT-NA and the DAT-NA+VR, all other control variables had an insignificant correlation coefficient and percentage variance between each other.

(4) the dependent variable, Mathematics 100, and the control variable, grade IX Mathematics, had a correlation coefficient of +.691986 which meant that grade IX Mathematics accounted for a percentage variance of 38.316 in Mathematics 100.

(5) in regards to the dependent variable, Mathematics 100, the control variables, DAT-NA and DAT-NA!VR, had a percentage variance of 22.752% and 24.802% respectively.

(6) as it was the case for the dependent variable, General Science 100 the control variables, sex difference, age difference, and the socio-economic conditions had a low correlation coefficient to the dependent variable Mathematics 100. These controls also explained very little of the variance in Mathematics 100.

(7) the original dependent means for the semestered group in Mathematics 100 was adjusted downward from 66.430 percent to 64.701 percent. The original dependent means for the non-semestered group in Mathematics 100 was adjusted upward from 58.090 to 58.978. The semestered group's original dependent means was adjusted downward because of that group's original superiority in the two sub-tests of the Differential Aptitude Test, and the socio-economic conditions.

(8) the null hypothesis was rejected since the calculated F value was 5.64 and exceeded the $F_{.05}$ value which was 3.87.

(9) the interpretation of the dependent means and the F ratio indicated that the semester plan was superior to the ten month school year and had influenced students' achievements in Mathematics 100 at Silver Heights Collegiate.

CONCLUSIONS

This study sought to explore the effectiveness of the semester plan in General Science 100 and Mathematics 100 at Silver Heights Collegiate. The specific research hypotheses were designed to assess the learning effectiveness as shown by achievement marks in General Science 100 and Mathematics 100.

All other things being equal, that is, assuming that only the effects of the semester plan on students' achievement had been compared to the effects of the ten month school year on student achievement, evidence was found to support the acceptance of the semester plan and as a result supports the introduction of the semester plan at Silver Heights Collegiate. Because the semester plan is a large and relatively unexplored area in Manitoba, important variables affecting students' achievement were left uncontrolled. These were mainly control variables such as motivation of students and teachers, novelty of the system, attendance, retention span, facilities, methods of instruction, evaluation and, undoubtedly, other factors affecting student achievement.

Even though this investigation was limited to students who attended Silver Heights Collegiate and took General Science 100 and Mathematics 100, the study performed a necessary function. It demonstrated that students' achievement in General Science 100 and Mathematics 100 of Silver Heights Collegiate students taught under the semester plan, was superior to that of the non-semestered counterpart.

To avoid leaving the reader with the impression that this study supplied factual material to justify the inception of the semester plan and to warrant lasting effects, the writer would like to caution that the

conclusions are tentative and cannot be generalized. A further study should be done in a few years to appreciate fully the merits of the semester plan.

RECOMMENDATIONS FOR FURTHER STUDY

Based on the findings of this study, the following recommendations are made for further study.

(1) Since control variables affecting achievement appear to be the key in evaluating the effects of the semester plan on student achievement, it is recommended that motivation of students and teachers, study habits, retention span, attendance, facilities, instructional methods and evaluation might be considered for future studies.

(2) Although sex difference, age difference, and socio-economic conditions had a low correlation coefficient and percentage variance to the dependent variables General Science 100 and Mathematics 100, it is recommended that these controls be kept when investigating two different groups as though they are equal. The analysis of covariance will establish the magnitude of their relationships, and the trivial differences, if any, between the two groups can become influential in the adjustment of two dependent means.

(3) Similarly, it is recommended that the Differential Aptitude Test be considered for future, similar studies.

(4) Future studies might assess the relative merits of the semester plan for each category: the gifted, the remedial, the student of mature years, etc.

(5) It is recommended that a future study try to ascertain the influence

of the semester plan in some of the humanities, such as, English, History, French and so on.

(6) It is also recommended that a future study investigates the semester plan in order to establish its influence in subjects beyond grade X level.

SUMMARY

The sole purpose of this study was to ascertain whether students taught under the semester plan learned less, as much as, or more than students taught under the ten month school year. Once the data had been consolidated and investigated for the semestered and non-semestered groups, the findings provided information of a concrete nature. The semester plan had influenced students' achievement at Silver Heights Collegiate. The adjusted means and the F ratio clearly revealed that students' achievement in General Science 100 and Mathematics 100 was better.

The goal has been met, in that the study had shown that students learned more in General Science 100 and Mathematics 100 when taught under the semester plan. Furthermore, the implications of this study for administrators and teachers are dependent upon their needs and frame of reference and are left for individual interpretation. This study has provided factual material upon which to base or justify future considerations as to whether or not to adopt the semester plan.

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APPENDIXES

A. Gough-Socio Economic Scale

GOUGH SOCIO-ECONOMIC SCALE

H. Gough

Name _____

Sex _____

Homeroom _____

Grade _____

General Instructions

Please fill in the information above before reading the instructions.

This questionnaire contains a set of twenty questions about your family. You are to read carefully the directions for the following statements on page 2, and answer them according to the directions given. It is not a test, so it is very important that you answer the questions as carefully as you can.

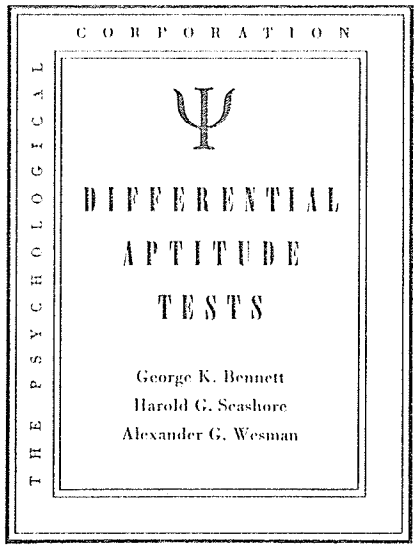
IMPORTANT - Your answers will be kept confidential and will not be used by anyone in our school.

NOW TURN THE PAGE AND READ THE INSTRUCTIONS FOR THE SET OF STATEMENTS WHICH FOLLOW.

Below are twenty questions about your family. Indicate your answer by circling either "yes" or "no" for each question.

1.	Does your family own a car?	A. Yes	B. No
2.	Does your family have a garage or carport?	A. Yes	B. No
3.	Did your father go to high school?	A. Yes	B. No
4.	Did your mother go to high school?	A. Yes	B. No
5.	Did your father go to university?	A. Yes	B. No
6.	Did your mother go to university?	A. Yes	B. No
7.	Is there a writing desk in your home?	A. Yes	B. No
8.	Does your family have a hi-fi record player?	A. Yes	B. No
9.	Does your family own a piano?	A. Yes	B. No
10.	Does your family get a daily newspaper?	A. Yes	B. No
11.	Do you have your own room at home?	A. Yes	B. No
12.	Does your family own its own home?	A. Yes	B. No
13.	Is there an encyclopedia in your home?	A. Yes	B. No
14.	Does your family have more than 100 hard covered books? (e.g. 4 shelves 3 feet long)	A. Yes	B. No
15.	Did your parents borrow any books from the library last year?	A. Yes	B. No
16.	Does your family leave town each year for a holiday?	A. Yes	B. No
17.	Do you belong to any club where you have to pay fees?	A. Yes	B. No
18.	Does your mother belong to any clubs or organizations such as study, church, art, or social clubs?	A. Yes	B. No
19.	Does your family own a color T.V. set?	A. Yes	B. No
20.	Have you ever had lessons in music, dancing, art, swimming etc., outside of school?	A. Yes	B. No

B. Differential Aptitude Test, Form L



FORM L

BOOKLET 1

VERBAL REASONING

Page 3

NUMERICAL ABILITY

Page 9

ABSTRACT REASONING

Page 13

CLERICAL SPEED AND ACCURACY

Page 20

Do not open this booklet until you are told to do so. Wait for the examiner's instructions. Then:

On the SEPARATE ANSWER SHEET, print your name and fill in the other requested information in the proper spaces.

In the space after **Form,** blacken the space for the letter **L.**

Then wait for further instructions.

DO NOT MAKE ANY MARKS IN THIS BOOKLET

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67-128 TB

1. ..... is to street as rd. is to .....

A. st. —— city
B. lo. —— city
C. st. —— road
D. ma. —— road
E. st. —— France

2. ..... is to cavalry as foot is to .....

A. horse —— travel
B. horse —— infantry
C. horse —— yard
D. cemetery —— yard
E. horse —— armory

3. ..... is to wide as thin is to .....

A. narrow —— weight
B. store —— present
C. narrow —— fat
D. nothing —— fat
E. street —— weight

4. ..... is to masculine as woman is to .....

A. man —— madame
B. malicious —— feminine
C. malicious —— girl
D. man —— feminine
E. man —— girl

5. ..... is to dispute as endure is to .....

A. argue —— invert
B. repute —— verdure
C. impute —— verdure
D. impute —— last
E. argue —— last

6. ..... is to verse as sculptor is to .....

A. poet —— artist
B. poet —— statue
C. music —— statue
D. reverse —— statue
E. reverse —— artist

7. ..... is to chain as bead is to .....

A. link —— pearl
B. watch —— pearl
C. iron —— necklace
D. pull —— necklace
E. link —— necklace

8. ..... is to animal as rind is to .....

A. husk —— melon
B. skin —— nut
C. skin —— melon
D. man —— hard
E. husk —— nut

9. ..... is to cork as box is to .....

A. bottle —— lid
B. bottle —— crate
C. bottle —— hat
D. bottle —— fight
E. brittle —— crate

10. ..... is to tusk as deer is to .....

A. elephant —— doe
B. ivory —— doe
C. elephant —— antler
D. ivory —— antler
E. ivory —— hunt

11. ..... is to contralto as tenor is to .....

A. singer —— song
B. sonata —— baritone
C. solo —— song
D. solo —— baritone
E. soprano —— baritone

12. ..... is to hang as guillotine is to .....

A. gallows —— behead
B. criminal —— behead
C. picture —— capitulate
D. picture —— behead
E. punish —— citizen

13. ..... is to tree as melon is to .....

A. apple —— vine
B. bush —— vine
C. elm —— water
D. elm —— ripe
E. bush —— sweet

14. ..... is to pea as shell is to .....

A. green —— nut
B. pod —— crack
C. green —— peel
D. green —— crack
E. pod —— nut

GO ON TO THE NEXT PAGE.

15. ..... is to steer as pork is to .....

A. cow —— pig
B. beef —— pig
C. bull —— pig
D. beef —— chop
E. bull —— chop

16. ..... is to sentence as sentence is to .....

A. jail —— phrase
B. word —— paragraph
C. word —— phrase
D. jail —— paragraph
E. jail —— fine

17. ..... is to Dick as Margaret is to .....

A. Richard —— Mary
B. Francis —— Frances
C. William —— Peggy
D. Richard —— Peggy
E. Richard —— Joan

18. .....is to childhood as adolescence is to.....

A. infantry —— adultery
B. infancy —— maturity
C. infantry —— intelligence
D. infancy —— adultery
E. health —— intelligence

19. ..... is to potato as beater is to .....

A. mashed —— egg
B. skin —— steak
C. skin —— egg
D. masher —— winner
E. masher —— egg

20. ..... is to dog as Guernsey is to .....

A. terrier —— cow
B. bark —— cow
C. tail —— cow
D. tail —— Jersey
E. bark —— Jersey

21. ..... is to top as base is to .....

A. spin —— bottom
B. side —— bottom
C. spin —— ball
D. apex —— bottom
E. ibex —— bottom

22. ..... is to eagle as Pekinese is to .....

A. sparrow —— collie
B. sparrow —— Chinese
C. flag —— Chinese
D. vulture —— Chinese
E. vulture —— crow

23. ..... is to river as coast is to .....

A. flood —— beach
B. tide —— sea
C. bank —— sea
D. flood —— sea
E. tide —— beach

24. ..... is to foot as elbow is to .....

A. toe —— shoulder
B. toe —— hand
C. knee —— hand
D. man —— hand
E. knee —— shoulder

25. ..... is to day as calendar is to .....

A. noon —— year
B. sun —— year
C. night —— year
D. sun —— March
E. clock —— year

26. ..... is to constitution as prologue is to .....

A. preamble —— play
B. independence —— epilogue
C. independence —— play
D. law —— epilogue
E. amendment —— epilogue

27. ..... is to proceed as stop is to .....

A. recede —— prevent
B. intercede —— prevent
C. halt —— go
D. profit —— go
E. intercede —— go

28. ..... is to horse as bray is to .....

A. neigh —— donkey
B. hoof —— donkey
C. saddle —— wagon
D. hoof —— wagon
E. hoof —— pony

GO ON TO THE NEXT PAGE.

29. ..... is to sea as rebellion is to .....

A. navy —— war
B. mutiny —— land
C. sailor —— war
D. sailor —— soldier
E. river —— revolting

30. ..... is to distance as pound is to .....

A. far —— ounce
B. far —— weight
C. travel —— ounce
D. rod —— ounce
E. rod —— weight

31. ..... is to door as pane is to .....

A. lock —— window
B. panel —— window
C. home —— window
D. lock —— glass
E. wood —— ache

32. ..... is to never as all is to .....

A. seldom —— whole
B. seldom —— every
C. always —— every
D. seldom —— none
E. always —— none

33. ..... is to future as regret is to .....

A. ahead —— past
B. ahead —— sins
C. hope —— past
D. ahead —— atone
E. forecast —— atone

34. ..... is to rain as levee is to .....

A. water —— departure
B. water —— rise
C. water —— wash
D. umbrella —— flood
E. cloud —— rise

35. ..... is to fish as gun is to .....

A. bait —— shot
B. cod —— trigger
C. rod —— shot
D. cod —— bullet
E. rod —— hunt

36. ..... is to pacifist as religion is to .....

A. atlantis —— minister
B. object —— minister
C. atlantis —— sacred
D. war —— atheist
E. conscience —— minister

37. ..... is to deft as awkward is to .....

A. clumsy —— stupid
B. hearing —— stupid
C. hearing —— ugly
D. clumsy —— skillful
E. blindness —— skillful

38. ..... is to nut as hook is to .....

A. bolt —— eyehole
B. fruit —— pitch
C. fruit —— bend
D. bolt —— bend
E. hazel —— bend

39. ..... is to land as knot is to .....

A. acre —— rope
B. mile —— sea
C. desert —— rope
D. mile —— meter
E. farm —— rope

40. ..... is to bird as shed is to .....

A. fly —— barn
B. fly —— dog
C. fly —— hay
D. moult —— dog
E. migrate —— barn

41. ..... is to physician as secretary is to .....

A. doctor —— office
B. nurse —— executive
C. doctor —— stenographer
D. medicine —— office
E. medicine —— executive

42. ..... is to England as lira is to .....

A. pound —— Italy
B. London —— money
C. London —— Mexico
D. London —— mandolin
E. London —— Italy

GO ON TO THE NEXT PAGE.

43. ..... is to city as national is to .....

A. mayor —— government
B. municipal —— country
C. Chicago —— government
D. mayor —— country
E. Chicago —— international

44. ..... is to prison as Louvre is to .....

A. warden —— paramour
B. warden —— museum
C. warden —— France
D. Bastille —— museum
E. crime —— artist

45. ..... is to Canada as Havana is to .....

A. Nome —— Cuba
B. Detroit —— Cuba
C. Toronto —— Cuba
D. Alberta —— Cuba
E. Alberta —— Florida

46. ..... is to opera as lyric is to .....

A. baritone —— music
B. baritone —— poem
C. composer —— music
D. composer —— song
E. drama —— song

47. ..... is to bleach as flushed is to .....

A. color —— drained
B. color —— truffle
C. color —— blushed
D. color —— wan
E. gay —— drained

48. ..... is to static as dynamic is to .....

A. inert —— active
B. radio —— active
C. radio —— speaker
D. inert —— speaker
E. radio —— motor

49. ..... is to all as part is to .....

A. full —— separate
B. each —— separate
C. each —— many
D. full —— many
E. each —— whole

50. ..... is to diamond as circle is to .....

A. gold —— round
B. square —— oval
C. shape —— round
D. cube —— round
E. square —— round

STOP. YOU MAY CHECK YOUR WORK ON THIS TEST. DO NOT TURN TO ANY OTHER TEST.

Do not make any marks in this booklet

NUMERICAL ABILITY

Mark your answers on the separate Answer Sheet

DIRECTIONS

Find the space for Numerical Ability on the Answer Sheet.

This test consists of forty numerical problems. Next to each problem there are five answers. You are to pick out the correct answer and fill in the space under its letter on the separate Answer Sheet. If you do not find a correct answer among the first four choices, blacken the space under E as your answer. Choice E for every problem is "none of these" which means that a correct answer is not among the first four choices. Only one answer should be marked for each problem. Do your figuring on the scratch paper you have been given, and reduce fractions to lowest terms.

The following are examples of problems in the test. The samples of the Answer Sheets show how you are to mark your answers.

Example X.

Add	**13**	A	**14**
	12	B	**25**
		C	**16**
		D	**59**
		E	**none of these**

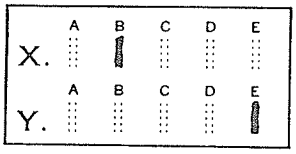
In Example X, 25 is the correct answer, so the space under the letter for 25—B—has been filled in.

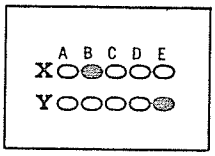
Example Y.

Subtract	**30**	A	**15**
	20	B	**26**
		C	**16**
		D	**8**
		E	**none of these**

In Example Y, the correct answer has not been given, so the space under the letter for "none of these"—E—has been blackened.

SAMPLES OF ANSWER SHEETS





Remember, each answer must be reduced to its simplest terms. For example, if two choices are **1 ½** and **1 ²⁄₄**, only the **1 ½** is correct.

DO ALL YOUR FIGURING ON THE SEPARATE SHEET OF SCRATCH PAPER.

You will have 30 minutes for this test. Work as rapidly and as accurately as you can. Do not spend a long time on any one problem. If you are not sure of an answer, mark the choice which is your best guess.

DO NOT TURN THE PAGE UNTIL YOU ARE TOLD TO DO SO.

ANSWER

1. Add

393
4658
3790
67

A 7908
B 8608
C 8898
D 8908
E none of these

2. Subtract

5473
2987

A 2485
B 2486
C 2496
D 3486
E none of these

3. Multiply

484
25

A 10900
B 11100
C 11900
D 11700
E none of these

4. Multiply

2.04
.75

A 1.5300
B 153.0
C 1530
D 15300
E none of these

5. Multiply

4.50
22

A .99
B 98.40
C 99.00
D 9900
E none of these

6. Multiply

.025
.025

A .001375
B .00625
C .625
D 1.375
E none of these

7. Multiply

.016
.016

A 256
B 25.6
C .00256
D .000256
E none of these

ANSWER

8. Divide

$46\overline{)69}$

A $1\frac{13}{46}$
B $1\frac{23}{46}$
C 1.5
D 15
E none of these

9. Divide

$.75\overline{)2.25}$

A .0003
B .03
C .3
D 3
E none of these

10. Divide

$3.6\overline{).72}$

A .02
B .2
C 2
D 20
E none of these

11. Divide

$64.7\overline{)304.09}$

A .47
B 4.07
C 4.7
D 47
E none of these

12. Divide

$.04\overline{)4.036}$

A 1.009
B 10.9
C 10.09
D 100.9
E none of these

13. $\frac{1}{4} \div \frac{1}{8} =$

A $\frac{1}{32}$
B $\frac{1}{8}$
C $\frac{1}{2}$
D 2
E none of these

14. $\frac{2}{7} \times \frac{3}{7} =$

A $\frac{6}{49}$
B $\frac{3}{7}$
C $\frac{2}{3}$
D $\frac{6}{7}$
E none of these

GO ON TO THE NEXT PAGE.

15. $\frac{3 \times 10}{5 \times 9} =$

ANSWER

A $27/50$
B $1\ 1/2$
C $30/45$
D $2/3$
E none of these

16. Add

$4\ 3/4$
$9\ 1/2$
$13\ 7/8$

A $26\ 11/14$
B $27\ 1/8$
C $28\ 1/2$
D $28\ 11/14$
E none of these

17. Add

2 ft. 3 in.
28 ft. 11 1/2 in.
17 ft. 5 in.
4 1/2 in.

A 49 ft.
B 48 ft. 2 in.
C 47 ft. 24 in.
D 48 ft.
E none of these

18. Add

3 lbs. 3 oz.
6 lbs. 7 oz.
7 lbs. 5 oz.
11 lbs. 1 oz.

A 28 lbs. 16 oz.
B 28 lbs.
C 27 lbs. 16 oz.
D 18 lbs.
E none of these

19. Square root

$\sqrt{169}$

A 13
B 43
C 84 1/2
D 169
E none of these

20. Square root

$\sqrt{.09}$

A .03
B .3
C 3
D 9
E none of these

21. Square root

$\sqrt{\frac{4}{9} \times \frac{25}{36}}$

A $25/81$
B $25/36$
C $5/9$
D $2\ 7/9$
E none of these

22. $? = 33\frac{1}{3}\%$ of 963

ANSWER

A 32.19
B 231
C 321
D 32100
E none of these

23. $? = 12\frac{1}{2}\%$ of 816

A .12
B 12
C 102
D 104
E none of these

24. $? = \frac{4}{9}$ of 648

A 14.58
B 72
C 218
D 1458
E none of these

25. 15 = 75% of ?

A .20
B 10.25
C 20
D 22.5
E none of these

26. 25 = ? % of 125

A $1/5$
B 5
C 20
D 31.25
E none of these

27. 2.5 = ? % of 2

A 5
B 8
C 80
D 125
E none of these

28. $\frac{?}{8} = \frac{3}{24}$

A $1/8$
B 1
C 3
D 4
E none of these

GO ON TO THE NEXT PAGE.

ANSWER

29. $\frac{5}{9} = \frac{55}{?}$

A $55/99$
B 11
C 45
D 99
E none of these

30. $\frac{11}{4} = \frac{77}{?}$

A $77/28$
B 28
C 44
D 308
E none of these

31. Cube root $\sqrt[3]{32 \times 2}$

A 4
B 8
C 21 1/3
D 192
E none of these

32. Cube root $\sqrt[3]{.000729}$

A .000243
B .009
C .027
D .09
E none of these

33. Cube root $\sqrt[3]{\frac{1}{8} \times \frac{125}{64}}$

A 5/8
B $375/512$
C 2 1/2
D 15 5/8
E none of these

34. List price = \$75.00
Discounts = $33\frac{1}{3}\%$; 2%
Net price = \$?

A 25
B 48.50
C 49.50
D 50
E none of these

ANSWER

35. What **one** number can replace **both** question marks?

$\frac{2}{?} = \frac{?}{50}$

A 1
B 10
C 25
D 100
E none of these

36. What **one** number can replace **both** question marks?

$\frac{1}{?} = \frac{?}{36}$

A 6
B 12
C 35
D 36
E none of these

37. What **one** number can replace **both** question marks?

$\frac{4}{?} = \frac{?}{100}$

A 1
B 20
C 25
D 200
E none of these

38. What **one** number can replace **both** question marks?

$\frac{8}{?} = \frac{?}{12\frac{1}{2}}$

A 1 1/2
B 4
C 64
D 100
E none of these

39. What **one** number can replace **both** question marks?

$\frac{6.25}{?} = \frac{?}{16}$

A 4
B 10
C 16
D 50
E none of these

40. $\frac{9 + 1 \times 6 - 3}{4 + 2 \times 7 - 6} =$

A $57/50$
B $1\ 7/12$
C 1
D $57/36$
E none of these

STOP.

YOU MAY CHECK YOUR WORK ON THIS TEST. DO NOT TURN TO ANY OTHER TEST.