RELATIONSHIPS AMONG EXTERNAL ENVIRONMENT, SCHOOL SYSTEM VARIABLES, AND STUDENT ACHIEVEMENT

by

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ABSTRACT

This study examined the relationships among school external environment, school system variables, and student achievement. Data from 79 secondary schools in British Columbia were used. The unit of analysis was the school.

School external environment was measured by an index reflecting the demographic and socioeconomic environment of the school district. School system variables included school size and school process variables. Student achievement was measured by school mean scores on the provincial grade 12 mathematics and English examinations and teacher ratings of student intellectual development.

The main analytic techniques employed in the study were Pearson's correlations, principal components analysis, canonical correlation analysis, and hierarchical multiple regression analysis.

The results confirmed that school external environment was significantly positively correlated with student achievement measures. School external environment accounted for about 34% of variance in school mathematics examination scores, 8% of variance in school English examination scores, and 15% of variance in teacher ratings of student intellectual development.

The results indicated that school system variables as a set and student achievement measures as the other were significantly positively correlated. At $p<.05$ level, school size, teacher preparation and assignment, attention to individual student's needs, professional development, and school culture in the

school system variable set accounted for 15% of variance in student achievement.

Controlled for school external environment, treated as separate measures of student achievement, school mathematics examination scores were found to be correlated with school system variables as a set. Specifically, school size and individual attention in the school system variables set were identified to be significant.

School English examination scores were found not to be correlated with school system variables as a set, school external environment being statistically controlled.

Teacher ratings of student intellectual development were found to be correlated with school system variables as a set. Two variables in the school system variable set, Parent/community Participation In Education and School Culture, were identified to be significant, school external environment being statistically controlled.

The study concluded by stating that school system variables, which are under the control of educators and policy makers, accounted for a meaningful proportion of variance in student mathematics achievement and teacher ratings of student intellectual development. Further investigation to test the causal links among the variables was suggested.

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Chapter I

Introduction

Over the past 20 years, dramatic social and economic changes have taken place in British Columbia. These changes represent an explosion in knowledge coupled with powerful new communication and information processing technologies. The structure of the economy is shifting from being primarily resource-based to becoming a mixed economy, with increasing emphasis on the information and service sectors. Society itself is changing and becoming much more diverse: ethnic diversity is increasing, family structures are changing, and the population is aging (British Columbia Ministry of Education, 1990).

Recognizing the changing social and economic context and its significant impacts and demands on education, the British Columbia Ministry of Education recently initiated a Royal Commission on Education to conduct a extensive study of the British Columbia school system. Based on the findings of the Commission's report, *A Legacy for Learners* (Sullivan, 1988), the British Columbia Ministry of Education mandated the mission of the public school system in the province in the following terms:

> The purpose of the British Columbia school system is to enable learners to develop their individual potentials and to acquire the knowledge, skills and attitudes to contributes to a healthy society and a prosperous and sustainable economy (Ministry of Education of British Columbia, 1990).

The goals of the school system are further specified as:

> Schools have prime responsibility for the intellectual development of student and shared responsibility for social, human and vocational development (Ministry of Education of British Columbia, 1990).

These mandates from the Ministry clarified the purpose, goals, and responsibilities of the school system. They are significant statements in the sense that they lay down a value framework and a common language by which all the efforts of the system can be focused.

Given this value framework, a question arises as to how the system can achieve these goals and objectives effectively and efficiently. To answer this question, one needs to know the mechanism by which the system operates and the students learn. It was in relation to this eventual end that the following preliminary research was undertaken.

Another reason for this study was derived from the rising public concern for school accountability. Education has become one of the most expensive social services in many industrialized countries, and its cost is still increasing. For example, from 1965-66 to 1985-86, the per student expenditure has increased by seven times (current dollar) in the United States (Guthrie, 1988). In British Columbia, per student expenditure arose from $3343 (current dollar) in the 1985-86 school year (Ministry of Education of British Columbia, 1988) to $6156 (current dollar) in 1990-91 (Ministry of Education of British Columbia, 1991), almost a doubling in five years. Taxpayers are becoming more and more concerned with how schools spend money and what the effects are in terms of student achievement. From both the educator's and the policy-maker's points of view, finding ways to improve student learning while keeping the cost at an acceptable level is of critical significance. This again demands a thorough understanding of what works and what doesn't work in school system. A preparatory step is, then, to identify which factors, if any, and to what an extent are correlated with achievement.

To this end, the present study investigated various facets of school systems and their relationships with student achievement. It examined the relationships between school external environment and student achievement measured by school mean scores on provincial mathematics and English examinations and staff ratings of student intellectual development; the relationships between school system variables, including school size and selected school process variables, and the student achievement measures; and the relationships between school system variables and student achievement after the influence of school external environment being statistically removed.

The findings of the study indicated that school external environment is significantly positively correlated with all the selected student achievement measures. School size and the school process variables as a set was found to be correlated with student achievement measures as another set. Treating each student achievement measure as a separate variable indicating one aspect of achievement, partialling out the correlation of school external environment, school size and attention to individual student were found to be significantly positively correlated to school mathematics examination score, while parent and community participation in education and school culture were correlated with teacher rating of student intellectual development. No school system variables was identified to be significantly correlated with school English examination result. The variation in school means English examination score was not explained by the variables selected in this analysis.

A number of assumptions have been made as the premises for this study. An important assumption dealt with the use of the provincial examination results over three school years in one study. It has been assumed that there was no

significant difference in the provincial mean scores on the mathematics and English examinations over the three years. This assumption was checked by an analysis of variance before the main analysis. Another founding assumption referred to the quality of the data of school process variables collected from provincial secondary school accreditation review process. Although not designed for this study, the data from this source were assumed to have reasonable reliability, considering the formal provincial accreditation procedures. More detailed descriptions of the assumptions and their bases are presented in later sections where they are introduced.

At least three limitations bound the utility of the information generated from this study. They cover the areas of the research design, external validity, and unit of analysis. The full deliberation of these limitations and the corresponding suggestions for future studies are presented in the final chapter of this report.

Chapter II

Literature Review

For half a century, extensive studies of school effects have been pursued by many researchers, educators, and policy-makers from different perspectives. From a systems point of view, the school operation has been depicted by an input, process, and output model (Easton, 1965). A simplified version of that model is shown in Figure 1.

In this model, school system, like other systems, has three major components: input, process, and output, and functions in a social, political, economic, and demographic environment. The model implies that student achievement is influenced by the system's external environment, input, and operation. In other words, it means that student achievement can be understood by analyzing its relationships with school external environment, school input, and school process variables.

Two major research paradigms fall under this general model of school systems. The one is input-output research, which looks at school effect from a productive and financial viewpoint. The other is the school effectiveness studies, which focus attention on school process. Since the two paradigms approach the problem from different perspectives with different methodologies, this review is organized and presented in two parts.

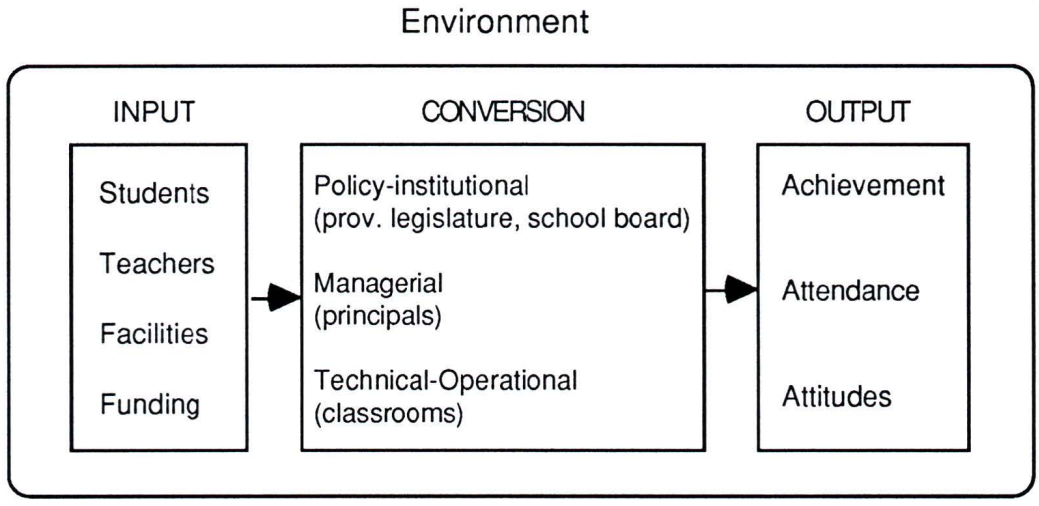

Figure 1. A Simplified Systems Model of Education (Easton, 1965)

Input-output Research

The input-output research looks at the effects of different school inputs upon school outputs from a systems perspective. Different input factors such as student background, teacher experience, teacher education, per student expenditure, as well as school facilities and equipment have been examined in relationship to student achievement, often in the form of standardized examination results. The attempt has been to identify input factors which were significantly and consistently related to student achievement.

Research findings have been accumulated in this area (Bossert, 1988). The following section will summarize briefly the findings regarding the effects of input factors upon student learning, one of the school output/outcome measures. It is organized by input factors, including student background, teacher attributes, school and district size, and school expenditures.

Student Background

Perhaps the most agreed upon research finding regarding school effects is that student socioeconomic status (SES) predicts student learning. Students from higher socioeconomic status families have performed better than those from lower socioeconomic families in almost all the studies carried out in the past 40 years (Coleman et al., 1966; Averch, Carroll, Donaldson, Kiesling, & Pincus, 1972). For example, Summers and Wolfe (1976) studied a sample of 627 elementary school students, 533 junior high school student, and 716 high school students. They found that the socioeconomic background of a student

largely determined achievement. White (1982) compiled 620 correlation coefficients between SES and academic achievement from 200 studies. At $p<.05$ level, nearly all 620 correlations were significant. Children from higher SES families, neighborhoods, and districts tended to score higher on achievement measures than children with lower SES backgrounds.

The relationship between SES and academic achievement was found to be dependent on the subject areas. In an study in British Columbia, Anderson (1972) reported that the effect of SES was principally on mathematics and science achievement ($r=.22$ to $.23$). SES was not found to be significantly correlated with English, social studies, and French achievement ($r=.02$ to $.18$).

Teacher Attributes

The research findings regarding the relationships between student achievement and teacher education and experience are ambiguous. The degrees teachers hold and the experience they have were found to be either positively or negatively related to student learning outcomes, depending on the study. Summers and Wolfe (1976), in a study of school resources that may influence academic achievement, found that teacher experience was associated positively with the performance of high achievers and negatively with the performance of low achievers. However, whether or not the teacher held an advanced degree seemed not to be related to student achievement. Nevertheless, Schneider (1985), after a study of school effects in four urban elementary schools, pointed out that teachers with fewer years of experience were more effective because they were still highly motivated in comparison to teachers who had more experience.

School and District Size

Studies of the relationships between student performance and school/district size have produced more controversies and questions than answers. For half a century, large schools and districts alike were deemed admirable because they could offer comprehensive instructional programs with greater quality at lower cost than could small schools and small districts (Friedkin & Necochea, 1988). Based on this belief, the consolidation movement has taken place. In 1990 there were more than 150,000 school districts in the United States. Today there are approximately 16,000. In British Columbia, the number of school districts has been reduced from 650 in 1945 to 75 in 1990. Moreover, a new round of consolidation movement seems to be on the way. At least ten states (Georgia, Illinois, Iowa, Massachusetts, New York, North Carolina, Rhode Island, Texas, and Vermont) in the United States have recently renewed their efforts to consolidate the small school districts within their borders, under the pressure for excellence and the shrinking enrollment (Haller, 1992).

However, many studies have shown that large size is often associated with poor achievement, student alienation, and system bureaucratization. Kiesling (1968), in one of the earliest works exploring the question of school characteristics and achievement of elementary school in New York state, found a negative relationship between achievement tests (math and verbal ability tests) and school size. His study included schools with enrollments between 200 and 4000 students and controlled for socioeconomic differences.

Chambers (1972) found that large school size had a negative impact

both on student academic achievement and on the affective outcomes of schooling. Larger schools were associated with lowered student examination results and lessened student participation and satisfaction. Walberg and Fowler (1987), in a more recent study in New Jersey, supported the hypothesis that large school districts are associated with poorer achievement. He found that large districts significantly and consistently achieved, on the average, less than smaller districts in that state. Fowler and Walberg (1991) also found that large (typically urban) high schools are more disorderly than small (typically rural) ones. These research findings seems to be in contradiction to the theory of size-economies and to the direction of the resumed school consolidation movement. Considering its educational and financial implications, size effect, if any, deserves further investigation.

To reconcile popular theory with the research findings, Friedkin and Necochea (1988) postulated a contingency perspective. They reasoned that there are both positive and negative mechanisms by which school/district size may affect performance. On the positive side, larger organizations may provide more opportunities. Larger systems are likely to have more resources derived not only from economies of scale but also from their political influence. With their greater resources, larger systems can offer higher salaries in order to attract and retain expert personnel. They may more regularly maintain and upgrade their facilities and equipment. They may more thoroughly divide and specialize the labor of personnel, increasing the diversity of services rendered.

On the negative side, larger systems have particular constraints. Problems with coordination and control increase with system size. More time and energy may be spent on non-productive activities. Moreover, larger

systems are likely to be associated with greater frequency of exceptional pupils. This not only reduces the resources available for core services by the increased administrative complexity of the system but also by the disproportional distribution of resources between regular and the exceptional pupils. The outcome may be a relatively low ratio of resources per pupil for the majority of pupils with undistinguished service requirements.

According to Friedkin and Necochea, the contingent is student socioeconomic status (SES). If the student body has a high SES, the opportunities of large size would dominate and larger size would be associated with better performance. If the student body has a low SES, as in some urban areas in the United States, the constraints of larger size would intrude. Larger size would be associated with poorer performance.

Expenditure

A substantial amount of literature shows no consistent association between education expenditure and student learning. The Rand Corporation (Averch et al., 1972) provided the first synthesis of research on administrative, economic, and sociological inputs to schools, including expenditure per student and administrative and special staff cost. Its conclusion was that except for student socioeconomic status, research has found no factors that are consistently and unambiguously correlated with student achievement.

This conclusion has been supported by some recent studies. Walberg (1987), for example, reported after his New Jersey study, that per student expenditure on education was insignificantly or inconsistently associated with

achievement test scores. Low spending districts generally achieved as well as high spending districts of the same SES in New Jersey.

Carroll (1982), in a review of studies of school district expenditure equalization, concluded that increased expenditures go mainly into administrative and auxiliary activities. He found that school districts agree broadly on what constitutes an acceptable instructional program and that they exert every effort to provide one. In so doing, low-revenue districts concentrate on necessities and make do with disproportionally fewer non-instructional resources. He found that districts with higher revenues per pupil provided a somewhat costlier instructional program, but that they also devoted much larger shares of their budgets to non-instructional purposes.

Pupil-teacher ratio and class size were also found not to be strongly related to student learning. One of the largest syntheses on this topic summarized that among 691 comparisons of small and large classes, only 60% suggested that smaller is better (Glass, Cohen, Smith, & Filby, 1982). Moreover, class size has to be reduced to fewer than 5 students before the significant difference can usually be detected.

Other financial inputs, such as teacher salaries, cost of non-teaching staff, and expenditures on library and supplies, were also found to have no significant relationship to student learning. (Bridge, Judd, & Moock, 1979)

In summary, the input-output approach to school effects studies has produced non-significant and sometimes controversial relationships between input and output variables. Except for student socioeconomic background, no other school input factors have been found to be consistently correlated to student achievement.

Effective Schools Research

Another main entry into the inquiry of school effects has been the research on effective schools. Effective schools research focuses on the school and the processes within the school, rather than on system input and output. It sets the study at the school level rather than at the individual student, classroom, or district levels. The rationale for taking the school as the unit of analysis is that individual and classroom education occurs within the context of, and is affected by, the larger school organization. Thus, just as worker productivity cannot be studied without considering individuals, work groups, and the broader corporate environment, neither can educational achievement be understood with analysis only of individual learning and classroom process considered apart from the school organization.

Effective schools researchers usually develop lists of school characteristics that are believed to be associated with achievement in schools. A number of effective schools formulae were developed as the results of the studies. Three of them are outlined below. The first is the traditional Edmonds' (1979) effective school model, the second is Stedman's (1987) effective school formula, and the third is Levine's (1990) comprehensive list.

According to the Edmonds model, effective schools have the following characteristics:

(a) strong administrative and instructional leadership

(b) high expectations for students

(c) order and discipline

(d) emphasizing basic skills, and

(e) closely monitoring student progress

The model tends to depict and to advocate a closed organization which emphasizes an ordered process of production. In this type of ideal school, the principal is the leader both administratively and instructionally. He provides leadership in teaching and maintains the order of the school. The teachers are supposed to support the leadership from the principal. They set high expectations for students, develop assessment methods, and monitor student learning closely.

Stedman (1987) postulated, from his study, that effective schools possess the following properties:

(a) shared governance with teachers and parents

(b) skilled use and training of teachers

(c) individual attention to students

(d) parent and community participation in education, and

(e) ethic and racial pluralism

Stedman's model seems to be more democratic and open. It also directs more attention toward individual students. In his ideal schools, teachers and administrators work as a team to coordinate the delivery of the curriculum. Students are considered as individuals, each with different needs and potentials. They learn in different ways and at different paces. Parents and the community play a significant role in setting up school goals and in school operation. The school as an organization is open and derives its purpose from

its community. To provide service to meet the needs of the community, the school seeks feedback from its clients regularly.

Levine (1990), in his recent comprehensive review of research on unusually effective schools, summarized a more detailed list of correlates which were believed to be associated with student achievement. The major components of the list are:

(a) productive school climate and culture,
(b) focus on student acquisition of central learning skills,
(c) appropriate monitoring of student progress,
(d) practice-oriented staff development at the school site,
(e) outstanding leadership,
(f) salient parental involvement,
(g) effective instructional arrangements and implementation, and
(h) high operationalized expectations and requirements for students.

However, the effective schools research suffers from theoretical and methodological problems. Theoretically, there are no clear definitions of what constitutes effective schools in the first place. The list of characteristics of effective schools differs from study to study. It seems that what one will include as correlates of effective school is simply a matter of choice (Witte & Walsh, 1990).

Methodologically, current studies of effective schools are impinged upon by several considerations: (a) that existing research has been based on relatively small samples of schools, almost exclusively at the elementary level;

(b) that research have relied on case studies with varying levels of rigor and quantification; (c) that because the research designs have often been based on outlier studies, they say little about effective schools approaches for a broad spectrum of schools; and (d) that achievement has often been narrowly defined as mean scores on standardized tests (Witte & Walsh, 1990).

In summary, investigations, either in the input-output research or in the school effectiveness studies to this point, have not been able to map how the many components of the school system work together to produce achievement. No school input or process factors have been identified to be consistently related to student learning. The only exception is for student background, which is to a large degree beyond the control of the school system. Considering the importance of this issue, a comprehensive study of the relationships among all the system components, i.e., school external environment, input, process, and output, guided by established theoretical frameworks, in local setting, seems to be theoretically interesting and practically meaningful.

Chapter III

Research Design

The present study was intended to explore the relationships among school external environment, school system variables, and student achievement. The following sections describe the design and procedure of the study in terms of conceptual framework, hypothesis, sample, and statistical treatment.

Conceptual Framework

Several models were examined as possible theoretical framework for the study (Bryk & Raudenbush, 1988; Friedkin & Necochea, 1988). Considering the intended readership (policy makers and educators) and the nature of the available data from the BC Ministry of Education, Easton's (1965) school systems model was selected as the guiding framework. Based on this framework and the findings from literature review, a operationalized model, as shown in Figure 2, was developed for the present study.

Overall, as shown in Figure 2, there are three sets of variables in the model, namely, school external environment, school system variables, and school level achievement. The school system variables set was further broken down into school size and school process variables.

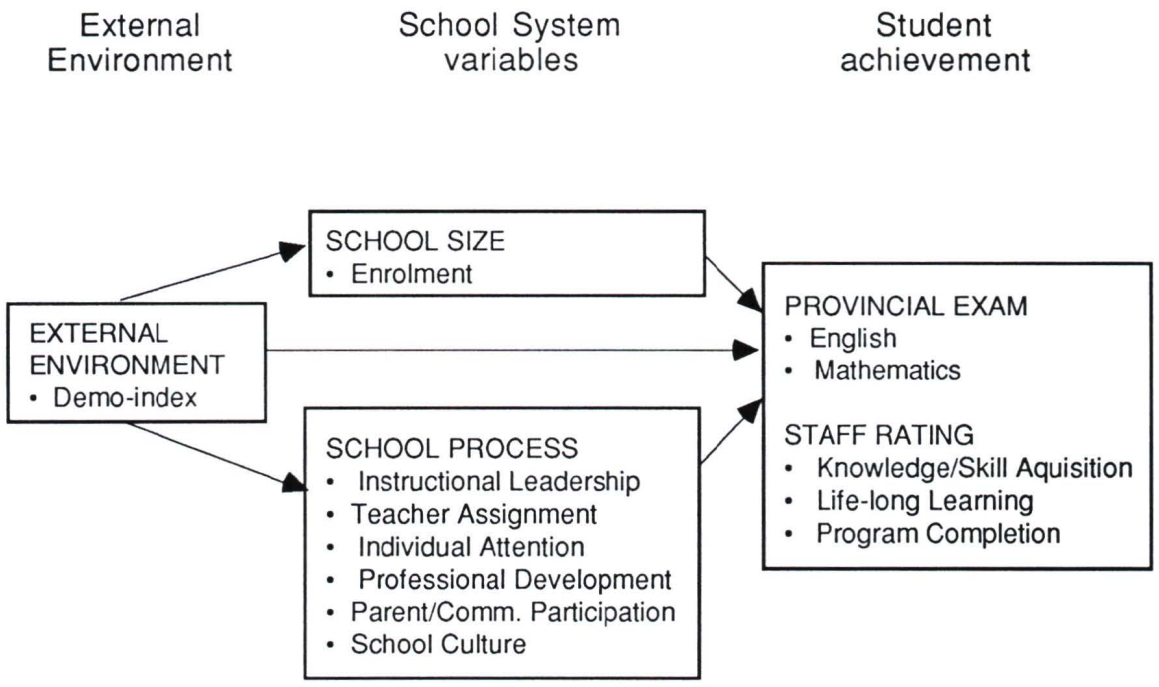

Figure 2. A Model of Student achievement Developed for the Present Study

School external environment, considering its impacts on students before they enter the school system and its relative independence from school effect, was used primarily as a control variable in this study.

School system variables are under the control of educators and policy-makers. They were used as the independent variables.

School level achievement measures are the output of the school systems in this analysis. They were used as the dependent variables. Detailed descriptions and definitions of these variables in each set are presented below.

School External Environment (DEMO-IDX)

School external environment, abbreviated as "DEMO-IDX" in the study, is a comprehensive index of the demographic and socioeconomic context of the districts in the province. This index was developed by Chris Hvid of the Information Management Branch, British Columbia Ministry of Education, using the 1986 census data of Statistics Canada. School district data of 500 variables, including community income, levels of education, age distribution, family structures, etc. were used to develop the index. The major statistical technique used to derive the index was multidimensional scaling (Hvid, 1989).

The index is a continuum representing the demographic and socioeconomic context of a school district in relation to the province. The raw scores were standardized so that the index has a mean of zero for the province and a range from -3.71 to 2.55. At the positive end of the scale are large urban districts with all the characteristics of the metropolitan neighborhoods associated with them. In contrast, at the negative end are the rural and small districts, bearing the correlates of remote communities.

The demo-index was included in this study as an approximate measure of student SES which has been reported to be significantly related to student learning in previous educational studies. Its introduction in this study served two purposes. First, it was used in bivariate models to verify the relationship between school external environment and student achievement measures in British Columbia setting. Second, it was included in multiple models to reveal the unique relationships between school system variables and student achievement after the differences in school external environment are statistically removed.

School System Variables

Two types of school system variables were included in the analysis. The first bears attributes of school organization; school size falls into this category. The second reflects school processes; staff satisfaction with aspects of school operation form this group. The common characteristic shared by the two is that they are internal factors of the school systems. To a degree, they are under the control of the educators and policy-makers of the province.

School size. School size (ENROL) was defined as the headcount enrollment of students in a school in the 1989-90, the 1990-91, or the 1991-92 school year, depending on the year the school underwent accreditation review. The data were collected from the Ministry's database.

The inclusion of school size in the study was based on the consideration of curriculum comprehensiveness as well as the ongoing debate of the effect of school size (Friedkin & Necochea, 1988; Walberg & Fowler, 1987).

School process. Six effective school characteristics from the aforementioned effective school models: instructional leadership (INS_LEAD), instructional assignment (ASSIGN), individual attention (IND_ATT), professional development (PRO_D), parent/community participation (PAR_PART), and school culture (CULTURE), found matching criteria in the British Columbia secondary school accreditation reports. The data for these criteria were therefore selected as the process variables in the analysis. The variables, variable labels, and their corresponding criteria in the secondary school accreditation manual as the instrument are listed in Table 1.

The school process data were assumed to be reasonably reliable due to the structure and the process of the provincial secondary school accreditation review. Because school accreditation was one of the main data sources, a brief discussion of the accreditation process and the accreditation report is presented below.

Secondary school accreditation in British Columbia is a control mechanism of the British Columbia Ministry of Education. Its purposes are (a) to ensure that schools meet provincial standards, (b) to assist school improvement, and (c) to assist schools to account for their performance to their school boards and the general public (British Columbia Ministry of Education, 1988).

Table 1

School Process Variables, Mnemonics, and the Matching Criteria in the Secondary School Accreditation Report

School Process Variables	Mnemonics	Matching Criterion Statements in B.C. Secondary School Accreditation Report used as the instrument
Instructional Leadership	INS_LEAD	Instructional leadership is effective in accomplishing school purposes.
Teacher Assignment	ASSIGN	Teachers are adequately prepared, experienced and assigned to their area of professional expertise.
Individual Attention	IND_ATT	Teachers employ a variety of instructional strategies to address the differing needs of students
Professional Development	PRO_D	There is a systematic ongoing process of professional/staff development in the school.
Parental/ Community Participation	PAR_PART	The school operates as a partner with parents, community agencies, and the local public to accomplish school and system goals.
School Culture	CULTURE	The school demonstrates a school culture which contributes to the attainment of system goals.

The process of secondary school accreditation review in British Columbia is formative in nature. The accreditation process helps schools to improve their performance by directing school staff to (a) conduct a comprehensive review of school operation, (b) identify strengths and weakness of their operation, (c) priorize the problems and concerns derived from the review, and (d) develop and implement action plans to address them.

School accreditation in British Columbia has a long history. Each year about one-sixth of the secondary schools in British Columbia participate in the process. During the review process, each school would set up a internal team for a self-assessment, using the manual prepared by the Ministry of Education. The manual has been undergoing a continuous change. However, for the 1989-90, 1990-91, and 1991-92 school years, the manuals were essentially identical. Criteria in five dimensions — student learning experiences, leadership and administration, teacher attributes, school and community, and school culture — provide the staff with an opportunity to conduct a comprehensive review of school operation and student performance. Extensive discussions among staff members are expected, which will lead to consensus regarding staff satisfaction with the criteria in the manual. The satisfaction ratings are then registered in the school self assessment report.

To verify school self-assessment, the British Columbia Ministry of Education organizes external teams of experienced educators and administrators to visit the schools after the self-assessment. The external team, after careful examination of the performance of the school and its self-assessment report, would either grant or defer accreditation status to the school.

The data for this study were collected in three school years. The reason for using multi-year data in one study was simply to increase sample size. There are about 35-40 schools accredited each year, which was not considered a large enough sample for the present correlational analysis. A problem arose, however, when these three years' data were put together. Although the criteria used in the accreditation review for the three years were essentially identical, different rating scales had been adopted. (The ratings in the 1989-90 school year were on a 5-point Likert scale, while those in 1990-91 and 1991-92 were on a 4-point scale). The 4-point scale (4—very satisfied, 3—satisfied, 2—dissatisfied, 1—very dissatisfied) was chosen for this study. Therefore, a conversion of data from the 5-point scale to the 4-point scale was conducted before the actual analysis began. The formula for the conversion is $y=0.75*(x-1)+1$, where x represents the ratings on the 5 point scale; while y is the corresponding value on the 4 point scale. This formula ensured that data on the 5-point scale were projected proportionally onto the 4-point scale.

Student Achievement

Student achievement in this study is an aggregate concept reflecting the achievement of all the students in a school as a group. The variation in achievement between schools was the focus of this analysis.

Student achievement was believed to be multidimensional. It has at least as many aspects as the number of goals the school system has. In British Columbia, as mentioned earlier, three general goals have been established: intellectual development, human and social development, and career

development. This study focuses on the student intellectual development domain, the prime responsibility of the provincial education system.

To measure achievement, again, there are at least three dimensions. The first is to measure achievement against a person's perceived potential; it is the personal growth dimension. The second is to measure a person's performance in relation to those of his peers. This is the competition dimension. The last one is to compare a person's performance with some external, societal standard. This is the criterion dimension. British Columbia provincial grade 12 examinations are standardized tests based on the provincial standard, This measure was selected to represent the competition and criterion dimensions. Teacher ratings on student intellectual development from the provincial secondary school accreditation review are assumed to reflect a individual's achievement against his/her potential as well as against the competition and external standard. It was therefore selected to indicate the personal growth dimension in addition to the other two dimensions.

Provincial examinations. School mean scores on provincial grade 12 examination of two subjects, mathematics (MATH) and English (ENGLISH) were selected to represent standardized examination results. The data were extracted from the Ministry's database of the 1989-90, 1990-91, and 1991-92 school years, depending on the year the school was accredited.

An assumption was made for the decision to use the three years' examination scores in this study. It was assumed that, at the provincial level, there was no significant difference in school mean scores in either mathematics or English over the three school years.

Tests for differences in examination results over the three school years were therefore constructed using one-way between-subjects analysis of variance (ANOVA). The results are presented in Appendix A. As can be seen in Appendix A, no significant difference in school examination scores either in mathematics or in English was found over the three school years. This result lent support to the assumption of equivalence across years.

The selection of mathematics and English as the subject areas to measure achievement was based on the criterion of importance. English is a fundamental skill students are expected to master. It represents one major area in the curriculum. Moreover, English has the highest examination participation rate, since most students in British Columbia must pass this course in order to graduate. Mathematics is important because it is another basic skill required in students' further academic studies and in the work place.

Teacher ratings. Teacher ratings are teachers' consensus ratings of the whole student body in a school with respect to major components of intellectual development. They were collected from the secondary school accreditation database. Three major components compose student intellectual development: (1) knowledge and skills acquisition (KNOWLEDGE), (2) creativity and appreciation of life-long-learning (CREATIVITY), and (3) academic success (SUCCESS), as defined by the Ministry's accreditation program. The full statements of the criteria for the component are listed in the last section of Appendix B.

Hypotheses

This study was designed to investigate the relationships among school external environment, school system variables, and student achievement, especially the relationships between school system variables and student achievement with the differences in school external environment removed. Accordingly, the hypotheses for the study were formulated as follows:

Hypothesis 1 — School external environment (DEMO_IDX) will be positively correlated with student achievement.

Hypothesis 2 — School system variables will be positively correlated with student achievement.

Hypothesis 3 — School system variables will be positively correlated with student achievement after the relationship with school external environment (DEMO_IDX) is statistically removed.

Sample

As mentioned earlier, this research is a study of secondary data acquired from the existing files of British Columbia Ministry of Education. The data were gathered from two major sources: the school accreditation report database of the 1989-90, 1990-91, and 1991-92 school years, and the Ministry's central

database. Eighty-six secondary schools underwent the accreditation process in these three school years; consequently, these schools fell into the sample. Within this group, five schools did not provide adequate data to warrant their inclusion in the analysis. After the deletion of these five schools, 79 schools were left for analysis. This sample comprises about 40% of all secondary schools with graduation programs in British Columbia.

A potential problem with this approach is that the sample was not necessarily representative of the province. Schools fell into the sample as they undertook the "once-in-six-years" accreditation cycle in these three school years. Although there were no special selection criteria known to the author in grouping the secondary schools into the six groups historically except for readiness, a brief check of representativeness of the sample was deemed desirable.

The extent of the potential sampling problem was partially clarified by comparing the central tendencies and dispersions of the variables in the sample and those in the population (shown later in the Results and Discussion chapter). The result of the preliminary check revealed that all the means and standard deviations of the study variables were close to the corresponding provincial norms except for the school demo-index, and that the schools in the sample dispersed extensively in all the characteristics under investigation. With respect to school demo-index, schools in the Greater Vancouver region were slightly over represented. The reader is cautioned when generalizing the findings to the whole province.

Treatment of Data

Corresponding to the hypotheses postulated above, three statistical analyses were conducted. The first analysis explored the bivariate relationships among all the variables selected in the study. The focus of this analysis is the total relationships between each pair of variables and the possible pattern of relationships among the variables. Pearson correlation analysis was used as the statistical tool.

The second analysis looked into the relationships between school system variables as the independent variable set and student achievement measures as the dependent variable set. Canonical correlation was employed as the main statistical tool for the analysis.

The third analysis treated each of the three achievement measures as an separate criterion. It focused on the correlations between school system variables and each achievement measure with the differences in school external environment removed. The statistical technique used was hierarchical multiple regression.

Chapter IV

Results and Discussion

This study set out to test three hypothesis: that school external environment would be positively correlated with student achievement; that school system variables would be positively correlated with student achievement; and that school system variables would be positively correlated with student achievement after the difference of school external environment is statistically removed. The hypotheses were tested using different statistical analysis techniques. The results are presented in the following three corresponding sections: data screening and bivariate analysis, relationship between school system variables and student achievement, and relationship between school system variables and student achievement with school external environment statistically controlled.

Data Screening and Bivariate Analysis

Before the main statistical analyses, the data were checked for missing values, sample representativeness, case to variable ratio, and multivariate outliers. To this end, the univariate descriptive statistics for all the original variables were first calculated. The results are presented in Table 2.

Table 2

Descriptive Statistics of the Raw Data

	N OF CASES	MINIMUM	MAXIMUM	MEAN	ST DEV
STUDENT ACHIEVEMENT (DVs)					
PROVINCIAL EXAMINATION					
MATH	81	27.00	78.00	61.39	8.67
ENGLISH	81	52.43	75.09	67.78	4.53
STAFF RATING					
KNOWLEDGE	79	2.00	4.00	3.22	0.44
CREATIVITY	80	2.00	4.00	3.12	0.49
SUCCESS	80	2.00	4.00	3.27	0.54
EXTERNAL ENVIRONMENT					
DEMO_IDX[1]	81	-3.71	2.55	0.42	1.26
SCHOOL SYSTEM VARIABLES (IVs)					
ENROL	81	97	1722	712.21	417.07
SCHOOL PROCESS[2]					
INS_LEAD	79	1.75	4.00	3.32	0.53
ASSIGN	79	2.00	4.00	3.46	0.48
IND_ATT	79	2.00	4.00	3.40	0.55
PRO_D	75	1.00	4.00	2.91	0.82
PAR_PART	78	2.00	4.00	3.34	0.55
CULTURE	77	2.00	4.00	3.18	0.49

1. See page 19 for definition of DEMO_IDX.

2. See Table 1 for definitions of school process variables.

Missing Values

Table 2 indicates that there were missing values in a number of school process variables. For example, the missing values for Professional Development (PRO_D) reached 7%. The reason for the missing values was clear; some of the schools did not provide complete information in their accreditation reports. Because deleting all the schools with missing values would markedly reduce the sample size and potentially introduce sample bias, a decision was made to replace the missing values with their respective variable means.

Sample Representativeness

To check for sample representativeness, the sample means and standard deviations of each variable were compared with the provincial means wherever those existed. As shown in Table 2, the grand sample mean scores for Mathematics and English provincial grade 12 examination were 61.39 and 67.78 respectively. They are very close to the corresponding provincial average scores for the 1990-91 school year (the provincial means were 61.30 for mathematics and 67.35 for English. The sample standard deviations for mathematics and English were 8.67 and 4.53 respectively; the corresponding standard deviations for the province as a whole were 10.14 and 4.51 for the 1990-91 school year, again very close to each other.

For DEMO_IDX, Table 2 indicates that the sample mean was 0.40 (compared with provincial mean of 0.00). This positive deviation of the sample mean from the population mean reflects a slight over-representation of schools from urban areas, especially from the Vancouver region. The sample standard

deviation for DEMO_IDX was 1.26, also slightly greater than the provincial value of 1.00. This reflects the diversity of schools in the sample. DEMO_IDX ranged from 2.55 for the largest metropolitan district to -3.71 for one of the most remote school districts in the province.

With respect to ENROL, the mean of the sample was 712.2, close to the provincial average of 690 in 1990-91. The enrollment data were also spread out. The smallest school enrolled only 97 students, while the largest had 1722.

In summary, inspection of the sample means and standard deviations did not reveal large deviations from the population parameters except for a slight over representation of urban schools. No strong reasons were found to reject the use of the sample.

Case to Variable Ratio

With respect to the issue of case to variable ratio, the sample was believed not sufficiently large enough. With 81 schools in the sample and 13 variables (five dependent variables, one control variable, and seven independent variables, as shown in Table 2), the case to variable ratio is approximately 6.2:1, which is less than the normally expected 10:1 ratio. Action was taken with regard to this concern.

As noted in the variable definition section presented earlier, three achievement measures: student knowledge and skills acquisition (KNOWLEDGE), student creativity and appreciation of life-long-learning (CREATIVITY), and student academic success (SUCCESS), are staff ratings on different aspects of student intellectual development. They are opinion survey results in nature. Bearing this in mind, principal components analysis was used

to uncover the underlying structure of the data. The results of that analysis are listed in Appendix C. The results show that there was one common dimension underlying the three staff ratings on student intellectual development. This factor extracted more than two-thirds of the variance in the three original variables. Consequently, this factor was designated as intellectual development (INT_DEV) and the factor score for each case was calculated and used in the canonical correlation and multiple regression analyses that followed.

Through the principal components analysis, the number of dependent variables was reduced to three (MATH, ENGLISH, and INT_DEV). With DEMO_IDX and the seven school system variables, a total of 11 study variables were left for analyses. The largest possible number of variables included in one analysis as designed in this study (canonical correlation analysis) was 10. In that case, the case to variable ratio would be 8.1:1, close to the usually required 10:1 ratio.

Multivariate Outliers

To detect multivariate outliers for canonical correlation analysis, a dummy variable of case number was created and this dummy variable was regressed on the 11 study variables (Tabachnick & Fidell, 1989, p. 69). The criterion for multivariate outliers is Mahalanobis distance at $p<.001$. The Mahalanobis distance of each case in the sample was calculated and evaluated as CHI square with degrees of freedom equal to the number of variables. Any case with a Mahalanobis distance greater than the critical value was identified as a multivariate outlier that had too much influence in the

analysis. Evaluated against this criterion, case 32 was detected as a multivariate outlier.

To find multivariate outliers with regard to the planned multiple regression analyses, each of the three dependent variables was regressed on the independent and the control variables. The residuals of the regressions were plotted against the estimated values of the dependent variables. Studentized deleted residual and Cook's D were consulted as the criteria for the detection of outliers. Evaluated against these criteria, two cases, case 32 and case 12 were found unusual. With respect to MATH, case 32 has a studentized deleted residual of -3.32 and case 12 has a studentized deleted residual of -3.64. This result confirmed the finding in the previous checking for canonical correlation analysis (case 32 and case 12 have the largest and second largest Mahalanobis distance). Consequently, the two data points were labeled as multivariate outliers and deleted, leaving 79 cases in the sample.

After the reduction of the number of variables through principal components analysis and the deletion of the two cases as multivariate outliers, the summary statistics for the final data set were re-calculated. The results are contained in Table 3.

Bivariate Correlation Matrix

To reveal the overall patterns of the correlations among the variables under investigation in general, and to examine the correlations between external environment (DEMO_IDX) and achievement in particular, the zero-order correlations of all study variables were computed. The results are contained in Table 4.

Table 3

Summary Statistics of the Final Data Set

	N OF CASES	MINIMUM	MAXIMUM	MEAN	STANDARD DEV
STUDENT ACHIEVEMENT (DV)					
MATH	79	38.88	78.00	61.98	7.73
ENGLISH	79	55.25	75.09	68.07	4.15
INT_DEV	79	-2.26	1.99	0.00	1.00
EXTERNAL ENVIRONMENT					
DEMO_IDX	79	-1.84	2.55	0.44	1.16
SCHOOL SYSTEM FACTORS(IV)					
ENROL	79	97	1722	708.81	415.16
SCHOOL PROCESS					
INS_LEAD	79	1.75	4.00	3.30	0.52
ASSIGN	79	2.00	4.00	3.45	0.47
IND_ATT	79	2.00	4.00	3.39	0.54
PRO_D	79	1.00	4.00	2.88	0.78
PAR_PART	79	2.00	4.00	3.33	0.54
CULTURE	79	2.00	4.00	3.17	0.48

Table 4

Correlation Matrix of Study Variables

	MATH	ENG	INT_DEV	DEMO_IDX	ENROL	ASSIGN	IND_ATT	PRO_D	INS_LEAD	PAR_PART
ENGLISH	0.36**									
INT_DEV	0.36**	0.31**								
DEMO_IDX	0.59***	0.27*	0.39***							
ENROL	0.50***	0.16	0.10	0.48***						
ASSIGN	0.21	0.09	0.17	0.10	0.19					
IND_ATT	0.25*	0.17	0.17	0.06	0.23	0.26*				
PRO_D	0.21	0.22*	0.12	0.11	0.17	0.17	0.21			
INS_LEAD	0.12	0.10	0.22	0.00	0.07	0.26*	0.03	0.08		
PAR_PART	0.05	0.14	0.28*	0.04	0.09	0.02	0.07	0.17	0.21	
CULTURE	0.18	0.18	0.39***	0.18	-0.05	0.20	0.28*	0.42***	0.09	0.14

N = 79

*$p<.05$. **$p<.01$. ***$p<.001$. (2-tailed)

An inspection of the correlation matrix reveals that there were certain patterns of the relationships among the variables. The three achievement measures (DVs), MATH, ENGLISH, and INT_DEV, were significantly, but weakly, correlated with each other. The six school system variables (IVs), INS_LEAD, ASSIGN, IND_ATT, PRO_D, PAR_PART, and CULTURE, were weakly and, in most of the cases, not significantly correlated with each other.

Between sets, the correlation seemed to concentrate along two lines. At $p<.05$ level, MATH in the dependent set is significantly correlated with ENROL and IND_ATT in the independent set. On the other hand, INT_DEV in the dependent variable set was significant correlated with PAR_PART and CULTURE in the independent set.

The correlation between MATH and ENROL was complicated by the correlation between DEMO_IDX and ENROL. In other words, there were shared variances among school external environment, school size and school mathematics examination scores. The attribution of the shared variance in MATH to the independent variables could not have been achieved by simply examining zero-order correlations. Therefore, multiple correlation techniques were required.

One indication from this correlation analysis was that school external environment (DEMO_IDX), the control variable, was significantly positively correlated with all the student achievement measures. The size of the correlations varied with the achievement measures. DEMO_IDX accounted for 34% of variance in MATH, 8% in English, and 15% in INT_DEV.

Relationships Between School System Variables and Student Achievement

Following the bivariate analysis, canonical correlation analysis was performed to investigate the relationships between school system variables as the independent variable set and student achievement measures as the dependent variable set. Utilizing the information in the correlations within each set, the purpose of the canonical correlation analysis was to discover the dimensions, if any, along which certain school system variables were related to certain student achievement measures. The analysis was preceded by evaluation of assumptions pertaining to it.

Evaluation of Assumptions: Normality, Linearity, and Homoscedasticity

To evaluate the assumptions of normality, linearity, and homoscedasticity, a preliminary run of canonical correlation analysis was carried out. The computer printout of the analysis is given in Appendix D.

The results of the evaluation indicated that there was one pair of canonical variates which were significantly correlated at the $p<.05$ level. An examination of the scatter plots of the canonical variates revealed that the assumption of normality was met while the assumptions of linearity and homoscedasticity were marginal but acceptable. Canonical correlation analysis was acceptable to proceed.

Canonical Correlation Analysis

After checking the assumptions, the results of the canonical correlation analysis were examined. The summary of the analysis is presented in Table 5.

Table 5

Canonical Correlations, Canonical Loadings, Percentage of Variance, and Redundancies

	Correlation	Variance
SYSTEMS VARIABLE SET		
ENROL	0.82	
INS_LEAD	0.29	
ASSIGN	0.40	
IND_ATT	0.48	
PRO_D	0.40	
PAR_PART	0.22	
CULTURE	0.46	
Proportion of variance		.22
Redundancy		.07
ACHIEVEMENT VARIABLE SET		
MA_EXAM	0.97	
EN_EXAM	0.45	
INT_DEV	0.57	
Proportion of variance		0.50
Redundancy		0.15
CANONICAL CORRELATION	0.56	

As shown in the last row of Table 5, the canonical correlation was 0.56, representing 31% variance overlap between this pair of canonical variates.

The canonical loadings of the variables upon the canonical variates are also shown in Table 5. Loadings in excess of 0.30 were interpreted. As shown in Table 5, the dimension had high loadings on ENROL (.82), moderate loading on ASSIGN (.40), IND_ATT (.48), PRO_D (.40), and CULTURE (.46) on the independent variables, and high loadings on MATH (.97) and moderate loadings on ENGLISH (.45) and INT_DEV (.57) on the dependent variables. Thus, larger schools with higher staff ratings of teacher preparation and assignment, attention to individual student needs, opportunities for professional development, and a productive school culture went with higher achievement in general and higher mathematics achievement in particular.

To reveal the extent to which school system variables covary with student achievement as another set, the importance of the student achievement variate was calculated and the redundancy index estimated.

The importance of a variate was determined by the proportion of variance it extracted from within its own set (Levine, 1977). As shown in Table 6, the canonical variate extracted 46% of variance from student achievement measures.

The between-set overlap of variance was measured by redundancy index (Levine, 1977). Table 5 shows that the redundancy of achievement measures was .15. This result indicates that the variance in the school system variables overlapped 15% of the variance in student achievement. In other words, given knowledge of the selected school system variables, 15% of the information in student achievement as measured in this study was redundant.

To sum up, the result of the canonical correlation analysis indicated that at $p<.05$ level, there was one dimension upon which school system variables and student achievement measures correlated. This dimension represents ENROL, ASSIGN, IND_ATT, PRO_D, and CULTURE in the school system variable set and general achievement, though dominated by MATH, in the achievement variable set. The overlap of variance between the school system variables and student achievement was moderate. The variate extracted from school system variables accounted for 15% of the variance in the three student achievement measures.

Relationships Between School System Variables and Student Achievement With School External Environment Controlled

The above analysis of the relationships between school system variables and student achievement indicated that there is a moderate relationship between the two sets. School system variables accounted for 15% of variance in the three student achievement measures. However, as noted in the literature review chapter, consistent positive correlations between student background and achievement have been reported in many previous studies. Chronologically, students are first exposed to the family and the community before they enter into the school system. Student background makes its impact on students prior to that of the school systems. Moreover, student background is, to a large extent, beyond the control of the school system. Therefore, a more meaningful question for educators and policy makers seems to be the extent to which achievement can be accounted for by school system variables, given

student background. In statistical terms, this can be expressed as the semi-partial correlation between school system variables and student achievement after the correlation of DEMO_IDX is partialled out. The following section is devoted to this concern.

To investigate the relationships between school system variables and student achievement with the influence of DEMO_IDX statistically removed, three series of hierarchical multiple regression analyses were conducted. In each series of multiple regression, one of the three student achievement measures, MATH, ENGLISH, and INT_DEV, was used as the dependent variable, the selected school system variables as the independent variables, and the DEMO_IDX as the control variable.

Two objectives were pursued in these hierarchical multiple regression analyses. The first was the estimation of the unique contribution of school system variables as a set, relative to DEMO_IDX, to the variance of student achievement measures. All school system variables were included in the analysis for this concern. The second was the identification of individual variables in the school system variables set which are correlated with student achievement measures over and above that of DEMO_IDX. School system variables with significant bivariate correlations with student achievement measures were examined, after the verification of the non-existence of suppresser variables in the school system variables.

The unique contribution of school system variables, relative to DEMO_IDX, to the variance of each student achievement measures was represented by the squared semi-partial correlations between school system variables and student achievement measure with DEMO_IDX partialled out.

The squared semi-partial correlations were calculated by subtracting the squared multiple correlation of the compact model, where only DEMO_IDX was in the model, from the augmented model, where school system variables as a set were included in the model in addition to DEMO_IDX. The significance of the correlations was determined through an F test. The F statistics for the semi-partial correlations were computed using Equation 1 below (Tabachnick & Fidell, 1989). As in the canonical correlation analysis conducted earlier, the hierarchical multiple regression analyses were preceded by the evaluation of assumptions pertaining to this analysis techniques.

$$F = \frac{\left(R_A^2 - R_C^2\right) / \left(PA - PC\right)}{\left(1 - R_A^2\right) / \left(N - PA\right)} \qquad \text{Equation (1)}$$

Where: R_A^2 = squared multiple regresson of the augmented model;

R_C^2 = squared multiple regresson of the compact model;

PA = number of parameters estimated in the augmented model;

PC = number of parameters estimated in the compact model; and

N = sample size.

Evaluation of Assumptions: Normality, Linearity, Homoscedasticity, and Independence of Residuals.

To evaluate the assumptions for multiple regression, the three dependent variables: MATH, ENGLISH, and INT_DEV were regressed on DEMO_IDX and the six school system variables. The residuals of the regressions were plotted

against the predicted scores of the dependent variables. The analyses of these residuals indicated that the assumptions of normality, linearity, homoscedasticity, and independence of residuals were met.

Multiple Regression Analysis of MATH on School System Variables With DEMO_IDX Controlled

The results of the series of multiple regressions of MATH on school system variable and DEMO_IDX are listed in Appendix E. Part of the most relevant results are also contained in Table 6.

Table 6 defines the models estimated. It reports selected analysis results which led to the calculation of the size and significance of the semi-partial correlations between school system variables and MATH with the correlation of DEMO_IDX statistically removed.

The first row in Table 6 reports regression analysis results of the compact model, denoted as Model C. For comparison purposes, the statistics of this model reiterate the findings in previous bivariate analysis, i.e., DEMO_IDX is significantly correlated with MATH. DEMO_IDX alone accounted for 34% of the total variation in school mathematics examination scores.

The second model, Model A1, in Table 6 is the augmented model where all the school system variables as a set were included. A comparison of the statistics between this model (Model A1) and those of the compact model (Model C) showed that school system variables as a set were significant. School system variables accounted for 12% variance in MATH over and above that accounted for by DEMO_IDX alone.

Table 6

Multiple Regression Analysis of MATH on DEMO_IDX and Selected School System Variables

No.	Model	R^2	sr^2	P	F	p
C	MATH = Constant + DEMO_IDX	.34		2		
A1	MATH = Constant + DEMO_IDX + ENROL + INS_LEAD + ASSIGN + IND_ATT + PRO_D + PAR_PART + CULTURE	.46	.12	9	2.222	<.050
A2	MATH = Constant + DEMO_IDX + ENROL	.41	.07	3	8.189	.005
A3	MATH = Constant + DEMO_IDX + IND_ATT	.39	.05	3	6.230	.016

NOTE: " sr^2 " in the third column represents the extra variance accounted for by the variables in each model over and above that accounted for by DEMO_IDX.

"P" is the number of parameters estimated in the respective model.

"F" and "p' reflect the significance test of the respective squared semi-partial correlations.

N = 79

This proportion of variance in MATH accounted for by school system variables, however small in size, is significant in education. Imagining the education community could find a way to increase student mathematics achievement, provincial-wise, by a few percentage point. It would be a substantial improvement of student learning and a tremendous success of the school system.

Having the significant set-correlation, the school system variable set was further examined to identify individual variables which were correlated with achievement after the correlation of DEMO_IDX was statistically removed. As shown in row A2, the semi-partial correlation between ENROL and MATH was significant at the $p<.05$ level. This finding indicated that school size was significantly correlated with school mathematics examination scores after the correlation of school external environment was statistically removed. ENROL accounts for about 7% of the variance in MATH over and above DEMO_IDX.

IND_ATT was significantly correlated with MATH in the previous bivariate analysis. With the control for DEMO_IDX, as shown in row A3 in Table 6, the correlation was still significant. IND_ATT accounted for about 5% of the variation in MA_EXAM over and above DEMO_IDX.

Multiple Regression Analysis of ENGLISH on School System Variables With DEMO_IDX Controlled

Similarly, a series of regression analyses of ENGLISH on DEMO_IDX and school system variables was conducted. The computer print-out is presented in Appendix F. Selected results of the analysis are shown in Table 7.

Table 7

Multiple Regression Analysis of ENGLISH on DEMO_IDX and Selected School System Variables

No.		Model	R^2	sr^2	P	F	p
C	ENGLISH =	Constant + DEMO_IDX	.08		2		
A	ENGLISH =	Constant + DEMO_IDX + ENROL + INS_LEAD + ASSIGN + IND_ATT + PRO_D + PAR_PART + CULTURE	.14	.06	9	0.698	>.100

NOTE: " sr^2 " in the third column represents the extra variance accounted for by the variables in each model over and above that accounted for by DEMO_IDX.

"P" is the number of parameters estimated in the respective model.

"F" and "p' reflect the significance test of the respective squared semi-partial correlations.

N = 79

The statistics for the compact model, Model C, in Table 7 repeated the findings in previous bivariate analysis, i.e., DEMO_IDX was significantly correlated with ENGLISH. DEMO_IDX alone accounted for 8% of the total variation in school English examination scores.

However, as shown in Table 7, at $p<.05$ level, school system variables as a set failed to show significant correlation with ENGLISH when DEMO_IDX was statistically controlled. In other words, school system variables, its size and operation, to the extent they are measured in this study, were not correlated with school mean scores on provincial grade 12 English examination. No further search for significant individual variables was performed.

Multiple Regression Analysis of INT_DEV on School System Variables With DEMO_IDX Controlled

The results of a series of regressions of INT_DEV on school system variables, with DEMO_IDX statistically controlled, is presented in Appendix G. Selected results of the analyses are shown in Table 8.

When regressed on DEMO_IDX only, the correlation coefficient of the model was significant at $p<.05$. DEMO_IDX alone accounts for 15% of the variance in the perceived student intellectual development.

When school system variables as a set, as well as DEMO_IDX, were included simultaneously, as shown in model A1, the squared multiple correlation increased to .35. Compared with model C, 20% of the variance in teacher perceived student intellectual development (INT_DEV) was accounted for by the selected school system variables over and above that accounted for

Table 8

Multiple Regression Analysis of INT_DEV on DEMO_IDX and Selected School System Variables

No.	Model	R^2	sr^2	P	F	p
C	INT_DEV = Constant + DEMO_IDX	.15		2		
A1	INT_DEV = Constant + DEMO_IDX + ENROL + INS_LEAD + ASSIGN + IND_ATT + PRO_D + PAR_PART + CULTURE	.35	.20	9	3.077	<.010
A2	INT_DEV = Constant + DEMO_IDX + PAR_PART	.22	.07	3	6.765	.011
A3	INT_DEV = Constant + DEMO_IDX + CULTURE	.26	.11	3	10.726	.002

NOTE: " sr^2 " in the third column represents the extra variance accounted for by the variables in each model over and above that accounted for by DEMO_IDX.

"P" is the number of parameters estimated in the respective model.

"F" and "p' reflect the significance test of the respective squared semi-partial correlations.

N = 79

by school external environment alone. School system variables as a set were significant.

To identify individual variables in school system variable set, PAR_PART, which has significant bivariate correlation with INT_DEV was added into model C. As the statistics for Model A2 show, the squared multiple correlation was .22. The squared semi-partial correlation of INT_DEV and PAR_PART with DEMO_IDX partialled out was, therefore, .07, p=.011. This result indicates that 7% of variance in the perceived student intellectual development (INT_DEV) was accounted for by this parent/community participation factor after correlation of school external environment is statistically removed.

Similarly, when CULTURE was added to model C, as represented by Model A3, the squared multiple correlation increased to .26. The squared semi-partial correlation was again significant at p=.002 level. CULTURE accounted for 11% of variance in the perceived student intellectual development over and above that accounted for by school external environment alone.

Summary

The results of the bivariate correlation analysis, canonical correlation analysis, and hierarchical multiple regression analyses are summarized and discussed as follows. The bivariate analysis revealed that school external environment (DEMO_IDX) was significantly correlated with all the three student achievement measures. DEMO_IDX alone accounted for 34%, 8%, and 15% of variation in MATH, ENGLISH, and INT_DEV respectively. Given the fact that students are exposed to the family and community before they enter the school

system and students are still influenced by the family and the community while they are in the school system, this finding seems to suggest that the student's home location, to a significant extent, determines the level of achievement of the students. This suggestion, however, should be further investigated for the causal links.

Treated as sets, the canonical correlation analysis revealed that there was one dimension along which school system variables and student achievement measures correlated. Higher achievement, especially for MATH, went with larger schools, with higher ratings of teacher preparation and assignment, attention to individual student's needs, professional development, and a productive school culture. At $p<.05$ level, these school system variables as a group accounted for 15% of variance in the student achievement measures.

The correlations between school system variable and student achievement were further analyzed by hierarchical regression where the correlation DEMO_IDX was removed. It was found that school system variables as a set showed a unique relationship with MATH over and above that of DEMO_IDX. School system variables selected in this study accounted for 12% additional variance in MATH over and above that accounted for by DEMO_IDX. In education context, this means that school system factors, which are under the control of educators and policy makers, account for a meaningful proportion of variance in student mathematics achievement. This potential school effect should be further investigated through causal modeling techniques.

After removing the correlation of DEMO_IDX, two school system variables, school size and attention to individual student needs, were found to

be significantly positively correlated with math achievement. School size and attention to individual student needs accounted for 7% and 5% of variation in MATH over and above that of DEMO_IDX. This result suggested that should all the schools be in the same external environment, larger schools with more attention to each individual student's needs would still achieve higher on the average on the provincial grade 12 mathematics examination.

This finding seems to be contradictory to most of the similar studies carried out in the United States. The explanation of the difference can be found from the different settings where the studies were carried out. Although larger schools are usually associated with urban areas, the urban areas in the United States and British Columbia are different. As student SES in urban areas in British Columbia is relatively high, according to the contingent theory (Friedkin & Necochea, 1988), the opportunities associated with larger size dominate.

After removing the correlation of school environment, school system variables as a set was not significantly correlated with English achievement. No further identification of individual variables which were correlated with English achievement was pursued. English was not well explained by the school system variables selected in this study. Other avenues should be explored.

Partialling out DEMO_IDX, school system variables as a group indicated a unique relationship with INT_ DEV over and above that of DEMO_IDX. The school system variables selected in this study accounted for 20% additional variation in INT_ DEV after adjustment for DEMO_IDX. This finding suggests that teacher's ratings of student achievement are correlated with their satisfaction with their own attributes and their school's operation, independent from school external environment. Apart from the moderate correlation with

student examination results, the higher the staff rate their attributes and their schools' operation, the more they report satisfaction with their students' intellectual development.

Two school system variables, parent/community participation (PAR_PART) and school culture (CULTURE) were identified to be significantly positively correlated with teacher ratings of student intellectual development after the correlation of DEMO_IDX was removed. Parent/community participation and school culture accounted for 7% and 11% of variation in teacher ratings of student intellectual development over and above that accounted for by school external environment.

Chapter V

Conclusions, Limitations and Suggestions for Future Research

Conclusions

In line with the hypotheses posited earlier, this study draws the following conclusions:

1. School external environment was significantly positively correlated with all the three student achievement measures at $p<.05$ level. School external environment alone accounted for 34%, 8%, and 15% of variation in MA_EXAM, EN_EXAM, and INT_DEV respectively. Hypothesis 1, that school external environment will be positively correlated with student achievement measures, is supported.

2. A number of school system variables: school size (ENROL), teacher preparation and assignment (ASSIGN), attention to individual student's needs (IND_ATT), professional development (PRO_D), and a productive school culture (CULTURE), covaried with student achievement as a general concept. At the $p<.05$ level, school system variables as a set overlapped 15% of variance in student achievement. Hypothesis 2, that school system variables will be positively correlated with student achievement measures, is partially supported.

3. Treated as separate measures of achievement, controlled for school external environment (DEMO_IDX), school mathematics examination scores were found to be significantly correlated with school system variables as a set.

School system variables as a set accounted for 12% of variance in mathematics achievement over and above that of school external environment (DEMO_IDX). Individually, school size (ENROL) and individual attention (IND_ATT) in the school system variable set were identified to be correlated with school mathematics examination scores. School size and individual attention account for 7% and 5% of the variance in math respectively over and above that accounted for by school external environment (DEMO_IDX).

School system variables as a set was not found to be correlated with school English examination scores (ENGLISH) after the correlation in DEMO_IDX is removed. English examination result is not well explained by any school system variable selected in the study. Further investigation with other set of variables are needed.

School system variables as the set account for 20% of variance in (INT_DEV) over and above that accounted for by school external environment (DEMO_IDX). Two variables in school system variable set, parent and community participation in education (PAR_PART) and school culture (CULTURE), are found to be correlated with the perceived student intellectual development (INT_DEV). Parent/community participation and school culture accounts for 7% and 11% of variance in teacher ratings of student intellectual development respectively over and above that accounted for by school external environment (DEMO_IDX). Hypothesis 3, that school system variables will be positively correlated with student achievement measures after the difference of school external environment is statistically removed, is partially supported.

To sum up and to put the findings in educational perspective, the study revealed that school system factors, which are under the control of educators

and policy makers, accounted for meaningful proportions of variations in student mathematics achievement and teacher ratings of student intellectual development. However, the relationship revealed was correlational. This and other limitations of the study and the corresponding suggestions for future investigations are presented in the following sections.

Limitations

There were a number of limitations in the present study. Three prominent ones are of particular relevance and therefore are explicitly stated below.

The first limitation refers to the design and the statistical analysis techniques used in the study. The model presented in the conceptual framework section was designed rather to facilitate the selection of variables for the analysis than establish causal relationships among the variables. Consequently, the statistical techniques selected, mainly canonical correlation and multiple regression analysis, are correlational. As a result, the present study provide information of linear correlation among the study variables. It does not provide information regarding the causal relationships among the variables.

The second limitation of the analysis concerns the unit of analysis. Using school as the unit, the variances between each class and each individual are overlooked.

The last limitation has to do with the external validity of the study. As mentioned in the report, the schools in the sample is slightly skewed in favor of

metropolitan areas. This demands caution in generalizing the findings to the whole province.

Suggestions For Future Research

Overall, the present study was a very preliminary, even primitive investigation of the school system and student learning in British Columbia. Its purpose is to provide a general overview of the function of the system and how the parts of the system are related. More elegant and sophisticated studies can be done in the future. Two directions are suggested out of the present exercise. The first is to investigate the causal relationships among school external environment, school system variables, and student achievement. As an ultimate goal of science, researchers should endeavor to explain the phenomenon under investigation. Given enough resources, more valid and reliable instruments could be selected or developed and more reliable data acquired. With the availability of more reliable data and using causal modeling techniques such as path analysis or LISREL, a causal analysis of the same theme of the present study seems to be promising.

The second possible direction is a multilevel analysis of student achievement. The school system is a nested system where student background and abilities, classroom, school, and district all potentially affect student achievement (Bryk & Raudenbush, 1988). To precisely model student learning, variances in all the levels should be captured and analyzed. With the hierarchical linear modeling techniques, this exercise is becoming practical.

Given the importance of knowing how the system works and how students learn, a study along these line would be not only rewarding but also pressing.

This study, based on a set of readily available Ministry of Education data, was bounded by a set of limitations and assumptions that are described above. The hypotheses were partially supported in the analyses of the data. With these parameters in mind, the study should provide a reasonable base for further inquiring into the factors and relationships which may influence student achievement.

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Appendix A

One-way ANOVA of School Mean Examination Scores by School Years

THE FOLLOWING RESULTS ARE FOR:
SCH_YEAR = 88/89

TOTAL OBSERVATIONS: 30

	MA_EXAM	EN_EXAM
N OF CASES	30	30
MINIMUM	40.000	55.250
MAXIMUM	76.590	75.090
MEAN	61.143	68.455
STANDARD DEV	8.287	4.577

THE FOLLOWING RESULTS ARE FOR:
SCH_YEAR = 89/90

TOTAL OBSERVATIONS: 29

	MA_EXAM	EN_EXAM
N OF CASES	29	29
MINIMUM	38.880	61.260
MAXIMUM	78.000	74.850
MEAN	62.831	67.795
STANDARD DEV	7.814	4.102

THE FOLLOWING RESULTS ARE FOR:
SCH_YEAR = 90/91

TOTAL OBSERVATIONS: 20

	MA_EXAM	EN_EXAM
N OF CASES	20	20
MINIMUM	52.330	59.170
MAXIMUM	73.860	74.690
MEAN	61.986	67.883
STANDARD DEV	6.966	3.656

SUMMARY STATISTICS FOR MA_EXAM

BARTLETT TEST FOR HOMOGENEITY OF GROUP VARIANCES

CHI-SQUARE = 0.661 DF= 2 PROBABILITY = 0.719

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F	PROBABILITY
BETWEEN GROUPS	42.003	2	21.002	0.345	0.709
WITHIN GROUPS	4623.211	76	60.832		

SUMMARY STATISTICS FOR EN_EXAM

BARTLETT TEST FOR HOMOGENEITY OF GROUP VARIANCES

CHI-SQUARE = 1.132 DF= 2 PROBABILITY = 0.568

ANALYSIS OF VARIANCE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F	PROBABILITY
BETWEEN GROUPS	7.353	2	3.677	0.210	0.811
WITHIN GROUPS	1332.709	76	17.536		

Appendix B

Summary Criteria for B.C. Secondary School Accreditation Review

I. Leadership and Administration

A. Philosophy and Purpose

1. The school's philosophy is a clearly articulated and well accepted statement
of direction and purpose.

2. The school's philosophy is reflected in the programs, learning experiences,
and school culture.

3. The school's statement of philosophy expresses local priorities and emphases
within a context of Ministry of Education and school district directions.

B. Planning and Decision-Making

1. The school adapts to changing needs through effective problem solving.

2. The school demonstrates effective problem solving which requires developing, evaluating and adapting plans commensurate with school purposes.

3. School personnel demonstrate active learning and relearning in adapting
to new solutions and decisions.

C. Administrative Roles and Responsibilities

1. Administrators fulfill leadership responsibilities in accomplishing school and system goals.

2. Administrators accept the responsibilities as defined by the School Act and Regulation, Administrative Handbook, and School Board Policy.

3. Administrators fulfill liaison roles and responsibilities in an effective fashion.

D. Supervision of Personnel

1. Personnel policies and practices are fair, based on valid and reliable data,
well-communicated, and understood by all.

2. Supervision of personnel involves evaluation activities in a range of personnel management: evaluation for selection, formative and summative evaluation of performance, and effective follow-up to evaluation.

3. Evaluation of performance indicates individual strengths and weaknesses.
Strengths are commended while deficiencies are addressed through follow-up improvement programs.

E. Supervision of Instruction and Curriculum

1. Instructional leadership is effective in accomplishing school purposes.

2. Instructional leadership fosters effective teaching practices and in the development and implementation of curriculum.

3. Appropriate materials and resources are facilitated by those responsible.

F. Communication

1. Effective communications exist among parents, students and staff.

2. Effective communications exist between school and community, between
the school and other schools, and between the school and district office.

3. Effective communication results in regular, meaningful interaction between school constituents.

G. Office Management

1. Office management provides supportive mechanisms for accomplishment
of school and system goals.

2. Office procedures and practices are efficient and effective in meeting needs of system constituents.

3. Resources are managed effectively in the attainment of school and system goals.

H. Facility/Resource Management

1. School facilities are adequate for the attainment of school and system goals.

2. School facilities consider for the health and safety of all persons involved.

3. Resources are be managed in such a way as to provide maximum aesthetic and functional value.

I. Policy and Procedure Management

1. School policy and procedure facilitate achievement of school and system goals.

2. School policy and procedure facilitate an effective use of both human and physical resources in the attainment of school and system goals.

3. School policy and procedure facilitate positive, efficient interactions between all system components.

II Teacher Attributes

A. Professional Relationships

1. Staff relations are conducted according to professional ethics.

2. Relationships between staff and students are modeled on those of a kind and judicious parent.

3. Staff exert a professional standard of care in dealing with students.

B. Professional Expertise and Instructional Strategy

1. Teachers are adequately prepared, experienced, and assigned to their area of professional expertise.

2. Teachers fulfill their professional responsibilities efficiently and

appropriately.

3. Teachers employ a variety of instructional strategies to address the differing learning needs of students.

C. Professional Development

1. Teachers engage in school-wide professional/staff development.

2. Teachers pursue individual professional/staff development.

3. There is a systematic, ongoing process of professional/staff development in the school.

VI School Culture

A. The school culture is a reflection of school philosophy and direction, and is manifest in a majority of school interactions.

B. This school demonstrates a school culture which contributes to:

1. the attainment of system goals
2. the attributes of quality

C. Shared perceptions of school constituents provide a unified and positive assessment of this school's culture.

V. School and Community

A. The school has developed its philosophy and programs in accordance with local community needs and concerns.

B. The school has formal and informal mechanisms designed to:

1. determine local community needs and concerns

2. assess the extent to which the public is satisfied with the school's operation.

C. The school operates as a partner with parents, community agencies, and the local public to accomplish school and system goals.

VI Student Intellectual Development

1. Students are developing the ability to analyze critically, to reason and think in
dependently, and to acquire basic learning skills and bodies of knowledge.

2. Students are developing a lifelong appreciation of learning, a curiosity about
the world around them, and a capacity for creative thought and expression.

3. Students are academically successful.

Appendix C

Principal Components Analysis of Teacher Ratings on Student Intellectual Development

LATENT ROOTS (EIGENVALUES)

1	2	3
2.005	0.601	0.393

COMPONENT LOADINGS	INT_DEV
Creativity & Life-long Learning	0.869
Academic Success	0.794
Knowledge & Skill Acquisition	0.787

VARIANCE EXPLAINED BY COMPONENTS

2.005

PERCENT OF TOTAL VARIANCE EXPLAINED

66.848

Appendix D

Canonical Correlation Analysis of Student Achievement and School System Variables

MULTIVARIATE TEST STATISTICS

WILKS' LAMBDA =	0.522			
F-STATISTIC =	2.402	DF = 21, 198		PROB =0.001
PILLAI TRACE =	0.559			
F-STATISTIC =	2.321	DF = 21, 213		PROB =0.001
HOTELLING-LAWLEY TRACE =	0.764			
F-STATISTIC =	2.463	DF = 21, 203		PROB =0.001
THETA =	0.318	S = 3, M = 1.5, N = 33.5		PROB =0.005

TEST OF RESIDUAL ROOTS

ROOTS 1 THROUGH 3			
CHI-SQUARE STATISTIC =	47.107	DF = 21	PROB =0.001
ROOTS 2 THROUGH 3			
CHI-SQUARE STATISTIC =	19.337	DF = 12	PROB =0.081
ROOTS 3 THROUGH 3			
CHI-SQUARE STATISTIC =	2.190	DF = 5	PROB =0.822

CANONICAL CORRELATIONS

1	2	3
0.564	0.459	0.172

DEPENDENT VARIABLE CANONICAL COEFFICIENTS
STANDARDIZED BY SAMPLE STANDARD DEVIATIONS

	1	2	3
MATH	0.859	-0.635	0.324
ENGLISH	0.069	0.080	-1.091
INT_DEV	0.239	1.020	0.318

CANONICAL LOADINGS (CORRELATIONS BETWEEN
DEPENDENT VARIABLES AND DEPENDENT CANONICAL FACTORS)

	1	2	3
MATH	0.969	-0.241	0.044
ENGLISH	0.453	0.167	-0.876
INT_DEV	0.568	0.817	0.096

INDEPENDENT VARIABLE CANONICAL COEFFICIENTS
STANDARDIZED BY SAMPLE STANDARD DEVIATIONS

	1	2	3
ENROL	0.771	-0.441	-0.371
INS_LEAD	0.161	0.208	0.009
ASSIGN	0.091	0.059	-0.269
IND_ATT	0.155	-0.028	0.366
PRO_D	0.036	-0.303	0.976
PAR_PART	0.036	0.533	0.177
CULTURE	0.402	0.653	-0.419

CANONICAL LOADINGS (CORRELATIONS BETWEEN
INDEPENDENT VARIABLES AND INDEPENDENT CANONICAL FACTORS)

	1	2	3
ENROL	0.824	-0.455	-0.139
INS_LEAD	0.285	0.335	0.003
ASSIGN	0.404	0.109	-0.156
IND_ATT	0.480	0.051	0.314
PRO_D	0.401	0.006	0.798
PAR_PART	0.215	0.576	0.269
CULTURE	0.462	0.643	0.084

Appendix E

Multiple Regression Analyses of MA_EXAM on School System Variables with School External Environment Controlled

DEP VAR: MATH N: 79 MULTIPLE R: 0.585 SQUARED MULTIPLE R:0.342
ADJUSTED SQUARED MULTIPLE R: 0.333 STANDARD ERROR OF ESTIMATE: 6.314

VARIABLE	COEFFICIENT	STD ERROR	STD COEF	TOLERANCE	T	P(2 TAIL)
CONSTANT	60.260	0.760	0.000	.	79.249	0.000
DEMO_IDX	3.892	0.615	0.585	1.000	6.326	0.000

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	1595.566	1	1595.566	40.024	0.000
RESIDUAL	3069.648	77	39.866		

DEP VAR: MATH N: 79 MULTIPLE R: 0.638 SQUARED MULTIPLE R:0.406
ADJUSTED SQUARED MULTIPLE R: 0.391 STANDARD ERROR OF ESTIMATE: 6.036

VARIABLE	COEFFICIENT	STD ERROR	STD COEF	TOLERANCE	T	P(2 TAIL)
CONSTANT	56.850	1.392	0.000	.	40.842	0.000
DEMO_IDX	2.974	0.669	0.447	0.772	4.444	0.000
ENROL	0.005	0.002	0.289	0.772	2.873	0.005

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	1896.196	2	948.098	26.022	0.000
RESIDUAL	2769.018	76	36.434		

DEP VAR: MATH N: 79 MULTIPLE R: 0.625 SQUARED MULTIPLE R:0.391
ADJUSTED SQUARED MULTIPLE R: 0.375 STANDARD ERROR OF ESTIMATE: 6.114

VARIABLE	COEFFICIENT	STD ERROR	STD COEF	TOLERANCE	T	P(2TAIL)
CONSTANT	49.601	4.369	0.000	.	11.352	0.000
DEMO_IDX	3.808	0.597	0.572	0.997	6.383	0.000
IND_ATT	3.152	1.273	0.222	0.997	2.475	0.016

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	1824.534	2	912.267	24.407	0.000
RESIDUAL	2840.680	76	37.377		

DEP VAR: MATH N: 79 MULTIPLE R: 0.674 SQUARED MULTIPLE R:0.455
ADJUSTED SQUARED MULTIPLE R: 0.392 STANDARD ERROR OF ESTIMATE: 6.028

VARIABLE	COEFFICIENT	STD ERROR	STD COEF	TOLERANCE	T	P(2TAIL)
CONSTANT	41.995	7.943	0.000	.	5.287	0.000
DEMO_IDX	2.983	0.696	0.448	0.713	4.289	0.000
ENROL	0.004	0.002	0.235	0.652	2.154	0.035
INS_LEAD	1.328	1.406	0.089	0.888	0.945	0.348
ASSIGN	0.693	1.580	0.042	0.833	0.439	0.662
IND_ATT	2.001	1.385	0.141	0.820	1.445	0.153
PRO_D	0.703	0.994	0.071	0.772	0.707	0.482
PAR_PART	-0.503	1.315	-0.035	0.919	-0.383	0.703
CULTURE	0.518	1.715	0.032	0.690	0.302	0.763

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	2121.260	8	265.157	7.296	0.000
RESIDUAL	2543.954	70	36.342		

Appendix F

Multiple Regression Analyses of EN_EXAM on School System Variables with School External Environment Controlled

DEP VAR: ENGLISH N: 79 MULTIPLE R: 0.274 SQUARED MULTIPLE R:0.075
ADJUSTED SQUARED MULTIPLE R: 0.063 STANDARD ERROR OF ESTIMATE: 4.012

VARIABLE	COEFFICIENT	STD ERROR	STD COEF	TOLERANCE	T	P(2 TAIL)
CONSTANT	67.637	0.483	0.000	.	139.986	0.000
DEMO_IDX	0.978	0.391	0.274	1.000	2.501	0.015

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	100.670	1	100.670	6.254	0.015
RESIDUAL	1239.392	77	16.096		

DEP VAR: ENGLISH N: 79 MULTIPLE R: 0.336 SQUARED MULTIPLE R:0.113
ADJUSTED SQUARED MULTIPLE R: 0.089 STANDARD ERROR OF ESTIMATE: 3.955

VARIABLE	COEFFICIENT	STD ERROR	STD COEF	TOLERANCE	T	P(2 TAIL)
CONSTANT	64.690	1.711	0.000	.	37.819	0.000
DEMO_IDX	0.899	0.388	0.252	0.987	2.316	0.023
PRO_D	1.035	0.577	0.195	0.987	1.793	0.077

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	150.992	2	75.496	4.825	0.011
RESIDUAL	1189.070	76	15.646		

DEP VAR: ENGLISH N: 79 MULTIPLE R: 0.377 SQUARED MULTIPLE R:0.142
ADJUSTED SQUARED MULTIPLE R: 0.044 STANDARD ERROR OF ESTIMATE: 4.053

VARIABLE	COEFFICIENT	STD ERROR	STD COEF	TOLERANCE	T	P(2 TAIL)
CONSTANT	58.297	5.340	0.000	.	10.916	0.000
DEMO_IDX	0.924	0.468	0.259	0.713	1.976	0.052
ENROL	-0.000	0.001	-0.030	0.652	-0.220	0.827
INS_LEAD	0.579	0.945	0.072	0.888	0.613	0.542
ASSIGN	-0.127	1.063	-0.014	0.833	-0.119	0.906
IND_ATT	0.951	0.931	0.125	0.820	1.022	0.310
PRO_D	0.786	0.669	0.148	0.772	1.175	0.244
PAR_PART	0.611	0.884	0.080	0.919	0.692	0.491
CULTURE	0.182	1.153	0.021	0.690	0.158	0.875

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	190.220	8	23.778	1.448	0.193
RESIDUAL	1149.842	70	16.426		

Appendix G

Multiple Regression Analyses of INT_DEV on School System Variables with School External Environment Controlled

DEP VAR: INT_DEV N: 79 MULTIPLE R: 0.390 SQUARED MULTIPLE R:0.152
ADJUSTED SQUARED MULTIPLE R: 0.141 STANDARD ERROR OF ESTIMATE: 0.927

VARIABLE	COEFFICIENT	STD ERROR	STD COEF	TOLERANCE	T	P(2 TAIL)
CONSTANT	-0.151	0.112	0.000	.	-1.355	0.179
DEMO_IDX	0.336	0.090	0.390	1.000	3.719	0.000

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	11.873	1	11.873	13.830	0.000
RESIDUAL	66.100	77	0.858		

DEP VAR: INT_DEV N: 79 MULTIPLE R: 0.471 SQUARED MULTIPLE R:0.222
ADJUSTED SQUARED MULTIPLE R: 0.201 STANDARD ERROR OF ESTIMATE: 0.894

VARIABLE	COEFFICIENT	STD ERROR	STD COEF	TOLERANCE	T	P(2 TAIL)
CONSTANT	-1.767	0.631	0.000	.	-2.803	0.006
DEMO_IDX	0.326	0.087	0.379	0.998	3.736	0.000
PAR_PART	0.486	0.187	0.263	0.998	2.601	0.011

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	17.275	2	8.638	10.815	0.000
RESIDUAL	60.697	76	0.799		

DEP VAR: INT_DEV N: 79 MULTIPLE R: 0.507 SQUARED MULTIPLE R: 0.257
ADJUSTED SQUARED MULTIPLE R: 0.238 STANDARD ERROR OF ESTIMATE: 0.873

VARIABLE	COEFFICIENT	STD ERROR	STD COEF	TOLERANCE	T	P(2 TAIL)
CONSTANT	-2.305	0.666	0.000	.	-3.461	0.001
DEMO_IDX	0.286	0.086	0.332	0.969	3.306	0.001
CULTURE	0.687	0.210	0.329	0.969	3.275	0.002

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	20.048	2	10.024	13.152	0.000
RESIDUAL	57.925	76	0.762		

DEP VAR: INT_DEV N: 79 MULTIPLE R: 0.593 SQUARED MULTIPLE R: 0.352
ADJUSTED SQUARED MULTIPLE R: 0.278 STANDARD ERROR OF ESTIMATE: 0.849

VARIABLE	COEFFICIENT	STD ERROR	STD COEF	TOLERANCE	T	P(2 TAIL)
CONSTANT	-4.595	1.119	0.000	.	-4.105	0.000
DEMO_IDX	0.336	0.098	0.390	0.713	3.424	0.001
ENROL	-0.000	0.000	-0.119	0.652	-1.002	0.320
INS_LEAD	0.291	0.198	0.150	0.888	1.468	0.147
ASSIGN	0.113	0.223	0.053	0.833	0.506	0.614
IND_ATT	0.150	0.195	0.081	0.820	0.766	0.446
PRO_D	-0.123	0.140	-0.096	0.772	-0.880	0.382
PAR_PART	0.393	0.185	0.213	0.919	2.124	0.037
CULTURE	0.579	0.242	0.278	0.690	2.397	0.019

ANALYSIS OF VARIANCE

SOURCE	SUM-OF-SQUARES	DF	MEAN-SQUARE	F-RATIO	P
REGRESSION	27.461	8	3.433	4.757	0.000
RESIDUAL	50.512	70	0.722		

VITA

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Title of Thesis: RELATIONSHIPS AMONG EXTERNAL ENVIRONMENT, SCHOOL SYSTEM VARIABLES, AND STUDENT ACHIEVEMENT

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September 20, 1993
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