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RESOURCE ALLOCATION AND STUDENT ACHIEVEMENT: A MICROLEVEL IMPACT STUDY OF DIFFERENTIAL RESOURCE INPUTS ON STUDENT ACHIEVEMENT OUTCOMES

By

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Abstract

This study examined the relationships between resource allocation and student achievement using a modified version of a conceptual model designed by Bulcock (1989) within a general model proposed by Guthrie (1988). Five research questions were developed from a review of literature to investigate the relationship between microlevel student input variables and student output variables--both cognitive and affective. The mediating effects of the student perceptions of the quality of school life on student achievement outcomes were also examined.

Multiple regression analyses were utilized and data were analyzed at both the individual and school levels. Models were used to investigate the indirect effects of the quality of school life on student achievement outcomes. Substantively meaningful relationships were identified between linguistic resources, language usage and reading outcomes; socioeconomic level, gender, linguistic resources, language usage, and mathematics achievement; gender, student attitudes, and student well-being. All grade

eight Newfoundland students (10,146) were the subjects of the study. Participants in the study completed the Canadian Test of Basic Skills (CTBS) and the Bulcock Attitudinal Inventory (BAI). Females scored higher than males on every test of the CTBS and also had more favourable attitudes towards school as measured using the BAI. Urban students outperformed rural students by the equivalent of nearly one year on the CTBS scores.

A variable was constructed to test Bernstein's (1961) theory of language discontinuity. Bernstein contended that the further an individual's language code departed from the standard language code in use in that society, the greater the difficulty that person would have in learning. The language code variable was constructed using the language usage score from the CTBS to create a continuous variable. This language code variable proved to be highly explanatory in that it explained a large percentage of the variance in reading achievement outcomes and in mathematics achievement outcomes.

The measure for students' perceptions toward their schooling experiences explained a large percentage of the variance of student well-being.

Two other noteworthy findings in the present study arose from relationships identified between mathematics achievement and independent variables. A strong relationship was identified between mathematics achievement and socioeconomic level. In general, the higher one's socioeconomic level the greater were the outcome measures in mathematics achievement. Indirect effects analyses produced a significant relationship between gender and mathematics achievement that favoured girls. The construction of the educational production function in the present study proved to be an accurate model.

The present study contributed to research in several ways. This is one of the first studies that has employed Quality of School Life indicators as developed in the BAI in an educational production function model. A second contribution was the inclusion of microlevel student linguistic resources as predictors of cognitive achievement outcomes. The third contribution of the present study was the high percentage of variance of cognitive achievement outcomes explained by the modified Bulcock model.

CHAPTER ONE

Background of Educational Production Function Study

Introduction

Chapter One provides a general introduction to this study. It outlines the brief history of production function approaches as they are applied to education. An attempt is made to define a production function that is an accurate predictor of student outcomes. This more accurate production function can then be used to help schools become more effective in achieving their stated educational goals. The chapter contains the conceptual framework that forms the theoretical basis of the study. Weaknesses of previous production function studies are reviewed and an attempt is made to refine techniques as advocated in resource allocation literature.

Background to the problem

Differences in the effectiveness of schools have been a concern to interested stakeholders in education throughout most of this century. How resources are

combined by those involved in the production of educational outputs greatly interests those who have to pay for education. Indicators of school effectiveness differ among the provinces in this country and among boards within provinces. This study examines the relationship between resources used in the schooling process and measures of schooling outcomes.

Interest in the productivity of the educational system increased following the release of the Equality of Educational Opportunity Report (Coleman et al., 1966). Coleman and his associates contended that schools had minimal effects on educational outcomes. The "Coleman Report" was a catalyst because it provided an impetus for theorists of all orientations to undertake research in what had previously been an obscure and highly specialized branch of educational administration (Cohn, 1979). Research similar to that of the Coleman Report formed the basis of input-output analyses and resource allocation studies for the next decade (Bowles, 1970; Bowles & Levin, 1968; Brown & Saks, 1975; Burkhead, Fox, & Holland, 1967; Cohn, Millman, & It-Keong, 1975; Hanushek, 1972; Katzman, 1968; Levin, 1970; Michelson, 1970; Summers & Wolfe,

1977). This field of research can be linked to organizational theory. Guthrie (1988) points out that a number of finance models evolved from social system models such as Easton (1965) and Parsons (1960).

Following methods used by similar productivity studies during the 1970's, a demand for greater accountability in education was made throughout the 1980's. This demand was fuelled by concern in many states over retention rates, truancy, and achievement scores. Politicians responded to these pressures with such actions as minimal competency testing, and expanded or new state roles in areas such as testing, curriculum development, technical assistance, and categorical programs (McLaughlin & Catterall, 1984). McLaughlin and Catterall argue that these state roles resulted in increased contributions to public education and a concomitant increase in public interest caused by rising state expenditures.

To justify grants to educational institutions, many jurisdictions adopted business approaches to education. These business approaches included the use of production functions to analyze the efficiency of educational systems (Cohn, 1979; Hanushek, 1972;

Rossmiller, 1978), cost effectiveness analysis (Levin, 1975, 1985; Levin, Glass, & Meister, 1984, 1986, 1987; Levin, Leiter, & Meister, 1986), and performance-based reward systems (Banta & Fisher, 1984; Gilman, 1988; Sie, 1983). Input-output studies, production function studies, or resource allocation studies in an educational context are studies that investigate or examine the relationships between inputs to the educational process and educational outcomes. Production function studies[1] are used to determine the efficiency of resource allocations within schools and school systems (Brown & Saks, 1986; Guthrie, 1988; Monk, 1981; Rossmiller, 1978).

Educational outcomes are often studied in either long or short run time periods. Long term educational output is a concern of the branch of economics of education known as human capital theory[2] (Becker, 1975; Guthrie, 1988; Mincer, 1984; Schultz, 1971). Short term

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[1]Production function studies are attempts by researchers to use mathematical techniques to identify the relationships between educational inputs (resources) and educational outputs (in the form of cognitive and affective student outcomes).

[2]Human capital theory attempts to quantify the returns to investments in education on both individual and social levels.

outputs of the educational system include cognitive, affective, and psychomotor achievement; basic knowledge; intellectual and management skills; analytical capabilities; and values, attitudes, and aspirations (Rossmiller & Geske, 1976). Studies which investigate the relationship between inputs to the educational system and educational achievement outcomes, or output are usually referred to in educational finance literature as input-output analyses. It is worth noting that some inputs can be manipulated or controlled by educators and policymakers while other variables cannot. Variables that can be controlled include resource allocations within the school setting. Resource background variables cannot be easily manipulated at least not in the short run.

Research approaches

Multiple regression analysis is the statistical technique used in most resource allocation studies (Bowles, 1969; Bowles & Levin, 1968; Brown, 1972; Brown & Saks, 1987; Cohn & Millman, 1975; Coleman et al., 1966; Friedkin & Nechochas, 1988; Hanushek, 1968; Levin, 1970, 1974; Link & Mulligan, 1986; Michelson, 1970; Rossmiller, 1978; Thomas, 1962; Walberg & Fowler,

1987). It is assumed that the regression technique can represent output values as a weighted combination of input values. This weighted combination is interpreted to show how important a particular resource variable is or what difference it makes to an outcome measure while controlling for the influence of the other variables (Gilman, 1988). Thus, as Gilman articulates, a production function can be used to define an instructionally efficient school by describing outputs as a weighted combination of inputs.

Effectiveness is an operational standard having to do with the degree to which goals are attained (Katz & Kahn, 1978). In most production function studies, effectiveness is operationalized through a standardized test, an attitudinal assessment, graduation rate, retention rate, or promotion rate (Cohn, 1979; Guthrie, 1988; Hanushek, 1986; MacPhail-Wilcox & King, 1986). Standardized tests of cognitive achievement are the most commonly used measure in investigating the efficacy of the educational process (Hanushek, 1986). Hanushek says that besides their common availability, test scores seem to be valued in and of themselves.

Measures of affect are occasionally used in input-

output analysis in education either as outcome measures or predictors of achievement (Cohn & Millman, 1975; Coleman et al., 1966; Levin, 1970; Whitt, 1989). Many of the early production function studies tend to deal superficially with attitudinal outcomes of the education process. The most frequently researched indicators include locus of control (Cohn & Millman, 1975; Coleman et al., 1966; Levin 1970), students' educational aspirations (Burkhead, 1967; Katzman, 1971; Mayeske, 1971), and parents' educational aspirations for their children (Levin, 1970).

Bulcock (1988a) observes that early work in this attitudinal area is traced to the classical studies of Tennenbaum in the 1940's. Tennenbaum (1940) reported that 20-40% of students in grades six to eight were dissatisfied with major aspects of their school experience. Boys generally tend to be more unhappy than girls (Jackson, 1968). Epstein (1981) indicates that age also plays a part in attitude formation since there is a general tendency for student reactions to become less positive over time.

Epstein (1981) also speculates that school structure might affect age trends in student attitudes.

How a school system offers its program could negatively impact on the development of student attitudes. Epstein states:

> Students who are eleven to fifteen years old are the population placed in greatest jeopardy by the selection of the organization of grade levels...(They) may be placed in either elementary, middle, junior, or high school. The psychological, sociological, social psychological theories underlying the grade schemes and their effects on cognitive and affective outcomes are not well understood.(p.275)

Epstein and McPartland (1976) develop a quality of school life model to measure student attitude toward school. Isherwood and Ahola (1981) observe that it measured a commitment to school, to teachers, and to classroom work. Researchers investigating students' perceptions concerning the quality of school life assert that student attitude towards school is an influential predictor of school achievement (Bulcock, 1988a; Bulcock, 1989; Bulcock & Whitt, 1989; Whitt, 1989).

Most production function studies are mainly

concerned with efficiency of the educational system (Cohn, 1979; Coleman et al., 1966; Thomas, 1962). In economic terms, efficiency involves acquiring additional marginal output for each unit of input by altering either the input or output conditions (Johns, Morphet, & Alexander, 1983). Cohn maintains that efficiency of any enterprise is measured by the ratio of output to input.

Contemporary approaches

Efficiency has a number of different components for economists (Guthrie, Garms, & Pierce, 1987). Allocative efficiency is of interest to economists because if resources are not allocated in an effective manner there will be inefficiency in the production process. Resource allocation is of less concern than how resources are used after being allocated. Educational decision makers have to be able to accurately predict societal demand for educational services and allocate sufficient resources to satisfy those demands. If the allocation of resources by government and its agents does not match societal wants, an underutilization and concomitant inefficient use of resources could occur. Guthrie et al. state that

technical efficiency from an economics perspective refers to efforts to maximize output at a set input level or to minimize resource inputs to obtain a desired output level.

To increase efficiency in an era of constricted fiscal and human resources requires a redistribution of available resources (MacPhail-Wilcox & King, 1986). Implicit in the MacPhail-Wilcox and King argument is the notion that resources would be transferred from less productive to more productive uses. Cohn (1979) argues that no progress in improving educational efficiency is possible unless one attempts to analyze the educational production process, to model the relationship between inputs and outputs, and to find the means by which outputs (outcomes) per unit of inputs (resources) can be increased. Inputs are sometimes categorized on the basis whether they can be controlled or are difficult to manipulate by educators. Resource allocation studies fall under the general rubric of production function studies. Input-output analysis has been the major research approach in resource allocation research.

Current developments in resource allocation studies

Much of the research into the relationships between resources and outcomes has pursued the effects of purchased resources on outcomes (Monk, 1992). Monk also pursues research that investigated the relationships between non-purchased inputs and educational outcomes. He traces this approach to research developed by Becker (1965).

Input-output models are based on the assumption that schools have attributes. These analyses employ research strategies to measure educational outcomes. Production functions are used to help explain variations in student achievement (Gilman, 1988). When reasons for differences are isolated, planners try to use the information to improve the educational process.

Even though the educational process is extensively researched, clear policy prescriptions are difficult to derive (Hanushek, 1986). The earliest attempts to shape policy are based on studies such as the Coleman Report (1966), the "Plowden Report" (1967), or the Jencks et al. (1972) study. Hanushek (1986) argues that some of the major findings of these studies were later refuted, even through re-analyses of the original data, and that

policies derived from the studies were often inappropriate.

Educators and economists have attempted to improve their resource allocation techniques throughout the past two decades. Brown and Saks (1975, 1987) argue that much of the difficulty with resource allocation studies stems from the methods of analyses. Monk (1986) supports their contention and criticizes earlier studies because of the generality of the questions pursued. Hanushek (1986) reinforces this claim and states that questions should not only be asked about levels of resource endowments but also about how these resource endowments are used. Many of the early resource allocation studies utilized macrolevel analyses aggregated at either school or system levels. Microlevel studies, studies conducted with the student treated as the unit of analysis, making comprehensive use of specific questions concerning exact levels of resource uses, are scarce in the economics of education literature. Current researchers advocate more study at the microlevel of analysis so as to gain more accurate indicators of schooling outcomes (Brown & Saks, 1987).

Alexander and Salmon (1995) argue that the

opportunity to evaluate the substitution of elements in the education model is severely limited. They state that while outputs of schools vary widely, inputs often do not vary greatly at all. Hanushek (1991) defined efficiency as consisting of two components: knowledge of the relationships between inputs of the educational process and a research decision that connects inputs of the educational process to their educational outputs. Hereford and Keith (1991) concluded that there probably are not many policy manipulable predictors of academic achievement much above the level of the classroom. Alexander and Salmon (1995) state that the collection of data at the classroom level is the direction research must take in order to develop usable production function models. They stress the need for production function studies to include a measure of innate ability as an input. They point out that most cross-sectional studies lack such measures. The inclusion of linguistic resource variables in the present study provides the model as specified with this ability indicator.

While many advances have been made in production function studies over the past two decades, much

refinement in technique is still required. From a policy perspective it is very important to understand which inputs are alterable and which are fixed in both short and long run periods (Hanushek, 1989). Much of the educational productivity research relates student background variables (Levin,1970; Michelson, 1970; Summers & Wolfe, 1977), teacher and classroom characteristics (Brown, 1972; Murnane, 1975; Summers & Wolfe, 1977), school characteristics (Burkhead, 1967; Cohn & Millman, 1975; Murnane, 1975; Wolfe, 1977), district characteristics (Burkhead, 1967; Hanushek, 1972) and student attitudes (Bulcock, 1988b; Cohn & Millman, 1975; Katzman, 1971; Levin, 1970; Whitt, 1989) to educational outcomes.

From these broad categories, researchers identify specific indicators of cognitive and affective outcomes within the educational production function process. Educators generally recognize attitudes as both inputs and outcomes of the educational process. Appendix "A" contains lists of indicators under student and teacher-classroom characteristics. These indicators are found consistently in the literature to be statistically significant in predicting student outcomes, both

cognitive and affective.

Bulcock (1988a) develops a model in the Quality of School Life tradition based heavily on research conducted in Australia by Williams and Batten (1981). Williams and Batten describe six indicators to measure student perceptions of the quality of schooling they received. Bulcock significantly extends the Williams and Batten approach by adding a teacher variable. Bulcock & Beebe (1988) treated this teacher variable as an independent variable developed to measure the effect teachers have on students as role models.

For the purposes of this study, attitudinal indicators of educational outcomes are drawn from the enhanced model developed by Bulcock (1988a). Bulcock's model measures seven distinct variables which predict student achievement in the attitudinal domain. These variables prove to be very powerful predictors of student attitudinal outcomes (Bulcock & Whitt, 1989; Whitt, 1989).

Hoy and Miskel (1987) contend that theory is heuristic in that it stimulates and guides further development of knowledge. In the same manner an argument can be made that models are useful when they

Whitt, 1989).

Hoy and Miskel (1987) contend that theory is heuristic in that it stimulates and guides further development of knowledge. In the same manner an argument can be made that models are useful when they allow researchers to put order to diverse topics under study. For example, while the Bulcock model facilitates analysis of attitudinal outcomes, it also provides a means to permit scrutiny of cognitive outcome indicators.

Guthrie (1988) develops a model for ordering school finance studies. His model is based on the earlier social systems models of Parsons (1960) and Easton (1965). Guthrie argues that a general model is needed because the field of school finance has expanded so much and draws from economics, public finance, political science, sociology, law, and public administration.

Guthrie's (1988) model of school finance research is used in the present study as a convenient means of ordering variables to permit meaningful analysis. The Bulcock model of resource allocation and achievement is used within the Guthrie model to facilitate more

accurate measurement of the relationships between input variables and outcome indicators. Bulcock's model permits accurate measurement of student attitudinal outcomes. Bulcock (1988a, 1988b) successfully completed research using attitudinal indicators as mediating variables. Epstein (1981) claims that the high correlation between student attitude and standardized cognitive achievement indicates that affective measures can make important independent contributions to school assessment programs.

Improvements in computing technologies permit researchers to manipulate and analyze many input and output variables simultaneously. The production function literature is imprecise in predicting variations in student outcomes. Isherwood and Ahola (1981) contend that other types of survey data such as family background characteristics, peer structures and processes, and school conditions can further extend our understanding of student attitudes toward school.

The present study further refines techniques advocated in the literature for measurement of educational outcomes. It is anticipated that investigation of the education production process using

indicators of student achievement and attitudes for both process and outcomes measures will augment explanatory capabilities of input-output models for differences in student achievement and attitudes. The Guthrie (1988) model will be utilized in conjunction with the Bulcock (1988a) resource allocation measurement approach to attempt to augment accuracy of measurement of student outcomes as a result of differential resource endowments. This increased accuracy can then be used to define more effective resource allocation and thus promote greater efficiency in the educational system.

The present study is conducted in the province of Newfoundland. This province is chosen because extensive testing is completed on the entire student population under very rigidly controlled conditions. Thus the reliability of findings is likely enhanced as a result of the controls. The likelihood of replication of the study at future times is also enhanced as the testing program is completed at the same time every school year. The demographic diversity of the province is an additional factor that makes the likelihood of statistical differences between process and outcome

measures more likely. As well, the provincial ministry has agreed to make available to the researcher the results of the province-wide CTBS tests and the responses to the Bulcock Attitudinal Inventory (BAI).

Statement of the Problem

One of the main problems isolated in a review of the production function literature is the inadequacy of currently used approaches to account for variations in student achievement as measured both cognitively and affectively (MacPhail-Wilcox & King, 1986). The primary purpose of the present study is to investigate relationships between variations of resource combinations and student achievement outcomes within a provincial education system. As concern is frequently expressed about the effectiveness of the Newfoundland school system (Bulcock, 1992; Crocker, 1979), Newfoundland is a good context within which to investigate relationships between resource inputs and educational outcomes. The determination of which variables cause differences in outcomes cannot change the reality that many of the predictor variables are not readily controllable in the short run. Nonetheless,

the identification of accurate relationships between inputs and outcomes can help educators to concentrate on those variables that it is possible to alter in the short run. In some cases educational decision makers can substitute controllable resources to help compensate for deficiencies in those resources that are not alterable in the short run. Long term changes can possibly be recommended based increased knowledge derived from analyses of relationships within the present study.

This study specifically addresses the following research questions as identified in the literature:

1) Is there a relationship between community background variables and educational outcomes?
2) Is there a relationship between school characteristics and educational outcomes?
3) Is there a relationship between student background characteristics and educational outcomes?
4) Is there a relationship between student linguistic resources and educational

outcomes?

5) Do student attitudes have a mediating effect on educational outcomes?

Significance of the Study

Production function studies (input-output analyses or resource allocation studies) can be used to examine productivity or efficiency of educational systems (Banta & Fisher, 1984; Gilman, 1988; Sie, 1983). Hanushek (1989) says that findings of production function studies consistently indicate that some schools use educational resources effectively, whereas, others do not.[3] Because this is a population study involving large numbers of students, it should be possible to determine which inputs into the educational process actually make a substantive difference to educational outcomes. Brown and Saks (1986) convincingly argue that resource allocation studies conducted at the microlevel yield more useful findings than earlier studies aggregated at the school or school

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[3]In light of Hanushek's argument, analysis of the research questions was also conducted at the school level. This approach was taken to ensure that any significant differences in the relationships at the different levels of aggregation and any between schools effects were not missed.

board levels. Thus the unit of analysis for this study is the student and, if what Brown and Saks advocate is true, the research findings should contribute to knowledge in this area of research. This research can then help define more effective relationships between resource inputs and student achievement outputs.

These research findings would naturally have much greater applicability within Newfoundland than in other provinces. However, it is possible that some aspects of the study may have merit for educational researchers throughout the other Canadian provinces. The large number of students measured (10,146 students) also strengthens the findings and adds to their generalizability at least in the Newfoundland context.

Many production function studies either ignore or pay superficial attention to student attitudes within the educational process. Analysis of both cognitive and affective outcomes simultaneously should augment existing findings in the field. The combination of cognitive and affective outcomes into one production function enhances the explanatory aspects of the model and should provide a broader vision for future policy formulation by more completely defining the production

function at least in the jurisdiction being studied.

The inclusion of a variable to measure Bernstein's (1961) concept of language usage should also augment the explanatory power of the stated educational production function in the present study. If strong relationships are identified among or between variables it might be possible for educators to use this information to improve educational programs by altering resource combinations or by substituting for resources that are not alterable in the short run.

Another aspect of the present study that should make a significant contribution is the measurement of the relationship between student attitudes, using the Bulcock Attitudinal Inventory (BAI), and student achievement outcomes. It might be possible to determine if programs designed to change student attitudes towards learning can alter student achievement outcomes. One such policy developed by the provincial Department of Education and publicized in its annual report for 1983-84 was to promote equality of opportunity for both males and females in all areas of the curriculum. A second aim tried to discontinue gender stereotyping which adversely affected the image

of the learner. It is hoped that by analyzing data on the basis of gender that any change in outcomes attributable to this policy is measurable. The confirmation of effectiveness of such a policy direction will make a significant contribution to study in that area.

Limitations of the Study

Limitations of this research are discernible in a number of areas. The first limitation is that the research is conducted in a single province - Newfoundland. This fact is important because the governance of education in Newfoundland is different from any other province in Canada or state in the United States. Newfoundland's distinct public denominational system is unlike any other system found on this continent. All school boards are affiliated with specified religious denominations. Various boards may have different leadership styles and system goals that are very different from other denominations and which conceivably could affect educational outcomes. Generalizabilty of findings may be lessened because of these differences in the educational governance

structures in this province compared to other jurisdictions.

Limitations of resources for this study prevent the formulation of a longitudinal study design which could be used to analyze the relationships between inputs and outputs over time. The cross sectional design means that the research only presents the equivalent of a photographic snapshot as compared to the dynamics that a number of snapshots could offer.

CHAPTER TWO

Review of Literature

Introduction

This study is concerned with how educational resources are related to student cognitive and affective achievement outcomes. It employs contemporary production function theory to investigate this relationship. Chapter Two contains a presentation of production function theory. Production function theory is first reviewed and then its application to education is discussed. Examples of production function studies in education are presented. Strengths and weaknesses of previous approaches are cited to guide development of the theoretical base of this study. Critical issues of research in the production function domain of resource allocation are reviewed. Literature pertaining to the relationship of student attitudes to output of the educational system is also assessed. A theoretical foundation for variables retained as indicators for this study is established by identifying those inputs

which have been found in past studies to be significant. In order to achieve the goal stated in the previous chapter, the Guthrie model for ordering school finance research is explained in detail and is used as an overall framework for this study. Bulcock's resource allocation model is reviewed and is used to augment measurement accuracy in both the cognitive and the affective domains. The research questions to be investigated, as developed from the literature, are then presented.

Production Function Analysis

Quesnay, a French Physiocrat, tried in his **Tableau Économique** to show in quantitative terms the relationships of various parts of the economic system. The Physiocrats, a group of Eighteenth century French economic philosophers, held that all wealth originates in agriculture. Galbraith (1977) observes that, for a long time after Quesnay, scholars dismissed the **Tableau Économique** as an arithmetical curiosity.

Only in the mid-twentieth century was Quesnay's approach redeemed. Samuelson (1951) and Leontief (1953) were among the first economists of this century to

develop input-output analysis in the field of economics. Baumol (1961) developed mathematical models of the internal economies of organizations. Leontief's inter-industry analysis was fashioned much along the lines of Quesnay's work. Its wide acceptance won him the Nobel prize for economics in 1973.

In economics, input-output analysis is the name given to the attempt to empirically analyze production (Baumol, 1965). Investigators seek to measure what is produced and the quantity of each intermediate product that must be consumed in the production process, given the quantity of resources available and the state of technology. Input-output analysis is devoted to empirical investigations. It also seeks to take into account the interdependence of resources at varying stages of the production process. The output of one industry is often the input of another. This type of relationship is pursued later in an educational context.

Production functions are based on a number of related economic concepts. These concepts are

microeconomic[4] in origin and thus pertain to economic theory as it relates to an individual firm. The most relevant of these concepts are reviewed to provide the reader with necessary theoretical background.

In a traditional economic sense, firms produce goods to make profits. Revenues are compared to costs at each level of output and the production levels are chosen that allow the firms to maximize profits. The firms' costs are dependent on the prices they have to pay for their inputs, on the technical possibilities of combining these inputs, and on the skill of management combining them.

Production function theory, from an economic perspective, is essentially a guide for firms to allocate resources for set levels of production. Typically, different combinations of resources allow a firm to produce the same level of output. A firm's production function essentially describes its various technical production possibilities. A fisherman, for example, uses labour, nets, a boat, motor, bait, and various technological aids to produce a catch of fish.

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[4]Microeconomics is the study of economics as it relates to the individual or to a single firm.

As a producer, the fisherman has a fairly good idea of the technological connection between his input and his output. In other words, he has a good idea of what his production function looks like. Of course there are many factors impacting on the fisherman beyond his control such as size of sustainable yields of fish stocks, government policy, and climatic conditions.

As technology changes or the combination of resource inputs changes, the production function changes. Ayres (1944) argued that production relationships are frequently altered by changes in technology. If one accepts this approach, it might be reasoned that a production function might have greater short run than long run applicability, particularly in today's society since technological advances can quickly alter how resources are related or combined to produce outcomes. Drummond (1976) argues that in principle it is possible to measure the production function for every good and service produced by all firms at any particular moment in time.

Economists assume that if a firm uses only two inputs to produce one output, that one can draw a picture of that firm's production function. The fish

processor who wants to produce 200 tons of fish per year could produce that much fish using a high level of labour input or a high level of capital input.[5] Economists often identify a negative relationship between labour and capital. The greater the capital investment in an enterprise then the lower the labour/capital ratio.

Since the fish processor knows what his production function looks like, he can choose the least-cost method to produce his 200 tons of fish. It can be seen in Figure 2.1 that a fish processor could produce 200 tons of fish using a variety of resource input combinations. The line drawn to connect the various resource combinations represent an equal product line.

If a producer were to use an increasing amount of one resource input and a fixed amount of the other resource input, at some point returns from the variable input would diminish. In the example of a fish processing plant this could be caused because too many workers would eventually get in each other's way or

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[5] The operative definition of capital here is economic in nature and refers to any good or product that goes into the production of a final good or service.

there may not be enough production processing tables for everyone to work at full capacity. The labour/capital ratio or resource combination would be less than optimal. Thus, we observe that the fish processor would have achieved a diminished return to resource inputs.

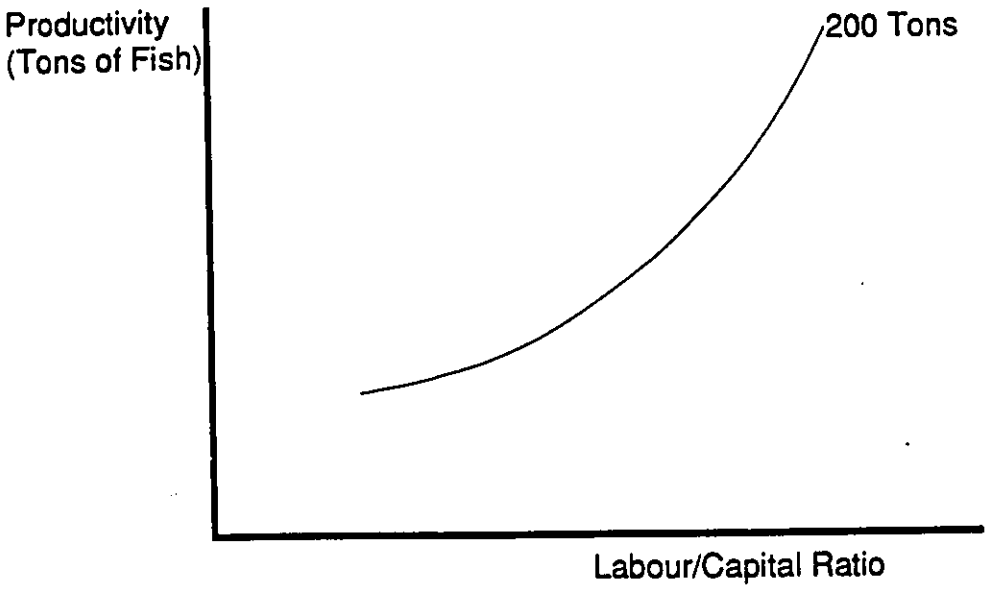

Figure 2.1

Fish processor's production function.

Baumol (1965) makes this general statement in support of that concept:

> As more and more of some input, *i*, is employed, *all other input quantities being held constant*, eventually a point will be reached where additional quantities of input *i* will yield diminishing marginal contributions to total product. (p. 254)

Economists (Baumol, 1965; Drummond, 1976) argue that production functions could help producers determine optimal resource allocations for any particular output level. Similar analogies can be made for resource allocation in the field of education. Monk (1981) states:

> By arguing that educational processes are analogous to industrial processes, analysts in recent years have drawn on economic theory to guide efforts to estimate the relationships between the provision of school resources and the production of educational outcomes. Collectively, these studies comprise the educational production function literature. (p.225)

The analogy between industrial output and educational outcomes can also be challenged by contrasting the production processes of both sectors (Macphail-Wilcox &

King, 1986). One of the underlying assumptions of production function studies is that industries have systems properties. Educational production function analysis is taken from economics. It is similarly based on the assumption that the production of education could be analyzed by treating the educational outcomes (outputs) as a function of various combinations of resource inputs.

Many of the studies conducted on education use linear multiple regression analyses (Bowles, 1970; Bowles & Levin, 1968; Brown, 1972; Brown & Saks, 1975; Burkhead, Fox, & Holland, 1967; Cohn, Millman, & It-Keong, 1975; Hanushek, 1972; Katzman, 1968; Levin, 1970; Link & Mulligan, 1986; Michelson, 1970; Summers & Wolfe, 1977; Walberg & Fowler, 1987). Many studies of this genre utilize economic analyses in the treatment of variables.

Mollenkopf and Melville (1956) completed the first production function analysis applied to the production of education. Their sample included more than 8,000 grade eight students and more than 9,000 grade nine students. Outcome measures in their study were student scores on aptitude tests and achievement tests.

Thirty-four independent variables were retained to represent school inputs. The variables used as predictors were those which the researchers felt were most likely to describe the production of educational outcomes. Data in their study were analyzed using stepwise multiple regression techniques. This procedure analyzes predictors from most significant to least significant in terms of the contribution to the explanatory power of the model. Significant relationships were found to exist between their student achievement measures and instructional spending per pupil, number of special staff personnel, average class size, and pupil-teacher ratio.

Thomas (1962) constructed a production function which used longitudinal data. His study pursued the relationship between student achievement and families of variables representative of home, school, and community characteristics. He found significant relationships between student achievement and beginning teachers' salaries, number of volumes in the school library, and teacher experience.

Kershaw and McKean's (1967) use of achievement measures for input-output analysis in education

advanced this field of research in education. Data such as the size of the library, availability of counsellors, class size, teacher qualifications, and per pupil expenditures were used as input measures. The resulting analyses were then used as guides for more efficient allocation of resources in the educational system.

Thomas (1967) suggested statistical control of appropriate background variables in order to identify low-productivity and high-productivity schools. He outlined the following procedure:

1) A fairly large number of schools or school systems are randomly selected.
2) Census type data are gathered from the environment of the educational system. (e.g. income, parental education, occupation)
3) The relationship between achievement and background variables is analyzed using regression techniques.
4) Then a regression line, relating achievement to a set of background variables is drawn. (p. 15)

The above procedures, or close approximations thereof, were used for many of the studies completed over the next several decades (see Appendix A). It appears that Thomas' interpretation is somewhat imprecise in that regression lines are usually restricted to simple models with one predictor variable. His fourth step outlines a procedure that relates to a set of background variables.

One of the difficulties in allocating resources to schools is the inability of researchers to accurately identify which resources promote the greatest achievement gains for students. This efficiency approach to resource use is becoming more crucial as access to societal resources becomes increasingly difficult. Greater efforts are made in recent years to achieve **Pareto Optimality**. This describes an economic condition in which resources are redistributed in the economy in such a way that output is increased without making anyone worse off. In essence, it entails moving resources from less to more productive uses while not disadvantaging any particular segment of society.

As mentioned in Chapter One, input-output models of this nature are used to help educators determine how

to allocate resources more effectively within the school system (Monk, 1984; Rossmiller, 1978). Input-output models take various forms but for the most part are usually expressed as mathematical equations, often referred to as production functions. A production function is a mathematical equation used to relate an input or series of inputs with an output (Gilman, 1988).

Thomas (1971) advocated the application of microeconomic analysis to the study of the internal operation of schools. He suggested the use of marginal concepts to education. He stated:

> The essence of the analysis is the study of the effect of small changes in the independent variables (inputs) on the dependent variables (outputs). These changes are called marginal changes, and the analysis is referred to as marginal analysis.(p. 63)

Thomas intended for his production function to apply to a school (or at least a classroom) as the unit of analysis. He went on to make the argument that the law of diminishing returns might apply in education as it does in industry. At the school level, Thomas pointed

out that the largest single task of a school principal was the allocation of student time and teacher time. Since teacher time is the single most expensive resource in educational systems in North America, the more effectively a principal can allocate this resource then the greater will be the marginal return to that resource.

The most well known production function study, and perhaps the most controversial, is the Equality of Educational Opportunity Report or the Coleman report (Hanushek, 1986). Reaction to the findings of the Coleman report spurred research in what had previously been an obscure and specialized branch of educational research (Cohn, 1979). Its indictment of school effectiveness stimulated interest in all areas of educational research. It is reviewed here to provide the reader with additional understanding of why this study was considered important in this field of research.

Coleman et al. (1966) studied 645,000 students in the United States, geographically dispersed and well distributed by school size and type. Ninety-three input variables and 10 outcome variables were initially

obtained from the data. Coleman attempted to determine how school and non-school variables relate to achievement. The results indicated very little association between school factors (taken singly or collectively) in comparison to non-school factors. Cohn (1979) contends the Coleman report was unique because of the size of the sample, number of variables investigated, number of research associates, wideness of distribution of the sample, and the volumes of data gathered.

A review of literature for the first decade after the Coleman report indicates its enormous effect on research in the area of school effectiveness. Studies criticizing Coleman's methodology and conclusions (Bowles & Levin, 1968; Bowles, 1970; Hanushek, 1972; Levin, 1970; Michelson, 1970;) and some study supporting Coleman's conclusions or certain aspects of the Coleman report (Jencks et al., 1972) dominate efforts during the next decade.

Hanushek (1986) states:

> Even though it remains the most cited analysis of schools, the Coleman Report is commonly held to be seriously flawed, and its

> importance is more in terms of intellectual history than insights into schools and the educational process. (p.1150)

Pedhazur (1982) also criticizes the Coleman et al. (1966) approach (variance partitioning). Cohn (1979) contends the Coleman report warranted criticism from three perspectives: 1) uncertainty whether the measurements used were sufficient for the task; 2) handling of the data was imprecise; and 3) the regression techniques were used in a way to prevent any strong showing by school factors.

The Jencks et al. (1972) study is also flawed even though Jencks et al. used path analysis. The variance partitioning approach used by Coleman et al. (1966) fails to deal with the problem of collinearity and captures only direct or main effects. The weakness of Jencks' et al. approach was that it failed to consider the indirect effects. The technique to consider the indirect effects was not known in the early 1970's when Jencks et al. completed their study. The result of Jencks' et al. inability to consider the indirect effects was that they completely underestimated the impact of education on future income. Jencks et al.

also failed to examine the interaction effects in that they failed to consider the fact that the relationship between education and income depended on the occupation of the individual. While the Jencks et al. study has substantially greater validity than the Coleman et al. study, neither used measurement modelling such as confirmatory analysis to reduce the measurement error.

The earliest attempts to derive policy were often based on flawed studies such as the Coleman Report or the Jencks' study. Since some of their findings were inaccurate, many of the policies formulated as a result of those studies did not have the intended effect. This led to much, perhaps deserved, criticism being made toward use of educational production functions as a policy tool. Educators and economists attempted to improve their resource allocation techniques over the past two decades. Attempts were aimed at improving the overall efficiency of the educational system. A review of a number of input-output analyses is completed to distinguish among various approaches. A number of these different approaches are reviewed below.

Thomas (1971) argues that the term "function" indicates mathematical dependence. In education, he

explains, performance increments are related to inputs of student time, teacher time, equipment, and space. The assumption in this view of production functions is that larger increments of student time in mathematics will result in higher outcomes in mathematics. Thomas argues that educational practice is based on an implied production function. He defines 'value added' in an educational context as the amount of additional learning that takes place at each stage of the process. His conception of a generic educational production function is one that measures increments to learning over some period of time. His production function is stated in the following manner:

$$p^1 - p = f(x_1, x_2, x_3, x_4, x_5)$$

p^1 is performance at time $p + 1$; p is performance at time p; x_1 is student hours; x_2 is teacher hours; x_3 is equipment; x_4 is space; and x_5 represents unidentified variables. In this conception of a production function, the totality of inputs is the environment to which the student is exposed. Thomas' approach is similar to other constructions of production functions as can be seen below.

Levin (1974) develops an equation which he

represents as a generic form of an educational production function. Educational achievement in his equation is a function of the student's family background, school variables, neighbourhood variables, and individual characteristics. It takes this form:

$$A_{it} = g(F_{i(t)}, S_{i(t)}, P_{i(t)}, I_{i(t)})$$

In this equation each of the above values means the following:

A_{it} = the educational outcomes for the student$_{it}$ at time t.

$F_{i(t)}$ = the student's family background characteristics cumulative to time t.

$S_{i(t)}$ = school inputs pertaining to the ith student cumulative to time t.

$P_{i(t)}$ = neighbourhood and peer characteristics cumulative to time t.

$I_{i(t)}$ = initial cognitive endowments of ith student cumulative to time t.

Levin's education production function is somewhat similar to those formulated by individual entrepreneurs of industrial firms in that it represents what one, as an educator, feels affects educational outcomes.

Levin's model is what economists call a static

model in as much as it represents a snapshot of educational production at a particular moment in time. Murnane and Phillips (1981) develop a dynamic framework which allows researchers to use longitudinal data in their analysis. Another addition to the Levin model by Murnane and Phillips is their treatment of vectors of student characteristics. These vectors represent families of variables which can be introduced into the analysis simultaneously. The Murnane and Phillips model is presented below:

$$A_t = a + bA_{t-1} + cD + dF_t + fP_t + gS_t + hT_t + e_t$$

These mathematical symbols represent the following:

A_t = human capital at the end of a particular school year t.

A_{t-1} = human capital at the end of the previous school year (t-1)

D = a vector of the child's demographic characteristics

F_t = a vector of family characteristics in year t.

P_t = a vector of neighbourhood and peer characteristics in year t.

S_t = a vector of school characteristics in year t (excluding teacher characteristics).

T_t = a vector of teacher attributes in year t.

e_t = an error term that was considered to be normally distributed with zero mean and constant variance.

Other researchers try different approaches to the problem of analyzing production. Phillips and Marble (1986) pursue research employing a Cobb-Douglas production function[6] in which they examine the effect of education on farm productivity. In its simplest form they show the Cobb-Douglas production function to be:

$$Y = a\ {}_{i=1}xbi_ie^r$$

where Y is the output; x is the physical input; b is the elasticity[7] of Y with respect to X; and e is the

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[6]A Cobb-Douglas Production Function is one that is based on the assumptions that the production function is linear and homogeneous, i.e., that it yields constant returns to a proportionate increase in the use of all inputs. See Douglas, P.(1934). **The theory of wages**. New York: MacMillan.

[7]Elasticity is a term employed by economists which relates the responsiveness of one factor to changes in a different factor. The elasticity of Y with respect to X can be defined as the percentage change in Y divided by the percentage change in X (where the elasticities are calculated at the point of the means of each of the dependent variables).

error term. Education is seen in this function as one of the x_i inputs. Using this production function, if the resulting elasticity for education is found to be positive and significant, then it could be said that education had a positive effect on productivity. Other farmers are then compared with the frontier production to determine how efficient or inefficient their operations are. The Phillips and Marble construct is known in economic literature as a frontier production function. A similar approach in effective schools research would attempt to identify the characteristics that would make a school most effective.

Sengupta and Sfeir (1986) apply similar techniques to construct a frontier production function for schools in California. They state their production functions for schools as follows:

$$Y = f(q, A_s)$$

where q is the quality available; s is the size as measured by enrolment; and A is the augmenting value depending on quality and time. Here the cost of increasing the quality variable is an increasing function of q and s. Sengupta and Sfeir point out that it is clear that the total cost of schooling would be

minimized by expanding the school until the increase in quality improvement cost associated with adding one more student is just offset by the decrease in average instructional costs due to adding one more student. This would be the point where marginal cost[8] is equated with marginal revenue[9] in economics terminology.

Man and Inman (1984) state that a production function is an equation specifying how inputs combine to produce outputs. Their model assumes that one can discover what makes a difference in school effectiveness by examining how inputs are combined with school factors. The main objective is to determine the best combination of inputs to optimize schooling output production. Man and Inman use the following simple production function:

$$Y = f (x_1, x_2, x_3, x_4, x_5, x_6)$$

where Y is achievement; x_1 represents teacher characteristics and behaviour; x_2 represents administrator characteristics and behaviour; x_3 is

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[8]Marginal cost is defined as the addition to the total cost of a product of producing one additional unit of that product.

[9]Marginal revenue refers to the additional revenue produced by producing and selling one additional unit of a product.

student body composition; x_4 is student learning climate; x_5 is pupil evaluation; and x_6 represents curriculum materials. Theoretically, this production function can be used to determine the impact of these factors in a school considered to be instructionally efficient. The Man and Inman form is much like earlier models developed by Thomas (1971) and Levin (1974). While the construction is similar, it is worth noting the evolution in the factors investigated. In the Thomas construction all of the variables were observed, whereas the Man and Inman approach has included factors in the affective domain, such as learning climate.

Many attempts have been made to improve understanding of resource allocation and its relationship to the efficiency of schools over the past several decades. One of the most cited research efforts in this regard is the Rutter, Maughan, Mortimore, and Ouston (1979) study **Fifteen Thousand Hours.** They completed a longitudinal study of inner London schools located in six London boroughs. Their title represents the total time students spend in school from the time they enter school at age five until normal school leaving age.

Results of the Rutter et al. (1979) study contradict findings of previous studies such as Coleman et al. (1966) and Jencks et al.(1972), which claim that schools do not make any difference. Their findings show that schools differ markedly with respect to pupil behaviour, attendance, exam success, and delinquency. A second finding of their study is that these variations in outcomes are systematically and strongly associated with the characteristics of schools as social institutions. As well, their research shows which school variables are associated with good behaviour and attainments, and which are not. A fourth finding of their research suggests that pupils are influenced by the way they are treated as individuals and that there is a group influence resulting from the ethos of the school. However, the Rutter et al. study was flawed in that contextual variables (higher order units of analysis such as classrooms and schools) may have been under-represented. The statistical technique did not take the hierarchical data structure into account.

Some researchers note that although the production function model is used extensively in research on school productivity, the models used do not yield much

information about how resource inputs are converted into educational outcomes (Rossmiller, 1982). Rossmiller notes that many researchers draw on general systems theory to describe the educational production process in greater detail.

Deller and Rudnicki (1993) completed a study of production efficiency in elementary schools in Maine. They utilized a series of standardized achievement tests that have been administered annually since 1986-87. The Maine Educational Assessment program tests six subject areas (writing, reading, mathematics, science, social studies, and humanities). The average test scores over a three year period (1986-87 to 1988-1989) were their measures of student output. Inputs included family influences, peer influences, and school inputs. Deller and Rudnicki report findings consistent with earlier studies that found that family and peer influences, both non-controllable resources, may be the most important determinants of student achievement in the state of Maine. Deller and Rudnicki differentiated in their study between those resources which were manipulable and those which were not.

Economic studies of elementary and secondary

schooling primarily concentrate on production processes and public finance questions involving government funding. Even though the educational process is extensively researched, clear policy prescriptions are difficult to derive (Hanushek, 1986). In economic analysis the assumption is made that all inputs can be varied freely. The reality differs considerably in the education process. The educational production function is unknown to both decision makers and researchers, and has to be estimated using imperfect data. Furthermore, some important inputs into the educational process cannot be changed - at least not in the short run - by decision makers.

The demand for educational reform results in many educational changes. To increase efficiency and equity, particularly in an era of constricted fiscal and human resources, requires a redistribution of available resources (MacPhail-Wilcox & King, 1986). Effectiveness is an operational standard having to do with the degree to which goals are attained. Models of institutional effectiveness that employ systems properties are less widely used in education (Katz & Kahn, 1978). This may be a result of trying to impose system approaches to

the production of educational outcomes when the adopted models do not sufficiently describe the educational process.

Standardized tests are the most commonly used measures in investigating the educational process (Hanushek, 1986). Performance on tests is used to evaluate programs (Levin, 1971) and to allocate funds (Banta & Fisher, 1984; Sie, 1973). Hanushek (1986) says that besides their common availability, test scores appear to be valued in and of themselves. He adds that:

> Parents and decision makers appear to value higher test scores ... at least in the absence of evidence that they are unimportant. In fact, the use of standardized tests as criteria for high school graduation (usually referred to as minimum competency testing) has increased dramatically in recent years and now is mandated in many states... At the individual level, test scores related to ability or achievement have obvious appeal.(p. 1152)

Thus while standardized tests might be the most accurate indicators of achievement to use in production function construction, they are available and are a

reasonable proxy as an outcome measure. On the other hand, Hanushek (1986) claims that some people, including many school practitioners, reject production function research entirely because they believe that educational outcomes cannot be adequately quantified.

Efficiency, in economic terms, is concerned with acquiring additional marginal output for each unit of input by altering either the input or output conditions (Johns, Morphet, & Alexander, 1983). The conception of Johns et al. is similar to the marginal analysis of Thomas (1971), as referenced earlier. Cohn (1982) says the efficiency of any enterprise is measured by the ratio of output to input. School districts which generate more output, higher achievement levels and more graduates, are regarded as the more efficient districts assuming of course that inputs are equal. Educational outputs are classified in a number of different ways: cognitive and affective; short-term and long-term; pecuniary and non-pecuniary.

Long-term output of the educational system is a concern of the branch of economics of education known as human capital theory (Becker, 1975). Short-term outputs of the educational system include cognitive,

affective, and psychomotor achievement; possession of basic knowledge; exhibits of intellectual and management skills; demonstration of analytical capabilities; displays of values, attitudes, and aspirations (Rossmiller & Geske, 1976).

No progress in improving educational efficiency is possible unless one attempts to analyze the educational production process, to model the relationship between inputs and outputs, and to find the means by which outputs per unit of input can be increased (Cohn, 1982). Input-output models are based on the assumption that schools have attributes. These analyses employ research strategies to measure educational outcomes. If differences in student achievement are identified, attempts are made to identify the sources of the differences (Gilman, 1988).

Rossmiller and Geske (1977) develop perhaps the earliest general systems theoretical model for economic analysis of schooling in which the school is viewed as a system amenable to economic analysis. Their model, shown in Figure 2.2, includes four major components: 1) resource inputs into the system; 2) the formal educational system and processes associated with

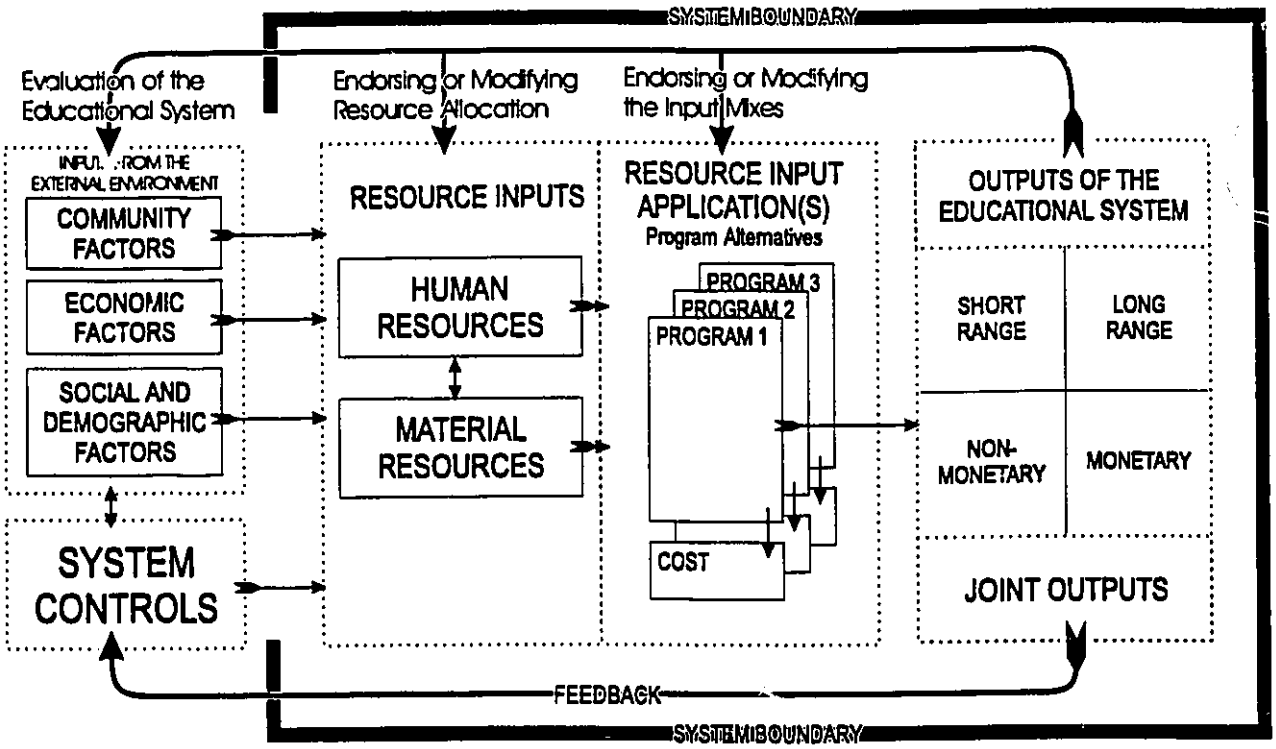

Figure 2.2
Rossmiller & Geske general systems model for schooling.

that system; 3) outputs of the formal schooling process

measured in short and long term; and 4) a feedback loop since their model is constructed in the open systems model tradition. While the Rossmiller and Geske (1977) model organizes the economic analysis of schooling, the more recent work by Guthrie (1988) allows for a current treatment of the educational production function approach.

The present study is organized using the model suggested by Guthrie (1988) as an overall framework to investigate the research questions as outlined in Chapter One. Variables retained for study are classified consistently with Guthrie's input, process, and output variables. Guthrie's model is explained in detail in the next section.

The Guthrie Model for School Finance

As mentioned in Chapter One, the Guthrie (1988) model for ordering school finance research is based on earlier social system models developed by Parsons (1960) and Easton (1965). His model is formulated as an overall means for ordering variables for meaningful analysis. He argues that the field of education finance has proliferated to the point that a general model is

needed to lend organization to the field.

The Rossmiller and Geske (1977) model is somewhat similar to the later Guthrie model. Their model, while fashioned in the open systems approach, is less comprehensive than the Guthrie approach. The Guthrie model differs substantially from that of Rossmiller and Geske (1977) because the conversion processes for transforming inputs into outputs receive more attention.

As can be seen in Figure 2.3, the educational subsystem in the Guthrie model is part of the overall social system. Educational inputs are converted through the educational process into outputs. As in all open system models, there is a component which allows for feedback from the environment in which the organization functions. Guthrie's model has four major components as did the Rossmiller and Geske model.

Resource inputs to the Guthrie model include students, faculty, facilities, and funds. These are provided to the subsystem by the social system in which the educational subsystem operates. These are the resources of the educational subsystem. The endowment of these inputs is related to the wealth of the

province or state and the local school area.

Guthrie's conversion sector includes processes at the policy-institutional level, at the managerial level, and at the technical-operational level. Actions at the policy-institutional level include legislation passed at the state level or policy and by-laws enacted at the school board level. Managerial actions are school level resource mix decisions made by the principal or the school administration team. Technical-operational conversions are actions taken by teachers in individual classroom settings.

Outputs of the Guthrie model are streamed into immediate and downstream outputs. Downstream outputs of the educational system are what Becker (1975) defines as human capital. Immediate outputs that Guthrie includes are achievement, attendance, and attitudes. Educational researchers sometimes include attitudes simultaneously as both inputs to and outputs of the educational production process (Bulcock, 1989).

Environmental feedback in the Guthrie model is divided into societal demands and supports. Community or societal support that Guthrie outlines takes the form of resources and personnel. These resources are

represented in the educational subsystem as educational inputs.

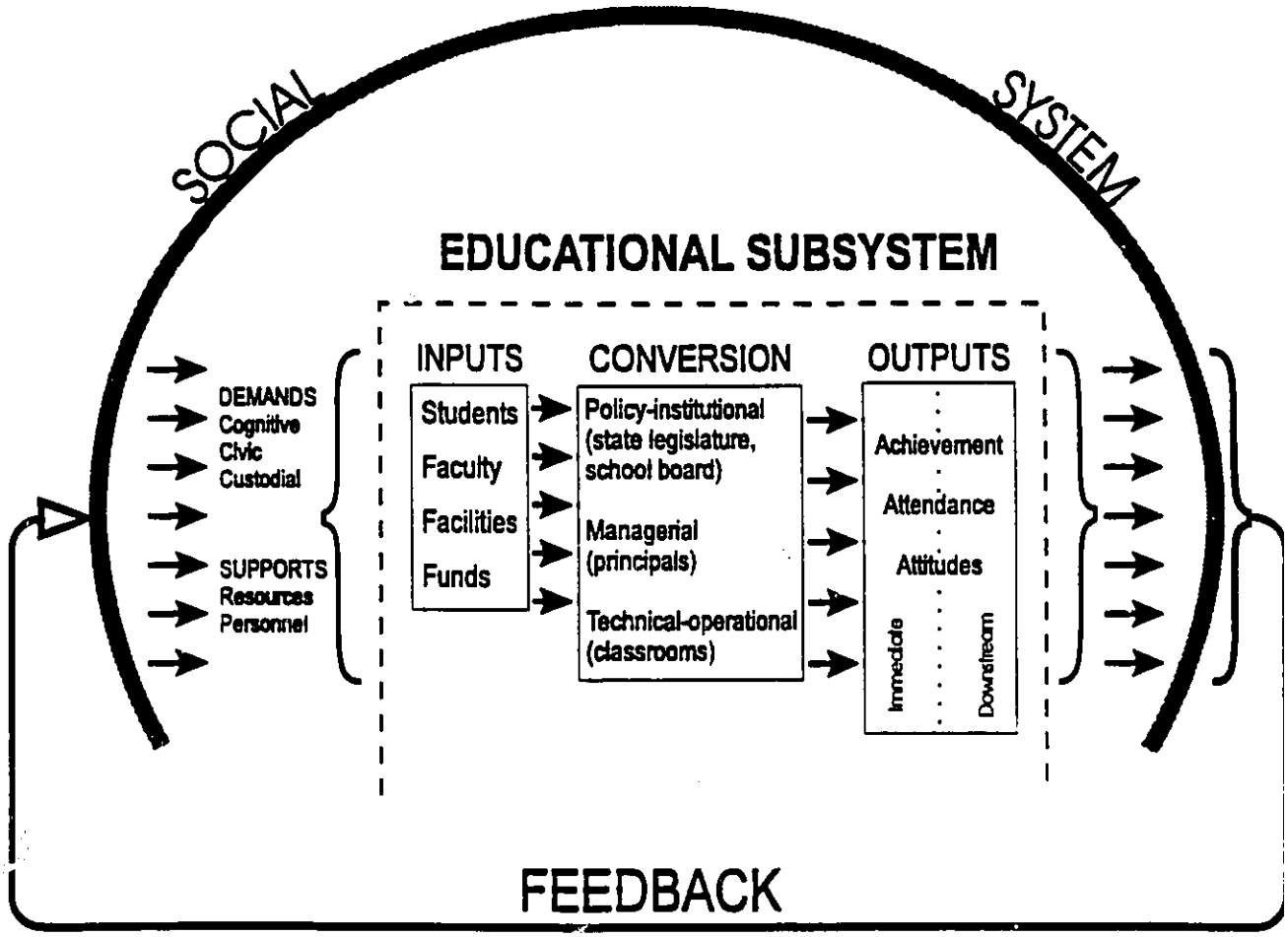

Figure 2.3

Guthrie's model of educational finance.

Demands from the social system include cognitive, civic, and custodial aspects. Cognitive demands are represented through expectations that students obtain

basic skills and knowledge. The educational institution certifies the levels and standards of those who graduate from their institutions. Other demands illustrated in the Guthrie model are included in the civic and custodial domains.

Guthrie (1988) states that as a large number of social scientists become interested in questions of school effectiveness, more precise models of school effectiveness are constructed. He cites the 1975 Murnane study and the 1979 Rutter et al. study as seminal in leading to new findings in the relationship between schooling and student achievement. The results of their findings restore public confidence in schooling about a decade after the indictment made by the Coleman report.

While Guthrie (1988) is critical of the accountability movement of the 1960's and 1970's, he points out that one useful result is an improvement in the general area of achievement testing and assessing pupil performance. Madaus, Airasian, and Kelleghan (1980) note that even though the results from achievement measures are far from ideal for public policy purposes, national, and state-wide testing

programs contribute usefully to the ability to measure school outcomes. This increased accuracy is partly the result of economic techniques being applied to education with increasing ingenuity (Guthrie, 1988).

Some of the criticism levelled at the application of management- and economics-oriented techniques to education is brought about by overzealousness on the part of well-meaning academics and school administrators (Guthrie, 1988). He points out that public-sector use of such programs as Program Planning Budgeting Systems (PPBS), Program Evaluation and Review Technique (PERT), Management by Objectives (MBO), and Competency-Based Teacher Education (CBTE) training programs suffers from questionable applications. These various plans, he notes, assume an agreement on and ability to measure school outcomes and the existence of techniques to control for outside influences that far exceed reality. Programs and technocratic strategies based on these plans yield negative results and in some cases dismal disutility (Kirst, 1975). Bossert (1979) concurs with this view. It seems that researchers applying these techniques in education ignore the

ceteris paribus[10] assumptions made by economists who employ them. To use present day analysis, one would say that the production function models were not a good fit or did not capture enough reality of the system to produce meaningful results.

Recently, more accurate predictive models are developed utilizing affective inputs (Bulcock, 1988a; Whitt, 1989). These models utilize research emanating from the effective schools research and are built around quality of school life work explored by Epstein and McPartland (1976) and Williams and Batten (1981). Many similarities exist between the Guthrie (1988) model for ordering study in the school finance area and the Bulcock (1989) model for studying the relationship between resource use and achievement. The Guthrie model and the Bulcock model are consistent in construction and are compatible to use within the one framework.

In the same way as the Guthrie (1988) model provides a useful mechanism for ordering school finance research, Bulcock's (1989) resource allocation model

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[10]*Ceteris paribus* is a Latin term frequently employed by economists to indicate the assumption that all variables other than those directly referenced remain the same. Freely translated it means other things being equal.

permits relatively easy operational measurement in a parallel fashion. Bulcock's resource allocation very closely resembles the educational subsystem of the Guthrie model. Bulcock's model deals in very great detail with attitudes both as inputs and outcomes of the educational process. His model is explained in greater detail below.

Bulcock Model of Educational Resource Allocation

Many of the studies completed since the production function approach has been applied to education report a strong relationship between SES variables and student achievement. Benson (1982) is one of the first to attempt systematic explanation of how SES factors affect school learning. His study tries to account for out-of-school influences on school learning. Bulcock's (1988a; 1989) work takes this approach to an even higher level of analysis in that it allows for a multi-level treatment of resource inputs. Bulcock combines approaches from the sociological tradition with those that employ economic analysis. His research takes the route advocated earlier by Monk (1981) by pursuing a multilevel perspective of resource allocation. Monk

contends that resource decisions at one level of the educational system affect and constrain decisions at other levels.

Bulcock (1988a, 1988b, 1989) has conducted much research relating the quality of school life to student achievement. Most Quality of School Life (QSL) research is completed by psychologists in the schooling satisfaction tradition. Bulcock (1988a) states that the basis for their work is the job satisfaction theory developed by Herzberg (1962). Herzberg holds that productivity is responsive to the morale of workers. Educational psychologists argue that school achievement is responsive to student morale and is measured by school attitude or liking for schooling.

An additional advantage of employing the Bulcock approach is that a great deal of his published research has been conducted using the Newfoundland population as a study group. His advances include more accurate measurement techniques based on improved sampling and higher order definitions of variables. Bulcock's definitions of rural and urban areas, census agglomerations, and many other frequently used sociological variables are widely adopted by

researchers in the province of Newfoundland.

Bulcock's (1989) resource allocation model links three broad groups of constructs in a schematic design that is characteristic of the structural modelling tradition. The groups of variables to the left of Figure 2.4 (X_9, X_{10}, X_{11}, X_{12}) are treated as exogenous variables and are seen to influence all that lie to the right of them. All other groups are endogenous variables whose variations are explained within the model. Variable groups are influenced by all others lying to the left of them. The relationships between endogenous constructs not separated horizontally are hypothesized to constitute multiple feedback systems. In this model the feedback parameters are not estimated, since Bulcock contends the estimation of non-recursive structural equations is fraught with problems attributable to non-orthogonal data and their attendant multi-collinearity problems.

The following structural equations describe the model.

$$X_8 = b_{8,12} X_{12} + b_{8,11} X_{11} + b_{8,10} X_{10} + b_{8,9} X_9 + e_1$$

$$X_7 = b_{7,12} X_{12} + b_{7,11} X_{11} + b_{7,10} X_{10} + b_{7,9} X_9 + e_2$$

$$X_6 = b_{6,12} X_{12} + b_{6,11} X_{11} + b_{6,10} X_{10} + b_{6,9} X_9 + e_3$$

$$X_5 = b_{5,12} X_{12} + b_{5,11} X_{11} + b_{5,10} X_{10} + b_{5,9} X_9 + e_4$$

$$X_4 = b_{4,12} X_{12} + b_{4,11} X_{11} + b_{4,10} X_{10} + b_{4,9} X_9 + e_5$$

$$X_3 = b_{3,12} X_{12} + b_{3,11} X_{11} + b_{3,10} X_{10} + b_{39} X_9 + b_{38} X_8 + b_{37} X_7 + b_{36} X_6 + b_{35} X_5 + b_{34} X_4 + e_6$$

$$X_2 = b_{2,12} X_{12} + b_{2,11} X_{11} + b_{2,10} X_{10} + b_{29} X_9 + b_{28} X_8 + b_{27} X_7 + b_{26} X_6 + b_{25} X_5 + b_{24} X_4 + e_7$$

$$X_1 = b_{1,12} X_{12} + b_{1,11} X_{11} + b_{1,10} X_{10} + b_{19} X_9 + b_{18} X_8 + b_{17} X_7 + b_{16} X_6 + b_{15} X_5 + b_{14} X_4 + e_8$$

Four sets of variables are identified as community size/isolation, school status, community status, and classroom configuration. These variables influence five sets of student responses to the organizational structures of the school shown as the opportunity to learn, adventure in learning, student identity, student status and perception of teachers, all of which in turn influence schooling outcomes. A set of schooling outcomes, notably reading and mathematical competencies, and student well-being. Each of these sub-aggregated models is constructed to permit more precise analysis of variables found to be accurate predictors in previous studies.

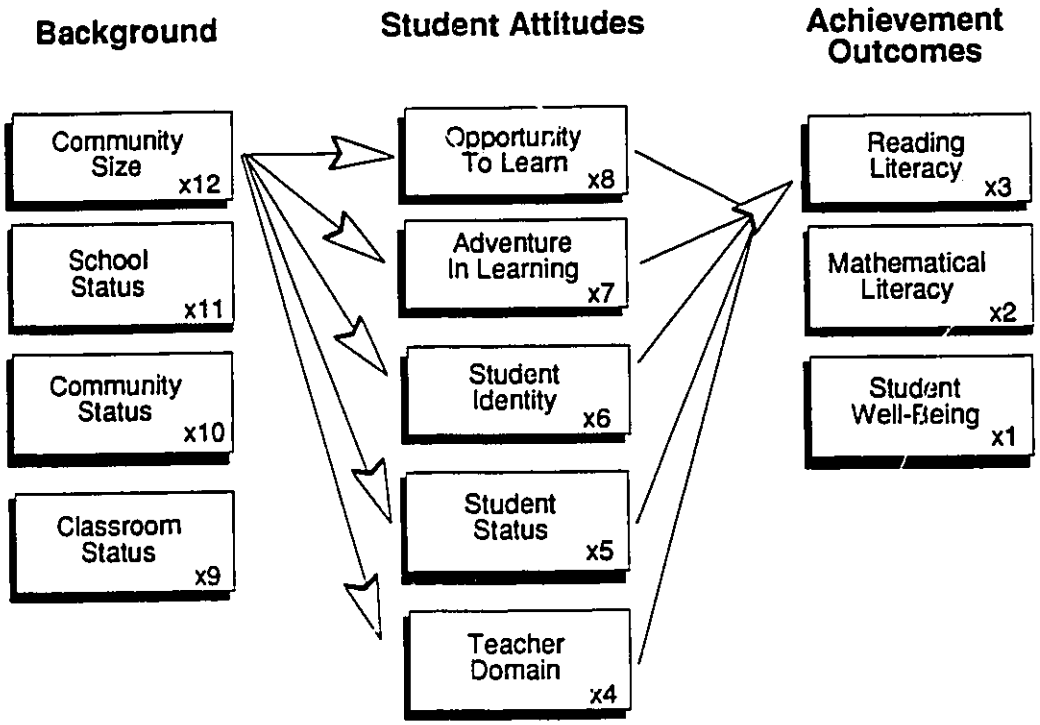

Figure 2.4
Bulcock basic resource allocation model.[11]

The variables used by Bulcock (1989) in his model are consistent with those variables described by the conversion portion of the Guthrie (1988) model. These variables are found to be significant predictors of educational outcomes. Guthrie cautions that educational finance research is proliferating as an area of study. Thus one of the strategies derived from

[11]It should be noted by the reader that only some of the paths are presented in this resource allocation model for the purpose of simplicity of presentation.

his concern is the potential to limit the number of variables retained in any particular study to permit meaningful analysis.

One of the main advantages offered by the addition of the Bulcock (1989) model to the Guthrie (1988) model stems from the fact that Bulcock's model incorporates a more comprehensive treatment of the affective domain. The student attitude component permits researchers to measure the effect of student attitudes on student outcomes. By using path techniques and structural equation modelling, his analyses permit partitioning of the variance in outcomes attributable to student attitude.

Background variables used in the Bulcock (1989) model are those found to yield significant results as input variables. These variables are categorized at the community, board, school, and classroom levels. His model concentrates on alterable variables; but at the same time he cautions that unalterable variables cannot be ignored in estimating the effects of the more manipulable policy influences. Some purchasable inputs such as teacher salaries, numbers and deployment of support staff, and transportation contracts are not

readily alterable in the short-term.

The student attitudes component of the Bulcock (1989) model is developed in the quality of school life research throughout the 1970's and 1980's. His model is based mainly on the Williams and Batten (1981) approach. Bulcock's main extension to their QSL approach is to add a teacher dimension.

Worthen, Borg and White (1993) point out that reliability coefficients for the QSL scale are reported as ranging from .86 to .89. Concurrent validity estimates were developed by comparing QSL scores on a large number of criterion measures of school activities, school evaluations, family experiences, and student aspirations. They claim that QSL is more rigorously developed than most school attitude scales and deserves careful consideration.

Bulcock's (1989) model treats students' perceptions towards the organizational structure of the school as alterable variables. Student responses in his model refer to what the schools do to students in the form of exposure to stimuli, expectations, encouragement, and the rewards and punishment which support goal attainment. This whole section of the

model (X_4 to X_8) is designed to measure student attitudes towards their experience within the school environment. He argues from the QSL tradition that schools are organized to meet four sets of societal expectations: expectations regarding the certification of competencies in basic skills; expectations concerning the intellectual and physical development of students; expectations related to the promotion of social integration; and expectations with respect to the development of social responsibility. An assumption of this model is that schools establish both formal and informal organizational structures to promote these expectations. An example Bulcock purports to illustrate these formal structures is an evaluation or certification structure designed to certify grade level competencies. Personal development is promoted through the curricular and instructional system of the school.

Bulcock's premise is that not all students respond to the organizational arrangements of schools as intended. Bulcock labels students' responses to the organizational structure of the school as the opportunity to learn, adventure in learning, student identity and student status. The fifth variable

surveyed includes the student perceptions of teachers as role models. These variables are depicted in his model as x_8, x_7, x_6, x_5, and x_4.

Another underlying assumption of his model is that, as a result of the complex set of influences and dispositions, students develop habits and orientations towards reading and orientations toward mathematics that influence their competencies in these areas. These influences have their roots in the community, the school, and home environments of the students. These blocks of exogenous student variables (x_{12}, x_{11}, x_{10}, and x_9) when analyzed using the QSL measures (x_8, x_7, x_6, x_5, and x_4) as mediating variables, predict in a powerful manner the endogenous outcome variables (x_1, x_2, and x_3) explained within the model.

The analyses permit validation of the relationships through the estimation of model parameters. The model defines the manner in which tabular analyses should be undertaken. These analyses establish the existence of a relationship in each case. Multivariate analysis is employed to elaborate the relationships between the variables with a view to explain why such relationships exist. Bulcock (1989)

makes the general point that a number of the separate concerns about the relationship between available resources and the three schooling outcomes (x_1, x_2, and x_3) can be explained by an explicit model in which the discrete relationships are analyzed in a manner designed to contribute to an informed understanding of what is happening.

Bulcock's emphasis on structural equation modelling means that his findings can be addressed in terms of the causes of individual and group differences at the individual, class, school, or community level. He argues that this should be done not merely because this is an objective of input-output analysis or of the structural equation tradition. Moreover, he suggests that the findings of studies utilizing his model can be used to develop more informed policies that can be used to enhance the reading literacy and mathematics numeracy of all students.

Outcome measures of the Bulcock (1989) model include two cognitive outcome measures -reading literacy and mathematical numeracy- and an affective outcome measure- student well-being and are represented in his model as X_1, X_2, and X_3. As stated earlier, these

outcome measures are endogenous variables. Another reason these variables are retained as outcome measures is that these measures are traditionally accepted as reasonable proxies of valued student outcomes.

Thus the Bulcock (1989) model allows the investigation of lagging achievement levels of Newfoundland students. If one accepts Cohn's (1982) arguments concerning the use of standardized achievement tests and Bulcock's approach to assessment of students' attitudes, then the provincially administered Canadian tests of Basic Skills (CTBS) and the Bulcock Attitudinal Inventory can be employed as measuring instruments to investigate relationships among variables found to be significant in the empirical literature.

An analysis of the data can then be conducted which hopefully can provide increased understanding of the relationship between resource allocation and student outcomes in the province of Newfoundland. Increased understanding can permit researchers to define more effective resource allocation procedures for educators.

As early as 1979, researchers suggested that the

province of Newfoundland had reached the limit of its ability to provide additional resources to the educational sector of the province (Crocker & Riggs, 1979). They illustrated very clearly that Newfoundland's resource allocation per pupil falls substantially below that of the Canadian average but that its effort to fiscal capacity[12] was the highest of any province. Furthermore, Crocker and Riggs argued that the province does not have the ability to increase the educational share of resources relative to other government departments. They state:

> It appears that substantial increases in expenditures are required if we are to offset the effects of inflation and continue to narrow the gap between this province and other areas of Canada. At the same time limitations of our ability to increase expenditures are all too apparent. In a sense, declining enrolment represents the only opportunity to bring about real increases in expenditure per pupil. (p. 68-9)

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[12]Effort to fiscal capacity is an economic measure used to compare the relative importance one jurisdiction places on fiscal spending in a sector compared to another jurisdiction. It measures actual spending against the level of wealth of the jurisdiction.

From an organizational perspective, the only other hope of improving the system in the interim is to improve the efficiency of resource allocation. As mentioned earlier, Pareto optimality becomes a system goal. Resources have to be shifted from less productive uses within the educational system to more productive uses without making any individual worse off. One of the main purposes of the present study is to define more accurate relationships among variables to permit educators to develop more effective ways of allocating resources to the educational process.

The research design utilized in the present study is carefully defined in the next chapter. Variables found to be significant in previous empirical studies are outlined and defined as they are used in this study. The Bulcock (1989) Model of Resource Allocation is retained to organize and lend order to the relationship between dependent and independent variables. Bulcock's Model is utilized with the Guthrie (1988) model as it facilitates operationalization of variables.

Research questions investigating the relationships between inputs (community background variables, school

characteristics, student background characteristics, student linguistic resources, student attitudes) and educational outcomes (measured using indicators for reading, mathematics and student well-being) are organized in a manner which is consistent with both the Guthrie model for educational finance research and the Bulcock model for resource allocation.

The present study seeks to provide increased accuracy in the construction of an educational production function. While many of the input variables are not readily alterable, it is necessary to include these variables in order to understand as completely as possible the relationships among the retained variables. This increased understanding will allow policymakers and educational administrators to substitute purchasable or alterable inputs to compensate as appropriately as possible for those indicators that are not controllable or alterable. Such an approach is consistent with Monk's (1992) assessment of the utility of production function studies. The research design to investigate relationships of resources to student outcomes in the present study is presented in the next chapter.

CHAPTER THREE

Research Design

Introduction

Chapter Three contains information on the design of the study. Variables identified in the review of literature are operationalized. The presentation of variables is organized under input variables, process variables, and output variables.

The design is structured to define as accurately as possible the production relationships between inputs to the educational process and student achievement outcomes. Variables retained are those that have been identified in empirical studies as significant predictors of student achievement outcomes and that have been possible to operationalize in this study. A new variable constructed to measure the relationship between a student's language usage and achievement outcomes is also included in the analyses.

The chapter is divided into three main sections.

The first section describes the population that is studied. It outlines the context in which the study is completed and describes the population studied. The second section contains a description of the variables retained in this study. Input, process, and output variables utilized in the resource allocation model are explained. Operational definitions are provided for the independent and dependent variables. The third section of the chapter contains the data treatment and analysis. Validity and reliability of the measurement model are then explained.

Population

Context of the Study

This study was conducted in the Province of Newfoundland and Labrador during the 1989-90 school year. A public denominational system, funded 95% by the provincial government and 5% by local tax sources, was administered by 32 school boards. These 32 school boards administered all day-to-day operations of the schools.

Denominational educational councils (DECs) representing the major religious denominations,

establish school board boundaries for each denomination. These DECs control and allocate capital spending among boards. Content of religious education programs is also under the control of the DECs. The Integrated Education Council (Protestant) operates 18 school boards, the Catholic Education Council operates 12 school boards, while the Pentecostal Assemblies and the Seventh Day Adventists operate one school board each.

Curriculum within the province is under the central control of the Department of Education: a curriculum division devises programs of study to be followed by all students within the province. Curriculum time allotments, setting time parameters for each subject, are also developed by the curriculum division. All boards are required to ensure that their schools meet at least the minimum time allocations.

The Evaluation and Testing Division within the Ministry oversees norm-referenced standardized testing, criterion-referenced testing at the elementary level, and public examinations for Grade 12. The Division annually administers the Canadian Test of Basic Skills (CTBS) to either grade four, six, or eight students in

the province. For the 1989-90 school year, Grade 8 students were the cohort chosen. Boards were also requested to have their Grade 8 students complete the Bulcock Attitudinal (BAI), a questionnaire designed to measure student attitudes toward school.

Results of testing completed by the Ministry's Evaluation and Testing Division for the 1989-90 school year were made available to the researcher for study purposes. These results were made available in raw data format so as to avoid any statistical anomalies associated with norm-referencing.

Attributes of the population

The population studied was composed of all Grade 8 students in the province of Newfoundland and Labrador for the 1989-90 school year. The study group of 10,146 was comprised of 5,009 female students, 5,137 male students. These students attended 266 schools. Students attending rural area schools totalled 5,294 whereas 4,852 students attended schools located in urban centres.

Grade 8 teachers in the Province were an additional population studied. Full-time teacher equivalents were calculated for each school where grade

8 was taught. Schools were also differentiated structurally on the basis of grades actually taught in each school.

The Variables

Overview of variables

In this study, the proxy variable used for the environmental component consists of three variables that composed community background variables. These are: U_R, a dichotomous variable to indicate urban or rural location; REGION, a categorical variable to indicate one of five regions in the province in which the student lives; and SSEL, a linear composite measure designed to represent the socioeconomic level of the community in which the student lives. It should be noted that these variables are not easily alterable but are included for reasons outlined previously in Chapter 2.

The second component of the Guthrie (1988) model consists of inputs into the educational subsystem in the form of students, faculty, facilities, and funds. In the modified Bulcock model and under the constraints of this study, a number of input variables are

operationalized in this component. Student background variables are age, gender, VOCNR (number of vocabulary items correct on the CTBS test), and LCODE (a continuous variable constructed using Bernstein's Theory of Language Discontinuity as a guide). School level variables are comprised of student teacher ratios, full-time teacher equivalents, and enrolments. A proxy measure for facility is found in the variable that describes the school type in which the student studies.

The attitude component in the present study is composed of five input quality of school life measures as advocated by Bulcock. The five input variables referred to in this study are opportunity to learn, adventure in learning, identity or the orientation of the student's self perception in relation to the group, status or prestige of the student, and teacher or the perception by the student of the teacher as a role model . These are affect measures and represented student perceptions towards schooling, teachers, and peers.

The fourth component of the Guthrie model consists of three output measures; achievement, attendance, and

attitudes. The model constructed in this study utilizes cognitive outcome measures as obtained from CTBS tests for reading and mathematics; and student well-being as obtained from the Bulcock inventory. Figure 3.1 presents a schematic presentation of the initial modifications to the Guthrie approach.

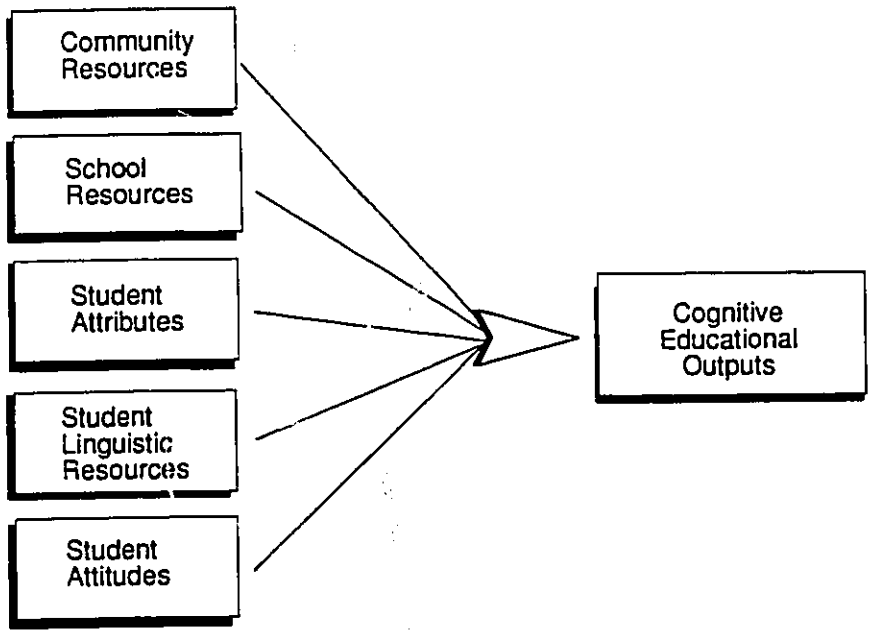

Figure 3.1
Modified Guthrie model.

A further modification of this approach makes the

overall measurement model easier to operationalize and easier to interpret for the purposes of analysis. Relationships to be tested using this model can be stated by expressing outputs as functions of the inputs retained as predictor variables.

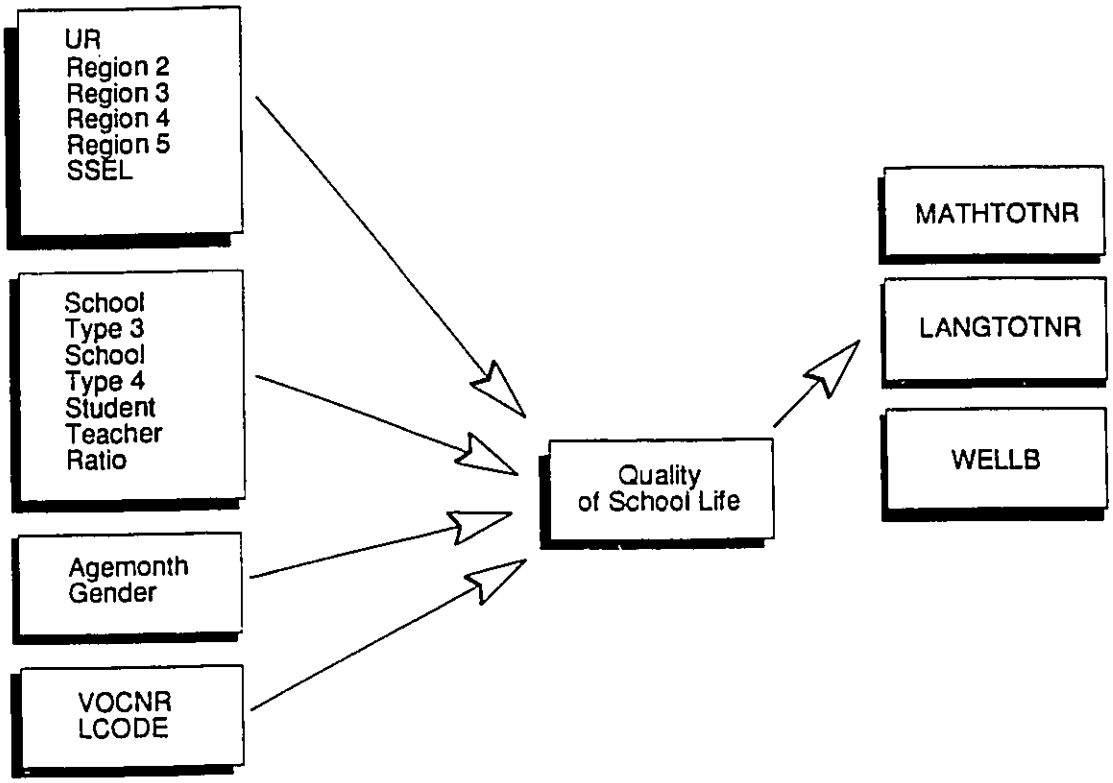

Figure 3.2
Modified measurement model

Figure 3.2 presents a schematic for the measurement approach used in this study as it is

modified from both the Guthrie and Bulcock models. More detailed presentation of variables is given below in an order consistent with measurement approach used in this study. Appendix "B" contains a table defining the category, mnemonics, type, and description of each variable.

Input Variables

A number of studies outlined in the literature review produce consistent results when specific resource variables are studied. Bulcock (1988a, 1988b, 1989), Whitt (1989) and Bulcock and Whitt (1989) report interesting and significant findings in the same general context as this study is completed. They developed a research methodology that was appropriate to the investigation of optimally allocating resources within the educational system, particularly within the Newfoundland context. Their research has identified many of the variables that one can operationalize within the Newfoundland educational system. Moreover, research problems associated with unique demographic features of Newfoundland are identified and recent researchers outline recommendations for further study, suggesting resource

variables that might yield significant results (Whitt, 1989). Bulcock proposes that variables retained to study allocation of resources be grouped in strands. In this study, variables are grouped in strands to correspond to each of the research questions.

Community background characteristics retained include: the region in which the student lives (REGION); a dichotomous variable for urban and rural students (U_R); and a linear composite designed as a proxy for socioeconomic status (SSEL). As is stated previously in Chapter 2, each of these variables is found in the literature to be a significant predictor of student educational achievement.[13]

For convenience of analysis, the province is divided into five separate regions (REGION). These are: the Avalon Peninsula, South Coast, Central Newfoundland, West Coast, and Labrador regions. Each region is specified as a dummy variable. To meet the condition of linear independence one dummy (indicator variable) is dropped (constrained to zero) in order to act as a reference point for interpreting the parameter

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[13]See Appendices A and B for studies reporting these predictors as having a significant effect on educational achievement.

of the other variables in the set.

A second background variable that is operationalized is a measure for urban and rural school location (U_R). Bulcock (1988) found that urban students outperformed rural students on achievement outcomes. This study pursues this finding to determine if a similar relationship exists in this population.

A proxy for socioeconomic circumstances is also developed (SSEL). This consists of the father's income (FTHRINC); the mother's income (MOTHRINC); the family income (FAMINC); and the number of people per room in the household (PPROOM)[14]. The linear composite SSEL is represented diagrammatically in Figure 3.3.

Each of the socioeconomic indicators contributes to the construct SSEL, the proxy for the socioeconomic level of the community in which the school is located. This socioeconomic vector is similar to the advance Murnane and Phillips (1981) made to the Levin (1974) approach. The theoretical advance permits construction of a second order variable from vectors of variables previously found to be good predictor variables. Other

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[14]The factor construction for SSEL can be see in Appendix C.

researchers found significant relationships between socioeconomic indicators and student achievement (Coleman et al., 1966; Hanushek, 1971; Jencks et al.,1972; Rossmiller, 1978).

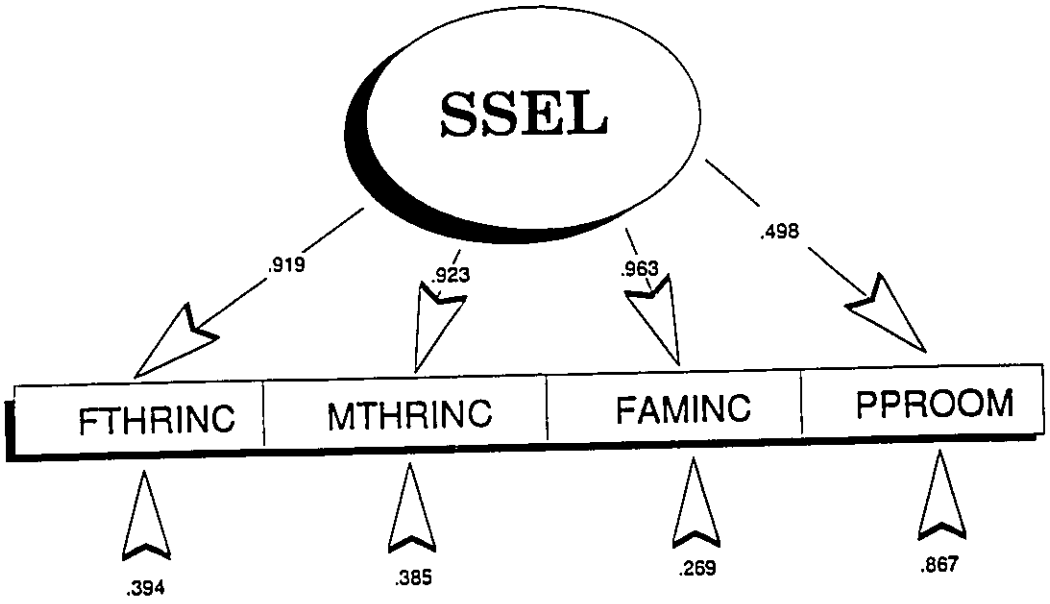

Figure 3.3
Student socioeconomic model. (Numeric values on the lines connecting SSEL to the observed variables are the values of the factor matrix coefficients. Numbers beneath the arrows represent the error of measurement.)

Input variables included in the model embrace various school types or the structure of the school (SCHTYPE). These include elementary, secondary, all grade, other multi-grade, and non-graded structures. A second school related variable is the number of full

time equivalent teachers (FTETCHRS). The final school variable included in our model is the size of student enrolment (ENROL). School size is also a good indicator of student achievement in past studies (Mortimore, 1993; Rutter, et al., 1979). Mortimore found that the smaller the school the higher the achievement levels of the students. Small schools in his study were in the 450 to 600 pupil population range. ENROL is divided by FTETCHRS to compute student teacher ratio (STR), which is operationalized in the regression equation.

Two student characteristics are obtained from the response sheets for analysis. Each of these is identified in the literature to be an important indicator at the junior high school level. These are student age in months (AGEMONTH) and gender (SEX). Age is a significant indicator of student output in a number of studies (Levin, 1970; Michelson, 1970; Whitt, 1989). Whitt found a significant, negative relationship between students' age and their achievement. The older students scored lower achievement outcomes. At the intermediate age level, the literature indicates that girls tend to have a more positive attitude towards school than boys (Jackson, 1968; Tennenbaum, 1940).

Gender is frequently found to influence student outcomes in other studies (Levin, 1970; Murnane, 1975; Summers & Wolfe, 1977; Whitt, 1989; Wolfe, 1977). Most of these studies present findings to indicate that boys tend to outperform girls in science and mathematics at the high school level.

Two indicators of linguistic resources are included in the model. As indicated in the literature, the vocabulary score (VOCNR) of an individual is often used as a proxy for background knowledge (Bernstein, 1961; Bulcock, 1988; Whitt, 1989). Another variable is constructed to discriminate the extent to which the individual's language code departs from the standard language. This continuous variable (LCODE) is used as an indicator of the individual's language discontinuity. The variable is constructed by taking the highest student score obtained on the language usage sub-test (USGNR) and then subtracting all other scores from that score. This construct differs from Bulcock's (1988) construction in that his LCODE variable is aggregated at the school level.

In Bulcock's (1988a, 1988b, 1989) research, he uses the language usage score of the highest achieving

school in the province to construct his LCODE variable. His variable is a school level variable. The present research creates a variable that takes the highest USGNR score, or language usage score, and creates a continuous variable by subtracting all other USGNR scores from that score. The newly created variable has a negative coefficient to represent the concept of linguistic discontinuity. Higher values reflect greater departures from the acceptable language usages. The USGNR score is used so as to construct a variable that is not confounded with the VOCNR scores.

Process Variables

Nearly all Grade 8 students in the province completed the Bulcock Attitudinal Inventory (BAI), a measure of the Quality of School Life. One school board refused to permit its students to complete the Bulcock Inventory on the grounds that individual teachers might be identified. The missing school board reduced the number of students completing the Bulcock Inventory to approximately 9,700.

This BAI contains 44 questions designed to ascertain student attitudes on 5 input items and two output items (See Appendix D). The five process

measures attempt to measure students' perceptions toward various aspects of their school lives. These measures are: (a) opportunity (OPPY)--the students'

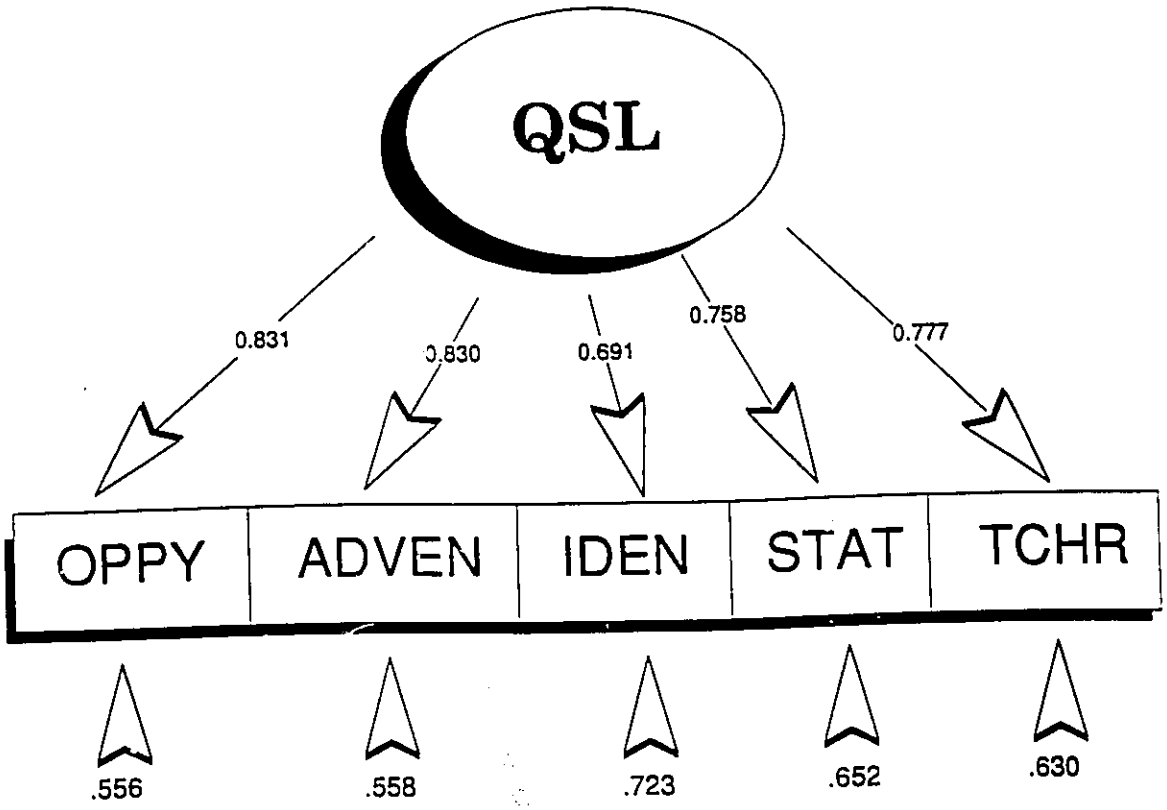

Figure 3.4
Quality of school life model. (Numeric values on the lines connecting QSL to the observed variables are the values of the factor matrix coefficients. Numbers beneath the arrows represent the error of measurement.)

perception of the school as the certifier of the

educational process; (b) adventure (ADVEN)--a student perception measure of schooling as an experience in learning intrinsically rewarding and leading to self-motivation; (c) identity (IDEN)- a student perception of one's development of self-awareness in relation to a larger society; (d) status (STAT)--the perception of a student of one's personal status as made by fellow students and teachers; and (e) teacher (TCHR)--the students' perceptions of their teachers as role models. Bulcock's QSL model is constructed as shown in Figure 3.4.[15]

Output variables

Previous studies identify inconsistent results depending on which variables are retained as scholastic attainment indicators (MacPhail-Wilcox & King, 1986). Those indicators that have been consistently significant in previous studies and that were possible to operationalize are retained for this study.

Indicators of mathematics and language achievement are retained from the CTBS scores. The composite measure on language is composed of sub-tests in

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[15]See Appendix E for further information on factor construction for QSL.

capitalization, punctuation, and spelling. Mathematics achievement is measured under the sub-tests of concepts, problem solving, and computation.

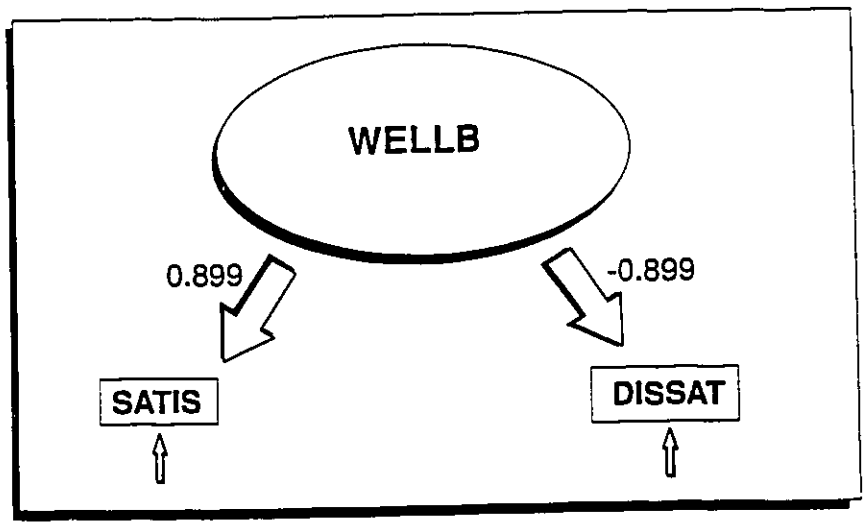

Figure 3.5
Model of student well-being. (Numeric values on the lines connecting WELLB to the observed variables are the values of the factor matrix coefficients. Numbers beneath the arrows represent the error of measurement.)

Bulcock's Model also contains two outcome measures of the well-being of students. The two dimensions are the positive effect or satisfaction (SATIS) and the negative effect or dissatisfaction (DISSAT). Bulcock constructs his instrument so that one of these measures is not necessarily the obverse of the other; although under ordinary circumstances, one would likely have been the negative correlate of the other. In his

research, Bulcock treats these variables simultaneously by creating a second order variable called student well-being. In this study, student well-being (WELLB) is a second order construct derived from SATIS and DISSAT.[16] This model can be seen in Figure 3.5.

Measuring Instruments

Two main instruments are utilized in this study; the Canadian Test of Basic Skills (CTBS) and the Bulcock Attitudinal Inventory. The CTBS and the Bulcock Inventory were administered to all Grade 8 students in the Province under the auspices of the provincial Department of Education. The tests were administered to all students in the month of October, 1989. Test administrators were trained by the provincial ministry and rigorous care was taken to ensure that test conditions were as consistent as possible.

The CTBS is a standardized achievement test designed to test overall achievement in five separate areas of study: Vocabulary; Reading comprehension; Language skills; Work-study skills; and Mathematics

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[16] See Appendix E to see how the satisfaction and dissatisfaction variables are constructed for this study.

skills. It is a norm-referenced test designed to measure how well students achieve objectives of the Canadian curricula. Individual student results indicate what level of achievement a student obtains compared with others in the norm group. Individual raw scores can be used to determine how well students have mastered curriculum objectives. Individual raw scores are employed in this study.

The second measuring instrument used is the Bulcock Attitudinal Inventory (see Appendix D). The instrument is designed to measure student attitudes on five input variables and two outcome variables. Using the Bulcock approach, variables are examined individually, but microlevel analysis is also conducted at the community, school, and classroom levels. This approach is seen as appropriate because it permits a comparison of the variables and meanings of each variable at each level of aggregation. Community and school characteristics are assigned to the individual, thereby allowing analysis to be done on the individual level. Some of the problems associated with this approach and proposed solutions to the problems are discussed below.

Bulcock (1988a, 1988b, 1989) develops a number of models that are extensions of his main model. These extensions foster further understanding of the relationships among input variables and student outcomes. Essentially, his disaggregated models allow more intense scrutiny of individual indicators to be retained from the literature and the data-gathering process. An example of the advantages his disaggregated models offer is illustrated in his cognitive outcome model. This model permits a graphic conceptualization of the global resource levels to all of the cognitive outcome indicators that have been retained. The relationship of each strand of input variables to cognitive outcomes within the model is estimated by using path coefficients.

The Bulcock approach permits a more detailed analysis of variables retained as indicators of achievement in the basic resource allocation model. This is similar in approach to what is recommended by Murnane and Phillips (1981).

Community resource indicators include population, geographic region, and a proxy measure for socioeconomic level of the community. This

socioeconomic proxy is the second order variable constructed from statistics obtained from Statistics Canada. School characteristics encompass the structure of the school on the basis of grades offered and on the number of full-time equivalent teachers within the school. These are variables which are found to be important indicators from QSL studies and from input-output studies. Student level characteristics consist of gender and age, both of which are found to be significant in previous studies and are possible to operationalize in this study (Bidwell & Kasarda, 1975; Brown, 1972; Katzman, 1968; Kiesling, 1969). Student age is measured in months. A continuous variable is constructed using Bernstein's theory of language discontinuity. LCODE is linguistic discontinuity or the size of the gap between standard and community language usage. VOCNR is a proxy variable used as a measure of the linguistic resources of students. It is not confounded with the LCODE variable, as only the language usage (USGNR) scores from the CTBS are used to construct LCODE.

Community background variables, school level variables, student characteristic variables, and

student linguistic characteristics are analyzed to ascertain whether or not student attitudes, as measured using the Bulcock Inventory, make any difference to cognitive student outcomes or attitudinal outcomes as measured by student well-being.

Mathematical Statement of Research Questions

These theoretical constructs are thus utilized to examine research questions as stated in the previous chapter. To investigate each research question, a structural equation relating the indicator variables to the outcome variables is constructed. Each research question is stated mathematically in a manner consistent with how the question is outlined.

The first research question is:

1) **Is there a relationship between community background variables and educational outcomes?**

The mathematical expression of the equation used to investigate this question can be stated as follows:

Achievement = f(U_R, REGION, SSEL)

Achievement is measured by using the scores obtained by students on subtests in mathematics and reading from the CTBS, and from attitudinal outcome measures from

the BAI. The dependent variable LNGTOTNR was composed of the scores achieved on the reading comprehension sub-test (RDGNR), plus the number right on the spelling comprehension sub-test (SPLNR), plus the number right on the capitalization sub-test (CAPNR), and the number right on the punctuation sub-test (PUNNR). This outcome measure was retained as a proxy representing reading literacy of the student population. MTHTOTNR consisted of CTBS scores in computational skills, concept development, and problem solving. The outcome measure of student attitudes is represented by the second order construct WELLB. WELLB is derived from the positive affect measure SATIS and from the negative affect measure DISSAT.

U_R is the dichotomous representation for urban or rural residence. REGION is the region in which each student goes to school. SSEL is a linear composite of community level economic indicators and serves as a proxy for socioeconomic status.

The second research question is stated as follows:

2) **Is there a relationship between school characteristics and educational outcomes?**

The mathematical equation used to investigate this

question is stated as follows:

Achievement = f(STR, SCHTYPE)

Achievement outcomes are measured the same for all of the research questions. School characteristics retained in the study include the student-teacher ratio of the class which each student attends. The second independent variable is the structure of the school in which the student is taught.

The third research question is stated as follows:

3) **Is there a relationship between student background variables and educational outcomes?**

The mathematical equation used to examine this research question is:

Achievement = f(GENDER, AGEMONTH)

GENDER represents the gender of the pupil. AGEMONTH is student age measured in months.

The fourth research question examines the relationship between student linguistic resources and educational achievement. It is stated as follows:

4) **Is there a relationship between student linguistic resources and educational outcomes?**

The mathematical equation to investigate this question is:

Achievement = f(VOCNR, LCODE)

The final research question asks the following:

5) **Do student attitudes (QSL) have a mediating effect on educational outcomes?**

The mathematical equation that represents this relationship is expressed as follows:

Achievement = f(QSL, U_R, REGION, SSEL, STR, SCHTYPE, GENDER, AGEMONTH, VOCNR, LCODE)

QSL is a second order construct and is shown in Figure 3.4.[17] QSL is added to the resource allocation model to ascertain whether or not student attitudes have a mediating effect on student achievement outcomes.

Data Analysis

Data in this study were analyzed using multiple regression analysis. SPSS 4.1 for IBM/CMS was the statistical package utilized. Models analyzed were constructed from the theoretical foundation developed in the review of literature. Pedhazur and Schmelkin (1991) stated that regression analysis is a method of analyzing the variability of a dependent variable by

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[17] See Appendix E for construction of variables composing QSL.

resorting to information on one or more independent variables, or predictors. Direct, indirect, and total effects of the predictor variables and the intervening variables on achievement outcomes were calculated.

Measurement models were used for each latent construct (unobserved variable) in the study. These constructs included the Quality of School Life (QSL) domain, SSEL (a linear composite of community level economic indicators), and WELLB (a construct developed from student responses designed to measure satisfaction of students). Construction of these latent constructs permitted analyses of data in groups or vectors so that a manageable number of variables could be studied at one time. This approach also acknowledged that single measures of each construct were not perfect and permitted more accurate measurement. A second direct or main effects analysis of these variables individually was then completed wherever statistical significance was found. Since the data for this study contained very large numbers, it was expected that statistical significance would have been present for many of the independent variables. Thus substantive meaningfulness became pertinent. Determination of substantive

meaningfulness for variables was derived mainly from the magnitude of the standardized beta coefficients. Huff (1954) claimed that a difference was only a difference if it made a difference. Thus the regression measure that became of greatest interest was the standardized Beta coefficient. In the present study if the standardized Beta coefficient was 0.1 or higher, then the variable was generally accepted as being substantively meaningful.

Direct, indirect, and total effects analyses were completed using an approach advocated by Alwin and Hauser (1975). T-values for total effects were considered significant when coefficients exceeded 2. This approach was used to overcome statistical problems identified earlier as having flawed both the Coleman et al. (1966) and the Jencks et al. (1972) reports. Both studies at that time were not able to calculate indirect effects as techniques had not yet been developed.

Raudenbush and Bryk (1988) contend that schooling is a multilevel process. Decisions on such things as resource distribution made at one level of the organization constrain decisions at the next level.

They contend that a proper conceptualization of the schooling process should include not only a model for how schools differentially allocate resources for instruction and opportunities for learning, but also how students differentially respond to given opportunities.

Bryk and Raudenbush (1992) indicate that statistical techniques are now available to consider hierarchical data structures. Their approach to hierarchical linear modelling might be a more effective way to analyze data in the present study. This method would capture much of the within schools effects that are lost by assigning school level variables to all students within a particular school. Unfortunately, no software is available to the researcher that would be able to satisfactorily handle the large number of subjects in the study.

As conceptualized, the model in the present study is a conservative model in that the within schools effects are underestimated. If the data were to be aggregated at the school level, two more problems become evident. Correlations between variables are inflated in the aggregation process. This results in a

situation in which the R^2 values produced at this level of analysis are inflated (Bryk & Raudenbush, 1992). S. Raudenbush (personal communication, April 11, 1994) contends, however, that socioeconomic variables nearly always present consistent results to statistical analyses, whether the level of analysis is at the individual, school, or community level of aggregation. Since most of the variables aggregated at the community level in this study are socioeconomic in origin, the need for simultaneous multilevel analysis might not be as crucial as one would first expect.

Another problem that prevents use of hierarchical linear modelling centres around the method by which data were gathered for the present study. Diprete and Forristal (1994) contend that multilevel data must have measurements for multiple micro units within the macro unit. They argue that analysis of such data can specify microlevel coefficients as functions of macrolevel variables but they cannot specify the "total effects" of context because only one microlevel observation is available for organizational unit. In the present study at the community and school level only one microlevel observation is available for each organizational unit.

The results of the analyses of data are presented in the next chapter. Descriptive statistics are presented for predictors used in the research design. The statistical treatments used to analyze the models and investigate the research questions are also detailed.

CHAPTER FOUR

Presentation of Data

Introduction

Results of the analysis of data are presented in this Chapter. The measurement models, as constructed from the Bulcock (1989) model and the Guthrie (1988) model, guided research questions concerning resource allocation. Each of the research questions was represented by a strand of variables in the general resource allocation model. Efficiency of resource allocations and their relationships to educational outcomes were the primary foci of the Chapter. Urban and rural differences were of interest, as were gender differences. Second order models utilizing latent variables constructed in Chapter 3 for some strands of variables were used to facilitate analyses and focus attention on the five research questions. Multiple regression techniques were used to identify any existing relationships between predictor variables and educational outcomes. A comprehensive overview and

analysis of pertinent statistics were described before individual research questions were examined. A statistical approach developed by Alwin and Hauser (1975) was used to measure the mediating effect of QSL on educational achievement outcomes. Tables were presented for both main effects analyses and analyses illustrating direct, indirect, and total effects.

Descriptive Statistics

Descriptive statistics for the dependent variables and independent variables were presented to add clarity to observations. Since this was a population study, much useful information was obtained from this source. In the main regression model, the variables were entered simultaneously utilizing enter procedures in the SPSS statistical package.

Table 4.1 contains descriptive statistics of microlevel background variables. Statistics were described at the full provincial level and were later described from an urban-rural perspective (see Table 4.2) and on the basis of gender (see Table 4.3).

The type of school (SCHTYPE) was sub-divided on the basis of grades offered within that school. These

divisions were: SCHTYPE2 (Secondary school); SCHTYPE3 (All grade school); SCHTYPE4 (other multi-grade schools). SCHTYPE was dummy coded. These structures were utilized in this research because such an approach has previously been found to contribute to quality of school life research (Isherwood & Ahola, 1981).

Table 4.1
Descriptive Statistics for Background Variables..

Variable	Mean	S_D	Cases
FTHRINC	14,887.64	6,626.80	10,146
MTHRINC	7363.26	2,581.35	10,146
FAMINC	24,908.65	10,170.49	10,146
PPROOM	0.52	0.15	10,146
UNEMP	20.44	12.90	10,146
FTETCHRS	22.63	9.45	10,146
ENROL	389.26	191.50	10,146
AGEMONTH	163.52	48.41	10,146
VOCNR	18.43	6.87	9,745
LCODE	-19.10	7.04	9,727
LNGTOTNR	72.96	21.09	9,593
MTHTOTNR	55.49	16.89	9,541

As can be seen in Table 4.1, male income ($14,887.64) was more than twice as high as female income ($7,363.26). This finding was consistent with inequities between male and female income in other jurisdictions. The level of unemployment (UNEMP) for the province of 20.44% was quite high compared to the overall rate for the country and was indicative of difficult economic times and other attendant problems that accompany low employment levels.

Full-time teacher equivalents (FTETCHRS) had a reported mean of 22.63. In urban schools, the number of full-time teacher equivalents was 28.05 while the average in rural schools was 17.66. Mean school enrolment for the 1989-90 school year (ENROL) was 389.26. Mean size for urban schools was 506.43 and in rural schools was 281.88. Using mean school size and the number of full-time teacher equivalents, the student-teacher ratio was computed at 18.1:1 for urban students and 15.9:1 for rural students.

In the regression analysis reported in this chapter, a positive sign on the coefficient representing the relationship between location (U_R) favoured rural students and a negative sign favoured urban students. The definition of urban and rural was developed from earlier research conducted by Bulcock (1988) and Hurley (1988). An urban town was one that had a population of 5000 or greater whereas a rural community was one 0 to 4999.

Age of students was reported in months and there was little difference between urban and rural student age. Mean student age was 163.52 months or thirteen years seven months. Males were a little more than a month

older than females.

Table 4.2
Urban and Rural Descriptive Statistics.

Variable	Urban Mean	Urban S_D	Urban Cases	Rural Mean	Rural S_D	Rural Cases
U_R	44396.31	43407.79	4852	1363.26	1311.34	5294
FTHRINC	18696.61	6337.56	4852	11396.68	4676.64	5294
MTHRINC	8717.63	2237.02	4852	6121.98	2227.70	5294
FAMINC	30948.92	8909.46	4852	19372.69	7836.58	5294
PPROOM	0.49	0.09	4852	0.54	0.18	5294
UNEMP	13.16	5.48	4852	27.11	14.09	5294
FTETCHRS	28.05	9.36	4852	17.66	6.28	5294
ENROL	506.43	190.63	4852	281.88	113.42	5294
AGEMONTH	163.41	41.58	4852	163.62	53.92	5294
VOCNR	20.02	7.22	4661	16.98	6.48	5084
LCODE	-17.88	7.26	4648	-20.21	6.95	5079
LNGTOTNR	77.23	21.94	4590	69.05	20.71	5003
MTHTOTNR	58.78	17.99	4569	52.46	16.29	4972

Other indicators favoured urban students. There were fewer people per room (PPROOM) in urban student homes (0.49) than in rural homes (0.54). Unemployment in urban areas (13.16%) was less than half the rate in rural areas (27.11%). Income levels of urban males ($18,696.61) were much higher than their rural counterparts ($11,396.68). This differential was exacerbated, it seemed, by the higher rates of unemployment that the rural inhabitants experienced. The differential in incomes between males and females was greater in urban centres than in rural areas but was substantial in both areas.

The number of vocabulary items correct (VOCNR) has

often been used in language arts research as a proxy for student linguistic resources (Bernstein, 1961; Bulcock, 1988). Both male and female students had a mean score of 18.45 on this outcome measure. The urban student mean for VOCNR was 20.02 compared to 16.98 for rural students. The higher scores for urban students were consistent with previous research efforts that reported higher achievement outcomes in urban centres than in rural areas (Bulcock, 1988a; Whitt, 1989).

Females (78.63 items correct) outperformed males (67.44 items correct) on every sub-test composing LNGTOTNR. The urban student mean (77.23) was also greater than the rural student mean (69.05). A similar pattern was also evident in the total number of mathematical responses correct (MTHTOTNR), as in LNGTOTNR, except that the discrepancy between the various population groups was less.

A negative for the Quality of School Life (QSL) measures meant that females scored more favourably than males on that particular item. A perusal of the means for QSL indicators showed females having more favourable perceptions than males towards school. These measures were consistent with previous findings in the

affective literature area (Tennenbaum, 1941).

Table 4.3
Male and Female Descriptive Statistics.

Variable	Male			Female		
	Mean	S_D	Cases	Mean	S_D	Cases
FTHRINC	14985.64	6655.49	5137	14809.99	6610.52	5009
MTHRINC	7397.42	2611.98	5137	7334.18	2552.60	5009
FAMINC	25025.32	10305.45	5137	24818.46	10043.76	5009
PPROOM	0.53	0.15	5137	0.52	0.15	5009
UNEMP	20.56	13.14	5137	20.24	12.64	5009
POP	2246.78	37089.25	5137	2285.07	37169.77	5009
FTETCHRS	22.84	9.42	5137	22.51	9.47	5009
ENROL	392.32	193.16	5137	387.33	189.50	5009
AGEMONTH	164.93	49.79	5137	162.96	43.52	5009
VOCNR	18.46	7.12	5010	18.45	6.89	4680
LCODE	-20.54	7.28	4998	-17.51	6.76	4680
LNGTOTNR	67.81	21.20	4928	78.63	20.80	4617
MTHTOTNR	54.29	17.97	4907	56.88	16.70	4587
SATIS	-0.19	1.03	4726	0.20	0.93	4452
DISSAT	0.16	1.00	4705	-0.17	0.97	4441
OPPY	-0.12	1.05	4687	0.14	0.92	4433
ADVEN	-0.18	1.04	4721	0.19	0.92	4457
STAT	-0.17	1.01	4679	0.11	0.92	4421
TCHR	-0.16	1.08	4687	0.18	0.88	4433
IDEN	-0.16	1.05	4773	0.17	0.92	4485

Findings that showed urban students outperforming rural students on outcome achievement measures were also consistent with previous studies (Bulcock, 1988a; Whitt, 1989). As well, evidence was again provided that girls at this age level generally tended to outperform boys. One of the questions pursued in this study investigated whether or not this performance differential was caused by the attitudinal differences measurable at that age. The inequity of these outcomes is discussed later in the study.

Regression Analyses

Reading literacy

Only raw test scores were used for analyses. The raw scores for the dependent variables were regressed against raw scores for the independent variables. In this way it was possible to determine the relative importance that unit changes in each of the independent variables caused in the dependent variables. As mentioned earlier, all variables were entered simultaneously using the enter method in the SPSS statistical package. Moreover, the concept of significance was of somewhat less relevance since the obtained population parameters were the population values in the study.

Table 4.4 was constructed to illustrate the results of the main effects regression analyses of the relationships between the student level independent variables and LNGTOTNR. The model specified to measure the relationships between LNGTOTNR and the student level predictor variables explained 80.7% of the variance in student outcomes for LNGTOTNR.

Table 4.4
Results of Regression Analysis for the Relationship Between LNGTOTNR and Independent Variables.

Independent Variables	B	SeB	Beta	Sig T.
U_R	-1.2788	.2541	-.0294	.0000
REGION2	1.8180	.3657	.0257	.0000
REGION3	.6538	.2714	.0130	.0160
REGION4	.6901	.3014	.0123	.0221
REGION5	2.2079	.4653	.0228	.0000
SSEL	-.0304	.1178	-.0014	.7965
SCHTYPE3	-.4375	.3284	-.0068	.1827
SCHTYPE4	.2465	.2242	.0052	.2716
STR	.0188	.0413	.0025	.6492
GENDER	3.9615	.2243	.0052	.0000
AGEMONTH	.0004	.0021	.0008	.8550
VOCNR	.5475	.0194	.1767	.0000
LCODE	-2.2532	.0192	-.7451	.0000

Constant = 100.8992 n = 8403 R^2 =.80725

An examination of the relationships using multiple regression procedures indicated that LCODE, the independent variable constructed to measure how far an individual's language code departed from the standard language code of the community, explained 78.4% of the variance. VOCNR explained about 1.4% of the variance. GENDER accounted for 0.8% of the variance and the other ten independent variables explained less than 1% of the variance in outcomes of LNGTOTNR.

A set of tables presenting similar analyses at the school level of aggregation is presented in Appendix "F". This separate analysis was conducted at the school

level of analysis to offset the inadequacy of the main analytical approach as cautioned by Raudenbush and Bryk (1988).

Table 4.5 contains the direct, indirect, and total effects for the relationship between reading literacy and retained indicator variables with QSL as a mediating variable. The table is a representation of the model construction as depicted in Figure 3.2. Variables are presented in strands as they are divided in the modified Bulcock resource allocation model. Community resource variables included in the model were U_R, REGION2, REGION3, REGION4, REGION5, and SSEL. Using only direct effects analysis as in Table 4.4 no substantively meaningful relationships were identified between community level independent variables and reading achievement outcomes.

Student level variables retained to investigate whether or not there was a relationship between school characteristics and educational outcomes did not produce any substantively meaningful relationships between reading literacy outcomes and SCHTYPE or STR.

Table 4.5
Direct, Indirect, and Total Effects of Independent Variables on LNGTOTNR with QSL as a Mediating Variable

Variable	Direct Effect	t	Indirect Effect	Total Effect	t
U_R	-.0258	-4.175	-.0006	-.0264	2.4206
REGION 2	.0251	4.577	.0006	.0257	2.3013
REGION 3	.0109	1.892	.0003	.0112	1.0266
REGION 4	.0108	1.890	.0003	.0111	1.0173
REGION 5	.0230	4.209	.0005	.0235	2.1539
SSEL	.0002	.038	.0000	.0002	0.0183
SCHTYPE 3	-.0094	-1.736	-.0002	-.0096	0.8799
SCHTYPE 4	.0030	.581	.0000	.0031	0.2814
STR	.0019	.324	.0000	.0019	0.1741
AGEMONTH	-.0012	-.256	-.0000	-.0012	0.1148
GENDER	.0882	17.515	.0021	.0903	8.3108
VOCNR	.1771	26.699	.0042	.1813	16.897
LCODE	-.7416	109.04	-.0174	-.7690	101.26
QSL	.0235	14.702			

R^2 = .8073 n = 8403

Indicators of school background characteristics AGEMONTH and GENDER also did not prove to be substantively meaningful predictors of student reading literacy outcomes.

Student linguistic resources (VOCNR) and language usage (LCODE) proved to be strong indicators of reading outcome measures. The level of linguistic resources had a strong positive effect on reading outcomes. The negative coefficient representing the relationship between LCODE and the reading literacy outcome measure indicated that the further an individual student's

language usage departed from the standard language code, the lower were that individual's reading outcome scores.

Mathematics numeracy

As can be seen from Table 4.6, two predictor variables dominated this model from a measurement perspective using only main effects analysis. LCODE and VOCNR were the only variables that produced substantive meaningfulness. Analysis of the relationships was then undertaken to measure the mediating effects of QSL on mathematics achievement.

Table 4.6
Results of Regression Analysis for the Relationship between MTHTOTNR and Independent Variables.

Independent Variables	B	SeB	Beta	Sig. T.
U_R	-1.0314	.3446	-.0296	.0028
REGION2	-.4202	.4917	-.0075	.3928
REGION3	-1.1128	.3690	-.0276	.0026
REGION4	.9798	.4081	.0218	.0164
REGION5	-.4251	.6287	-.0058	.4990
SSEL	.3440	.1610	.0196	.0325
SCHTYPE3	.7866	.4432	.0153	.0760
SCHTYPE4	.7734	.3048	.0205	.0112
STR	-.0159	.0559	-.0027	.7763
AGEMONTH	-.0022	.0281	-.0059	.4384
GENDER	-.6455	.2733	-.0188	.0182
VOCNR	.7240	.0264	.2913	.0000
LCODE	-1.0774	.0264	-.4423	.0000
Constant = 65.6824	n = 8135		R^2 = .47083	

Table 4.7 contains direct, indirect, and total

effects analyses of the relationships between mathematics numeracy and independent variables. Measurement of the direct, indirect, and total effects with QSL produced a more meaningful relationship than did only direct effects regression analysis of the relationship between SSEL and MTHTOTNR. Substantively meaningful relationships were identified between mathematics numeracy and SSEL. Students from higher socioeconomic levels achieved substantively higher results in mathematics achievement than those from lower socioeconomic levels.

The positive value of the coefficient representing the relationship between GENDER and mathematics achievement favoured females. Girls outperformed boys in mathematics. This finding is inconsistent with previous studies. The indirect effects of GENDER on MTHTOTNR were substantively meaningful with a coefficient of 0.1121. When student attitudes were considered females outperformed males. The indirect effects of GENDER were large enough to wipe out the advantage that males had over females as indicated by the negative value of the coefficient for GENDER using only direct effects analysis. Causes of these

differences are discussed later in Chapter 5.

Table 4.7
Direct, Indirect, and Total Effects of Independent Variables on MTHTOTNR with QSL as a Mediating Variable

Variable	Direct Effects	t	Indirect Effects	Total Effects	t
U_R	-.0263	-2.543	-.0669	-.0932	8.4419
REGION 2	-.0028	- .306	-.0002	-.0030	0.2706
REGION 3	-.0323	-3.346	-.0023	-.0346	-3.213
REGION 4	.0183	1.913	.0013	.0196	1.7679
REGION 5	-.0015	- .164	-.0001	-.0016	0.1443
SSEL	.0288	2.977	.0857	.1145	10.3327
SCHTYPE 3	.0183	2.023	.0370	.0553	5.0723
SCHTYPE 4	.0137	1.608	.0148	.0357	3.2216
STR	.0026	.262	.0007	.0033	0.2976
AGEMONTH	-.0096	-1.184	-.0006	.0102	0.9199
GENDER	-.0308	-3.641	.1121	.0813	7.3562
VOCNR	-.2953	26.350	.0209	.3162	30.0584
LCODE	-.4523	36.982	-.0301	-.4554	-37.376
QSL	.0707	8.435			

R_2 = .4742 n = 8135

As was indicated in the direct effects analyses, LCODE and VOCNR remained the most powerful predictors of MTHTOTNR even after the effects of QSL were included.

Student well-being

A third set of tables was constructed to illustrate the relationship between WELLB and retained independent variables. The model presented in Table 4.8 showed that only GENDER and LCODE had Beta coefficients

large enough to indicate a substantively meaningful relationship between WELLB and the independent variables when only direct effects were calculated.

The addition of QSL to the relationship between WELLB and the retained independent variables made a substantial difference to the explanatory capacity of

Table 4.8
Results of Regression Analysis for the Relationship between WELLB and Independent Variables.

Independent Variables	B	SeB	Beta	Sig. T.
U_R	.0366	.0267	.0183	.1706
REGION2	-.2043	.0382	-.0634	.0000
REGION3	-.0500	.0284	-.0219	.0785
REGION4	-.1609	.0340	-.0586	.0000
REGION5	-.3596	.0483	-.0878	.0000
SSEL	-.0387	.0125	-.0386	.0020
SCHTYPE3	.0849	.0349	.0284	.0150
SCHTYPE4	.0040	.0238	.0018	.8661
STR	-.0208	.0043	-.0616	.0000
GENDER	.3359	.0212	.1709	.0000
AGEMONTH	-.0009	.0002	-.0045	.6681
VOCNR	-.0064	.0020	-.0540	.0017
LCODE	-.0184	.0020	-.1330	.0000
Constant = .3581		R^2 = .0627		n = 8403

the model. By adding QSL to the relationship, an additional 48% of the variance was explained. This is seen below in Table 4.9.

As can be seen in Table 4.8, only GENDER and LCODE produced Beta coefficients large enough to indicate a substantively meaningful relationship between WELLB and

the retained independent variables using main effects regression techniques. A re-analysis of these relationships using QSL as a mediating variable and analyzing the direct, indirect, and total effects produced substantively meaningful relationships between WELLB and GENDER. LCODE was no longer a meaningful predictor of WELLB when QSL was used as a mediator.

Table 4.9
Direct, Indirect, and Total Effects of Independent Variables on WELLB with QSL as a Mediating Variable

Variable	Direct Effects	t	Indirect Effects	Total Effects	t
U_R	-.0073	- .768	-.0053	-.0250	2.2921
REGION 2	-.0447	- 5.319	-.0324	-.0771	7.0880
REGION 3	-.0033	- .370	-.0024	-.0057	0.5225
REGION 4	-.0346	- 3.944	-.0025	-.0371	3.4068
REGION 5	-.0288	- 3.424	-.0209	-.0497	4.5608
SSEL	-.0026	- .291	-.0019	-.0045	0.4125
SCHTYPE 3	-.0010	- .121	-.0007	-.0017	0.1558
SCHTYPE 4	-.0268	- 3.436	-.0189	-.0457	4.1931
STR	-.0166	- 1.830	-.0041	-.0120	1.0999
AGEMONTH	-.0067	- .895	-.0049	-.0116	1.0633
GENDER	.0619	8.009	.0449	.1168	10.7791
VOCNR	.0411	- 4.030	.0289	.0709	6.5148
LCODE	.0035	.312	.0024	.0057	0.5225
QSL	.7254	94.650			

R^2 = .546 n = 8403

Interpretation of Data for Research Question One

From the theoretical foundation developed in Chapter 2, a research question investigating the

relationship between student background variables and student educational outcomes was constructed as follows:

Is there a relationship between community background variables and educational outcomes?

Table 4.4 presents the results of the reading literacy component of the regression retained to investigate the first research question. When the substantive significance was examined using direct effects analysis, none of the community resource variables was of interest in this model, as no independent variable had a Beta coefficient greater than 0.1.

An analysis of the mediating effect of QSL on the relationship was then conducted. As can be seen in Figure 4.5, no meaningful relationships were identified between student reading literacy (LNGTOTNR) and any of the retained community variables.

A similar equation was constructed to investigate the relationship between community background resources and mathematics achievement and was presented in Table 4.5 in the present study. The same independent variables utilized in the literacy model were used

again in the mathematical model. However, using parallel arguments to those employed for the relationship between reading literacy and achievement, no independent variable had substantive meaningfulness using only direct effects analysis.

An investigation of the direct, indirect, and total effects of the retained variables on mathematics numeracy using QSL as a mediating variable produced a substantively meaningful relationship between MTHTOTNR and SSEL. These results were presented in Table 4.7 in the present study.

A third regression equation was constructed to investigate the relationship between community background resources and student attitudinal outcomes. A second order construct (WELLB) was used to measure student attitudes towards schooling and were presented in Table 4.8. Results for analyses of the relationships between WELLB and retained community variables were not substantively meaningful since the Beta measure for each was less than 0.1.

The direct, indirect, and total effects of the retained indicator variables on the dependent variable (WELLB) using QSL as a mediating variable were also

calculated and were presented in Table 4.9. No substantively meaningful relationships were identified between WELLB and community resource indicators.

Investigation of the relationship between community resource variables and student achievement outcomes produced a meaningful relationship between MTHTOTNR and SSEL. The positive coefficient value indicated that higher socioeconomic levels were associated with higher mathematics achievement. Thus it can be concluded that MTHTOTNR was the only student achievement indicator meaningfully related to a community resource variable and that variable was the proxy measure for the socioeconomic level of the community.

Interpretation of Data for Research Question Two

The second research question was asked as follows:

Is there a relationship between school characteristics and educational outcomes?

Individual student outcomes were measured using the same outcome measures, LNGTOTNR, MTHTOTNR, AND WELLB, as were used to pursue research question one. Two school characteristics were retained to investigate the

relationship between school characteristics and student achievement. These independent variables were student-teacher ratio (STR) and the type of school in which Grade 8 was offered (SCHTYPE). As mentioned earlier SCHTYPE was dummy coded. SCHTYPE was used to see if the structure of a school students attended affected their outcomes. STR was retained to ascertain whether or not a teacher effect was present in these schools as was evident in earlier studies (Edmonds, 1979; Lezotte, 1986; Rutter et al., 1979).

No substantively meaningful relationships were identified between reading literacy (LNGTOTNR) and school characteristics either using direct effects (See Table 4.4) or total effects analyses (See Table 4.5). The relationship between mathematics numeracy (MTHTOTNR) and the retained independent variables produced no meaningful relationships between MTHTOTNR and student variables retained at the school level using direct effects analysis or total effects analysis (See Table 4.7). Similar findings were also present for the relationship between WELLB and school level indicators. Thus the answer to research question two was negative for cognitive achievement outcomes and

negative for student attitudinal outcomes.

Interpretation of Data for Research Question Three

There was support in previous studies for the existence of a relationship between student background characteristics and student achievement (See Appendix A for examples). In this study, student characteristics that were operationalized included the gender of the student and student age in months. Research question three was worded as follows:

Is there a relationship between student background variables and student outcomes?

The relationship between GENDER and reading achievement outcomes (LNGTOTNR) did not produce substantive meaningfulness when analyzed using direct, indirect, and total effects analysis with QSL as an intervening variable.

GENDER was a meaningful predictor of mathematics numeracy (MTHTOTNR). According to Table 4.7 while the direct effect of gender on mathematics (net of other predictors) was negative (in favour of boys), the positive value of the coefficient for total effects analysis favoured girls. Thus indirect effects analysis

indicated that girls outperformed boys significantly in mathematics.

The third outcome measure included in the model was a measure of student well-being. As can be seen in Table 4.8, GENDER was related to the measure of student well-being when examined using direct effects analyses. The answer to research question three indicated a relationship between mathematics and GENDER. As well, GENDER was meaningfully related to WELLB.

Interpretation of Data for Research Question Four

The fourth research question investigated the relationship between student linguistic resources and student achievement. It was stated as follows:

Is there a relationship between student linguistic resources and student outcomes?

This relationship was found to be significant in research conducted by Bernstein (1961) and by Bulcock (1988). Both of the retained variables in the present study were meaningful predictors of reading outcomes when main effects analysis was conducted as can be seen in Table 4.4. As well, both predictor variables were substantively meaningful in that both Beta scores were

greater than 0.1. Thus there was strong support to indicate that student linguistic resources were related to reading outcomes. Computation of direct, indirect, and total effects, as seen in Table 4.5, also showed both indicators to be highly predictive of reading achievement outcomes.

Both student linguistic indicators proved to be highly predictive of mathematics achievement outcomes as can be seen in Table 4.7. LCODE was predictive of WELLB when using only direct effects analyses. However, when QSL was used as an intervening variable the coefficient value for the relationship between LCODE and WELLB was no longer meaningful. It can be concluded that student linguistic resource indicators used in the present study were accurate indicators of cognitive achievement outcomes but were not predictive of student well-being.

Interpretation of Data for Research Question Five

Research question five asks:

Do student attitudes (QSL) have a mediating effect on educational outcomes?

When the relationships between LNGTOTNR and community resource variables were examined no substantial differences were produced when QSL was added as a mediating variable. However, when student attitudes (QSL) were used as a mediator of the relationship between mathematics achievement and community resource variables, it was observed that SSEL, the proxy for community socioeconomic level, became a meaningful predictor of mathematics outcomes. The coefficient value of 0.1145 for total effects, as seen in Table 4.7 indicated this relationship.

The indirect effect of QSL on MTHTOTNR also significantly altered the predictive value of GENDER as a predictor of mathematics achievement. Using only direct effects analysis the negative coefficient of -.0308, as seen in Table 4.7, favoured boys. When the indirect effects were added to calculate the total effects for the relationship, the performance advantage that males seemed to have was wiped out entirely as can be seen by the positive value for the total effects measure.

QSL added greatly to the predictability of the model to measure the relationship between resource

indicator variables and student well-being. The amount of variance explained by the model increased from 6.27% when using direct effects analysis to 54.6% when QSL was added as a mediating variable. When QSL was used as a mediating variable between LCODE and WELLB, LCODE was no longer a meaningful predictor of student well-being.

Thus it was concluded that the answer to research question five was positive. QSL had a mediating effect on student achievement outcomes. The significance of these relationships in the context of this study is discussed in the next chapter.

CHAPTER FIVE

Discussions, Conclusions, and Recommendations

Introduction

This chapter contains discussion of the findings of the study. Research results are discussed for each of the research questions and, where possible, inferences based on the statistical results are explained within the Newfoundland context. As this was a population study, descriptive statistics were important as were direct, indirect, and total effects analyses used to analyze the study data.

Conclusions arising from the study are then discussed. Attention is paid to the extent to which significant predictors of student achievement outcomes are manipulable. The extent to which the present study contributes to existing theory in the area of educational production function literature is discussed. An examination of the findings was made to determine whether or not they were generalizable.

The final section of the chapter contains

recommendations for further study. It is used to encourage research in the direction where other meaningful relationships are likely to be found. As well, the level of analysis for future research is discussed.

Community Background

One of the main determinants as to whether or not a student's community affected achievement depended, in the context of this study, on whether one lived in an urban or rural area. Urban students' higher scores may be due in part to their increased access to learning resources associated with their urban location. The income differential between urban and rural communities also meant that urban students could make more use of various community programs that might have had user fees.

Urban students' attitudes were more favourable toward schooling than rural students. Much of this difference could have been attributable to the increased success urban students experienced at school. This was supportive of Bulcock's (1989) argument that student attitudes are an output of previous schooling

and an input to present and future schooling.

Urban schools were larger than rural schools and probably provided more co-curricular and extra-curricular activities than rural schools. Avalon Peninsula was more urbanized than the other regions. Parental educational levels and educational aspirations for their children are also variables that may have affected student attitudes. These variables, found effective in previous studies (Levin, 1970; Rossmiller, 1978), were not operationalized in the present study.

Class sizes in urban schools were larger than in rural schools. Student-teacher ratios for urban boards were 18.1:1, compared to 15.9:1 in rural schools. A confounding factor was that not all rural schools had enrolments large enough to have all separate single graded classes. This was evidenced by the average enrolments for rural boards of only 281, compared to 506 students for urban boards. In most rural schools, grades were offered from Grades 7 to 12, whereas in urban schools many of the boards offered intermediate and senior high grades separately. This meant that in rural schools fewer students were spread throughout more grades and that in a number of these settings

multi-graded classrooms were a reality. Thus teacher time may have been less available to students in rural schools even though there were fewer students per teacher than in the urban schools. On the other hand, students in all-grade schools held their own with students attending secondary schools even though they were behind in absolute terms. When one controlled for handicapping factors such as linguistic resources all-grade and multi-graded students actually performed at a marginally higher level than students attending secondary schools. This might have indicated that students attending secondary schools did not make the most of their presumed advantages.

In many studies completed in the past, relationships have been identified between socioeconomic background variables and achievement outcomes (See Appendix A). In this study, income levels in urban schools ($18,696.61) were much higher than for rural area schools ($11,396.68). Statistical results indicated that differing achievement outcomes existed within urban and rural communities. The discrepancy in socioeconomic levels meant urban students likely enjoyed enhanced educational opportunities compared to

their rural counterparts. The socioeconomic model employed in this study produced a meaningful relationship between SSEL and student achievement outcomes in mathematics. This finding was consistent with previous studies (Coleman et al., 1966; Jencks et al., 1972).

Newfoundland's school system was the lowest funded in Canada (Lawton, 1987). While the province funded 95% of total educational costs for the province, the system was not as equitable as it might have seemed at first glance. Approximately 80% of the entire provincial budget went to the payment of teacher salaries and other personnel salaries. This amount was consistent with the rest of the country. Approximately one quarter of the remaining 20% not spent on teachers' salaries was raised through local school tax authorities. School taxes in Newfoundland were collected in the form of poll taxes. The level of income from this source was directly dependent on the level of employment and economic activity in the community. People receiving welfare or unemployment insurance benefits were exempted from paying school taxes. Since the unemployment rate was more than twice as high in the

rural areas as in the urban areas, there was a large difference in the per capita income rural boards received compared to urban boards. This caused a disparity of resources between the rural schools and the urban schools. Thus urban location and higher socioeconomic status might have also given urban students an advantage over rural students.

A second factor that caused a school tax inequity between urban and rural boards was the level of economic activity generated in each area. The business tax paid in support of schools was much higher in urban areas, as there were higher levels of economic activity because of the population difference. The traditional hinterland and growth pole arguments from economic theory applied in this instance as well. If rural residents wanted to make major purchases they had to travel to an urban area. The local school tax dollars then stayed in that area. This exacerbated inequities between the two areas.

Some educators argued that urban students were advantaged merely by the fact that they lived in urban areas. Urban communities usually had higher levels of community resources than rural communities. These

resources included urban amenities such as arts centres, libraries, arenas, theatres, and other structures that provided residents enhanced learning opportunities. Such learning-by-doing could have been part of the reason that urban students outperformed rural students. This might explain some of the reason why urban students scored nearly one full year better than rural students on the reading literacy measure.

School Level Characteristics

Neither the structure of the school nor the student teacher ratio where students studied made a difference to reading outcomes, mathematics achievement, or student well-being. However, descriptive statistics indicated that students in secondary schools (SCHTYPE2) scored higher in mathematics than students in all-grade schools (SCHTYPE3) and other multi-grade schools (SCHTYPE4). Students in other multi-grade schools were less satisfied with their schooling experiences than were students in secondary schools. Reasons for these differences may have been similar to those discussed in the community resources section. Multi-grade schools

and all-grade schools are generally located in smaller communities. Thus larger schools were likely to have had only single graded instruction whereas many of the smaller schools had multi-graded classes. This finding, that school structure had no measurable effect on student attitudes outcomes was not consistent with previous research (Epstein, 1981; Isherwood & Ahola, 1981). This may have occurred because the school characteristic measures in the present study did not adequately measure this relationship.

Student Background Characteristics

Research in the quality of school life area indicated girls generally tend to have a more positive attitude towards school than boys (Tennenbaum, 1940; Whitt, 1989). This difference was also evident in this study as can be seen in Table 4.3. The negative means on the DISSAT measure indicate a more favourable attitude for girls towards school than for boys. Girls outperformed boys on every single sub-test composing LNGTOTNR. These differences indicate that gender made a difference and supported earlier findings in this area (Whitt, 1989).

The gender difference was more evident when QSL was treated as a mediating variable. Recent research indicated that boys outperformed girls in high school mathematics and science (Whitt, 1989) . However, in the present study girls scored higher than boys in each cognitive outcome measure and were more satisfied with their schooling experiences than the boys were. Student well-being was substantively related to the student background characteristics. Tennenbaum's (1940) and Whitt's (1989) findings, that girls generally have more favourable feelings toward school and may in fact have higher achievement because of these more favourable attitudes, were supported by this study. The negative Beta coefficient for AGEMONTH indicated that the older a student was, the more negative an attitude a student was likely to possess. This was consistent with quality of school life findings that indicated that students who met with a lack of success were likely to develop negative attitudes towards school (Epstein, 1981). Those students who produced negative results in this regard were likely to be those who had been retained in the same grade for two years. This finding provided support to those educators who argued

that grade retention of students was not a good idea.

One of the possible explanations why girls in this jurisdiction scored higher than boys in mathematics might be the effectiveness of programs to raise the level of awareness of teachers to gender differences introduced by the provincial ministry in 1983-84. In the past boys have been found to score higher than girls in mathematics (Whitt, 1989). If the provincial program was responsible for this change then it can be argued that gender differences in mathematics outcomes resulted from socialization rather than differences in cognitive abilities. The program concentrated on attitudinal changes of teachers and students concerning outcomes of females.

Student Linguistic Resources

Historically, Newfoundland has been composed predominately of Irish and English ethnic populations. Usually people settled in communities of similar ethnic background. The dialects of each of these two main founding peoples were vastly different. If one accepted Bernstein's (1961) argument concerning language discontinuity, then in this context one would expect to

find this variable to be strongly predictive of student outcomes. The levels of isolation and cultural distinction of the communities left the original dialects more intact than in the areas of Europe from which Newfoundlanders first moved (Story, 1982). Story observed that many linguists have travelled from Britain to Newfoundland to study British dialects. This was because the standard code in many communities was based on usages which were archaic nearly everywhere else. It seemed the departures from the standard code in many communities made that variable a strong discriminator among various groups. This distinction was dichotomized to an even greater extent because of the historically geographic separation of Irish and English into separate communities. Evidence from this study was strongly supportive of the earlier findings of Bulcock (1988a) which were based on Bernstein's (1961) theory of language discontinuity. LCODE was not related to student satisfaction with their schooling experiences. His LCODE construction as modified in the present study predicts as much of the variance of reading achievement as any other model in the current research literature.

Student Attitudes

The quality of school life measure retained in this study contained five sets of indicators tested using the Bulcock Attitudinal Inventory. The TCHR variable indicated positive attitudes of students toward their teachers. This may have reflected the generally held perception that teachers in the province of Newfoundland are very well respected. Another factor that could have led to this favourable measurement toward teachers was the high level of academic training of teachers in the province. Teachers averaged 6.4 years university level education, a statistic that placed them in a favourable position compared to the entire country (Department of Education, Newfoundland and Labrador, 1989).

Girls had more favourable attitudes toward schooling than boys. Bulcock's argument that outcome attitudes of one level are inputs to the next level were supported in the present study. This more favourable finding for girls was consistent with previous studies (Jackson, 1968; Tennebaum, 1940; Whitt, 1989).

QSL was found to have had a mediating effect on student achievement outcomes. When QSL was included in the analysis the relationship between GENDER and mathematics which was not predictive using only direct effects analysis attained values which were meaningful. Bulcock's approach to the construction of resource allocation models to study the effects of student attitudes on achievement outcomes proved to be very effective.

Significant Contributions to Research

The present study contributes to existing educational production function literature in several areas. These areas include use of QSL attitudinal indicators, use of the cognitive measure for language discontinuity, and the amount of variance predicted by the specified model. Each of these contributions is commented upon separately below.

Previous educational production function studies have utilized attitudinal indicators such as measures for locus of control. The author is not aware of previous educational production function research that has used QSL measures as developed in the BAI. As can

be seen in Table 4.9, the predictive power of the model to measure student well-being is greatly enhanced by the addition of the QSL variables to the model. As well QSL provides useful insight concerning the relationships between the cognitive outcome measures and retained exogenous variables. In particular, QSL had a strong mediating effect on the relationship between GENDER and MTHTOTNR.

A second contribution of the present study was the inclusion of student linguistic resources as exogenous variables. The measure of language discontinuity and the measure for linguistic resources the students already possessed were highly predictive of cognitive outcomes in both reading and mathematics. Student level linguistic resource measures have to the author's knowledge never been previously combined using such a large population. The decision to retain these variables as specified in the present model have been well supported by the present findings.

The modified Bulcock model used in the present study significantly extends efforts in the educational production function area. The model explains 80.5% of the variance in reading at the student level and 88.9%

of the variance in reading when analyzed at the school level. The model accounted for more than 47% of the variance in Mathematics at the student level and 56% at the school level. When QSL was included as a mediating variable 56.4% of the variance in well-being was explained at the student level of analysis and 67.4% at the school level. The predictive power of the specified model appears to have accounted for more variance than other production functions. Such accuracy in model specification was in itself a contribution to existing production function theory.

It can be argued from the present findings that the student linguistic indicators are the student level equivalent of verbal ability being an accurate indicator of who will make a good teacher, other things being equal. From a learning perspective this study provides compelling evidence that learning outcomes are affected a great deal by how students use language. This is an extension of educational production function research and previous research efforts which have not pursued the relationship between student language usage and learning outcomes. Moreover, it appears to have been a logical oversight of research not to have

pursued these relationships.

Policy Implications of Study

Discussion of policy and policy recommendations in the context of this study are based on the premise that there is a production function and that it is described by the relationships that were shown to be meaningful in the presentation of data. This approach is somewhat different from the theoretical construct offered by Monk (1992). As indicated in the introductory part of the study the aim of the present research was to more accurately identify meaningful relationships between resources and outcomes and thus to permit educators to use this increased knowledge to improve the system in whatever manner possible.

Government policies in Newfoundland focuses a great deal on the production side of the production function relationship. The Measurement and Evaluation Division of the Department of Education conducts ongoing research on criterion referenced testing in mathematics, reading, and other areas. This testing should continue as it permits educators and researchers accurate assessment as to how their programs are

working.

Government policies that could be influenced from the present study should address variables which have identified as being meaningfully related to educational outcomes. Policies could be developed to encourage more family participation in their schooling as advocated by Coleman (1988, 1991). Such involvement could be used to overcome the identified disadvantage children experience in schooling caused by language usage that digresses from the standard language code. Such an approach might allow students of lower socioeconomic background to wipe out the disadvantages in mathematics achievement that were associated in the present study with their lower socioeconomic status. Coleman (1988) argues that this social capital is an input into the schooling process that is manipulable.

Preschool policies that use the Coleman (1988) perception toward the concept of social capital might be undertaken to increase literacy levels in rural areas. Programs that work with parents in this milieu could be used to increase the linguistic resources that children possess when they begin school. As shown in the present study increases in linguistic resources

would result in enhanced outcomes.

The relationship of gender in the present study to outcomes might be a warning that in the Newfoundland school system programs to improve attitudes of males toward their schooling should be considered. Since the study showed that there is a relationship between attitudes and outcomes as have other previous studies (Bulcock, 1988b; Epstein & McPartland, 1976; Isherwood & Ahola, 1981; Whitt, 1989), perhaps policies could be developed with the goal being the fostering of more positive attitudes in males. This approach would be a departure from recent gender policies that have mainly addressed females.

Even though the present study was conducted in Newfoundland where the governance of education has been somewhat unique, implications from the present findings may have some applicability to other areas of the country, such as Ontario. The 1995 Begin-Caplan Royal Commission has recommended curriculum and evaluation changes for Ontario that will closely approximate what has been in effect in Newfoundland for at least a decade. Such control at the provincial level would allow the Ontario government to pursue policies that

have proven effective in Newfoundland. The Newfoundland government policy seems to have had an effect on gender differences in mathematics. Similar approaches could be investigated to determine possible utility for implementation in other jurisdictions.

Recommendations for Further Study

Recent writers advocate study of the relationships between resources and student achievement using a microlevel analysis (Brown & Saks, 1987; Monk, 1984; 1992). This study extends previous efforts in this area. As an area of research at the microlevel, more research can be conducted to determine which resources and which resource-uses contribute most to educational achievement. A comparison of the school level analysis (See Appendix F) with the microlevel approach provides support for the Brown and Saks' argument for study at the microlevel. The analytical approach using the student as the level of analysis identified more statistically meaningful relationships than the school level analysis.

The microlevel analytical approach used in the present study described substantive relationships

between retained independent variables and outcome achievement measures. Some of these relationships were not evident when analysis was conducted at the school level. Perhaps a future study could be undertaken using hierarchical linear modelling techniques to determine whether or not that approach would provide more accurate measurement of substantive relationships. In this way the within school effects could be extricated from the data. Although if Raudenbush's (personal communication, April 11, 1994) observation is valid, only marginal gains would be realized beyond this study. Many of the aggregated variables were dichotomous variables, hence, probably treated no differently by hierarchical linear estimators than the ordinary least square estimators.

Attempts should be made in future studies to determine why urban students outperformed rural students in this jurisdiction. Investigations could also be made to determine whether urban and rural influences are as important in other areas of the country. Such urban and rural investigations can try to separate reasons for the disparity in achievement measures.

An interesting finding in this study was the higher performance of females as compared to males. The present study seems to produce results that differ from previous findings, particularly in the mathematics achievement scores. Further study should be conducted to see if the present study is part of a trend or an outlier study that cannot be generalized to the entire Canadian population.

Research investigating Bernstein's (1961) theory of language discontinuity should also be conducted in another jurisdiction to determine whether or not it is as powerful a predictor of student outcomes as it is for the Newfoundland Grade 8 population. Bulcock's (1988) LCODE construction would be easy to operationalize for this purpose in almost any jurisdiction. The approach developed in the present study seems to have the potential to disprove recent findings of Herrstein and Murray (1994) in their bestselling book The bell curve. Herrstein and Murray argue that African Americans have I.Q.'s 20% lower than other Americans. A measurement of their language usage using Bulcock's LCODE variable as an intervening variable while controlling for factors such as

socioeconomic variables would probably wipe out the differential in I.Q. observed in the Herrstein and Murray book.

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APPENDIX A

Resource allocation indicators.

Table 1

Student background characteristics	Representative studies in which each was found significant.
Gender	Levin, 1970 Michelson, 1970 Murnane, 1973 Summers & Wolfe, 1975 Wolfe, 1977
Age	Levin, 1970 Michelson, 1970

Table 2

Teacher and classroom characteristics	Representative studies in which found significant
Class size	Mollenkopf, 1956 Bowles, 1969 Cohn, 1969 Averch & Kiesling, 1970 Klitgaard & Hall, 1975
Pupil-teacher ratio	Katzman, 1968 Kiesling, 1969 Brown, 1972

	Jencks, 1972 Sledge, 1975 Bidwell & Kasarda, 1975
Size of specific class	Thomas, 1962 Murnane, 1975 Summers & Wolfe, 1975
Number of special staff	Mollenkopf, 1956 Mayeske, 1969
Number of teacher preparations Number of days in school	Cohn, 1968 Kuhns, 1972 Bowles, 1969
Teacher experience	Levin, 1970 Guthrie, 1971 Brown, 1972 Boardman, 1973 Murnane, 1975 Summers & Wolfe, 1977 Rossmiller, 1978
SES background	Coleman, 1966 Hanushek, 1970 Rossmiller, 1978
Gender	Rossmiller, 1978
Salary	Thomas, 1962 Burkhead, 1967 Bowles & Levin, 1969 Cohn & Millman, 1975
Professional development and academic training	Cohn, 1968 Kiesling, 1970 Brown, 1972 Rossmiller, 1978 Summers & Wolfe, 1975

Appendix B

Resource and endogenous variables used in the Modified Measurement Model

Category	Mnemonic	Type	Description
Community Resource Variables	U_R	C	Population, R = 0-4999 U = 5000 or more
	REGION1	D	Avalon Peninsula (1),Otherwise (0)
	REGION2	D	South Coast (1),Otherwise (0)
	REGION3	D	Central Newfoundland(1) , Otherwise(0)
	REGION4	D	West Coast (1), Otherwise(0)
	REGION5	D	Labrador(1), Otherwise(0)
	SSEL	C	Socioeconomic level of community where school located[1]
School Resources	STR	C	Student-teacher ratio per school
	SCHTYPE2	D	Secondary school (1), or not (0)
	SCHTYPE3	D	All-grade school (K-12)(1), or not(0)
	SCHTYPE4	D	Other type of multi-grade school(1)or not (0)
Student Attributes	AGEMONTH	C	Age in months
	GENDER	D	1 = male, 2 = female
Student Linguistic Resources	VOCNR	C	Raw mean vocabulary score on CTBS.
	LCODE	C	Student's language code.[2]
Endogenous Variables	QSL	C	Perceived quality of student life[3]
	WELLB	C	Student well-being[4]

Footnotes:

1. SSEL, a linear composite variable was based on the Statistics Canada 1986 semi-decennial census data: (i) median male income per community, (ii) median female income per community, (iii) median family income per community, (iv) average number of rooms per person per household in community.

2. The LCODE variable was a continuous variable created by subtracting each CTBS language usage score (USGNR) from the highest USGNR score. Higher values represent greater departures from the standard language code.

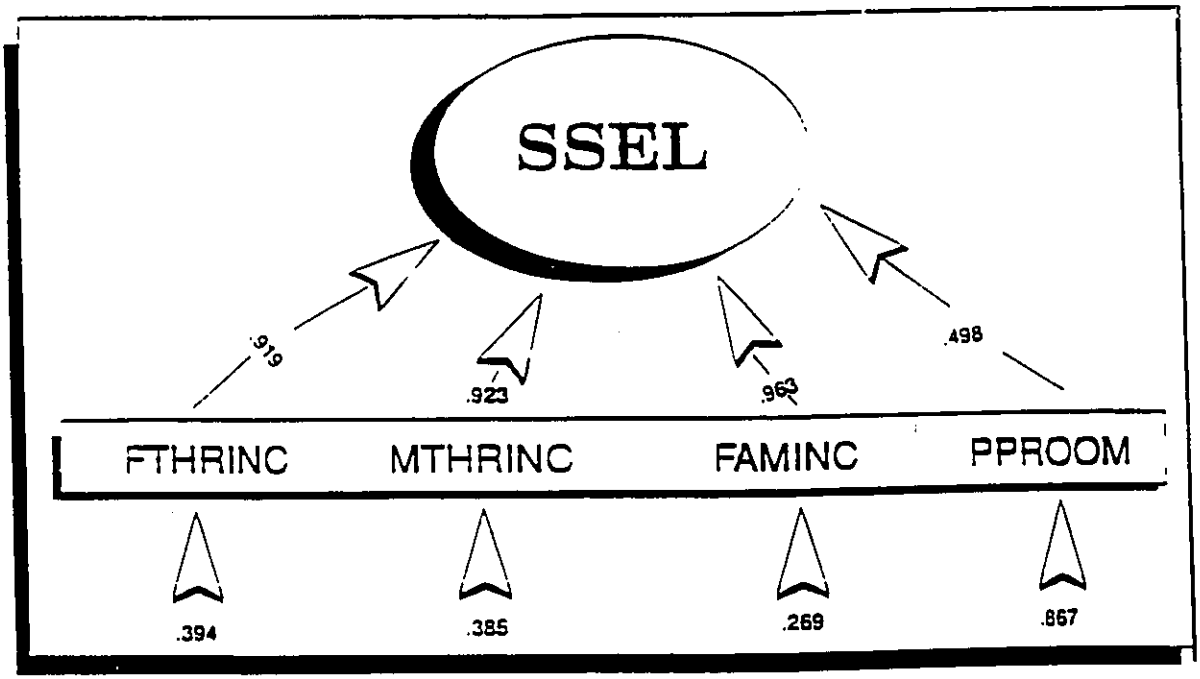
3. QSL in a 5 indicator second-order composite. Each QSL indicator is itself a weighted composite: (i) OPPY or the opportunity to learn,

(ii)ADVEN or adventure in learning, (iii)IDEN or identity as a student, (iv)STAT or student, and (v) TCHR or student perceptions of their teachers as supportive and caring.

4. WELLB is a two indicator second-order composite. The first indicator, SATIS, is a seven item composite measuring student satisfaction with schooling. The second DISSAT, or student dissatisfaction with schooling is also a seven item composite.

Key: C = continuous variable (interval or ratio scale), D= dichotomous or dummy variable coded 0-1 or 1-2.

Appendix C



Factor Analysis for Construction of Student Attitudinal Measure for SSEL

Indicators	Means	S_D	Factor Matrix	Communality	Eigen Value	Pct. Variation	Fsc. Matrix
FTHRINC	4887.63	6626.80	.919	.844	2.873	71.8	.320
MTHRINC	7363.26	2581.35	.923	.852	.831	20.8	.321
FAMINC	24908.65	10170.49	.963	.928	.246	6.1	.335
PPROOM	.552	.147	.498	.248	.051	1.3	.173

Alpha Unweighted Reliability = .744

Appendix D

Bulcock Attitudinal Inventory.

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
DEPARTMENT OF EDUCATION
DIVISION OF EVALUATION AND RESEARCH

LOCAL TEST 1: SCHOOL LIFE SURVEY

Directions: This is not a test. We want to know how you feel about your school. Each sentence on the next three pages begins with SCHOOL IS A PLACE WHERE particular things happen to you or where you feel a particular way.

We want you to say whether you definitely agree, mostly agree, mostly disagree, or definitely disagree with each sentence.

Please read each sentence carefully, then decide whether you

1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

with the sentence.

On the answer sheet find the number of the question you are working on and fill in the number of the answer which best describes how you feel. Don't forget to put SCHOOL IS A PLACE WHERE... at the beginning of each sentence so that it makes sense. The sample exercises at the right show you what to do.

SAMPLE EXERCISE

SCHOOL IS A PLACE WHERE

S1 I feel good about my work
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

S2 You have to put your school work first and your friends second
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

S3 I daydream a lot
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

ANSWERS

	1	2	3	4
S1	O	●	O	O
S2	O	O	●	O
S3	O	O	O	●

BEGIN WITH QUESTION 71

SCHOOL IS A PLACE WHERE...

71. I like to be
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

72. I feel restless
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

73. I am happy with how well I do
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

74. I like to learn new things
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

75. I learn to get along with other people
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

76. I know that people think a lot of me
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

77. teachers treat me fairly in class
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

SCHOOL IS A PLACE WHERE...

78. I get enjoyment
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

79. there is nothing exciting to do
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

80. I know the sorts of things I can do well
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

81. I find my work interesting
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

82. I can get along with most of the students even though they may not be my friends
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

83. people come to me for help
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

84. teachers listen to what I have to say
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

SCHOOL IS A PLACE WHERE...

85. I feel great
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

86. I feel bored
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

87. I know how to cope with the work
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

88. I like all my subjects
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

89. I have lots of friends
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

90. I feel important
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

91. teachers are usually fair
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

92. I really like to go
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

SCHOOL IS A PLACE WHERE...

93. I feel sad
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

94. I get satisfaction from the work I do
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

95. I am genuinely interested in my work
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

96. having different kinds of students in my class helps me get along with everyone
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

97. people credit me for what I can do
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

98. teachers give me the marks I deserve
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

99. learning is a lot of fun
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

SCHOOL IS A PLACE WHERE...

100. I feel lonely
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

101. I feel good about my work
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

102. I learn the things I need to know
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

103. you have to get along even with students you don't like
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

104. teachers ask me to help out
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

105. teachers help me to do my best
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

106. I feel happy
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

107. I get upset
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

SCHOOL IS A PLACE WHERE...

108. I can handle my school work
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

109. my friends and I get together on our own time to talk about what we have learned in class
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

110. I sometimes wish I were different than I am
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

111. people think I can do a lot of things
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

112. I like my teachers
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

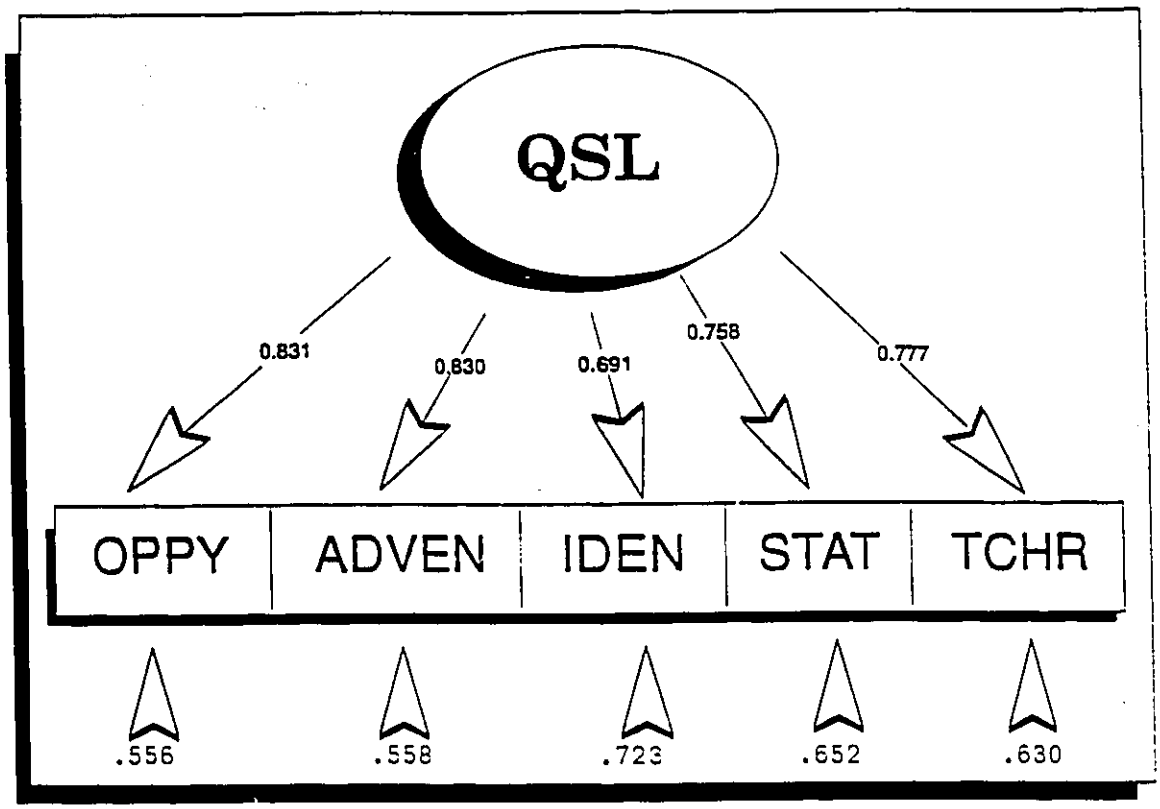
113. I feel proud to be a student
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

114. you are bossed around too much
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

115. the work I do is important to me
1) definitely agree
2) mostly agree
3) mostly disagree
4) definitely disagree

Appendix E

Construction of Variables that Compose QSL.

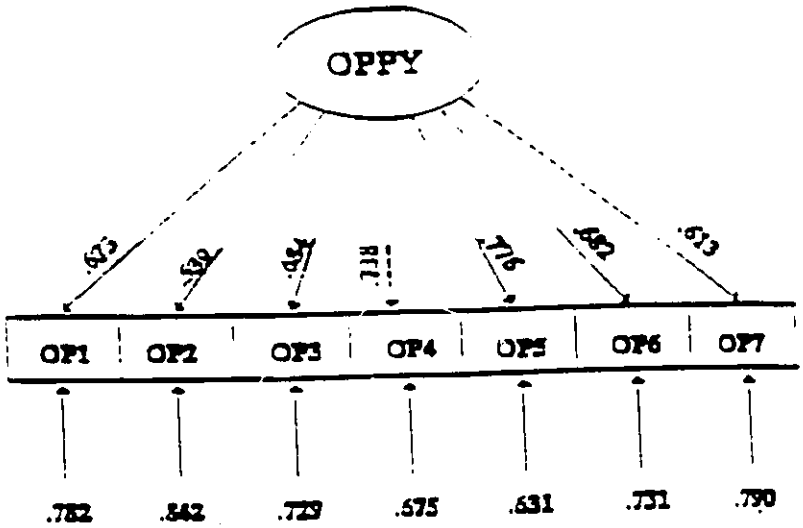


Factor Analysis for Construction of Student Attitudinal Measure for QSL

Indicators	Means	S_D	Factor Matrix	Communality	Eigen Value	Pct. Variation	Fsc. Matrix
OPPY	.016	.991	.831	.691	3.035	60.7	.274
ADVEN	.011	.997	.830	.688	.729	14.6	.273
IDEN	.011	.995	.691	.477	.489	9.8	.228
STAT	.012	.994	.758	.575	.421	8.4	.250
TCHR	.014	.996	.777	.603	.326	6.5	.256

Alpha Unweighted Reliabilty = .837

Opportunity to Learn Measurement Model

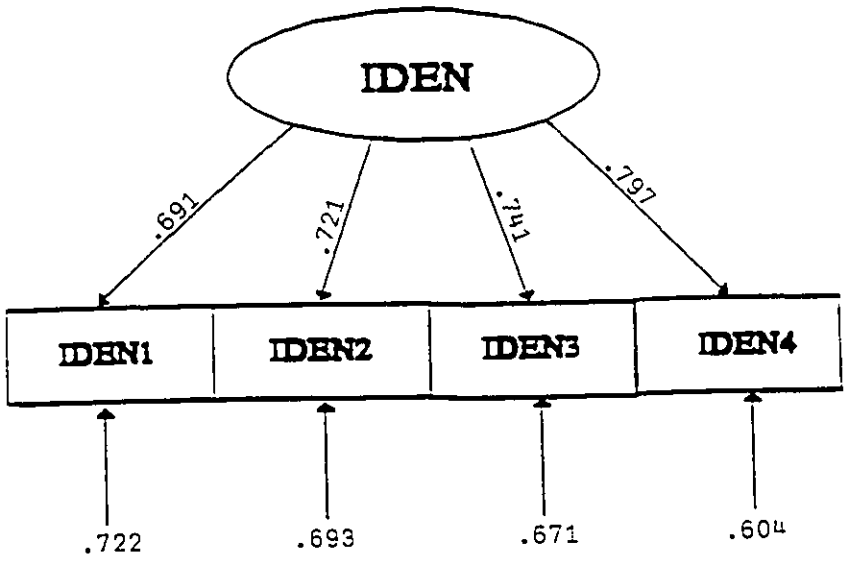


Factor Analysis for Construction of Student Attitudinal Measure for OPPY

	Means	S_n	Factor Matrix	Communality	Eigen Value	Pct. Variation	Fsc. Matrix
OOPY1	3.09	.877	.623	.388	3.134	44.8	.199
OPPY2	3.35	.677	.539	.291	.810	11.6	.172
OPPY3	3.09	.692	.684	.468	.784	11.2	.218
OPPY4	2.98	.749	.738	.544	.744	10.6	.235
OPPY5	2.99	.731	.776	.602	.762	8.0	.247
OPPY6	3.15	.714	.682	.466	.521	7.4	.218
OPPY7	3.28	.820	.613	.375	.445	6.4	.195

Alpha Unweighted Reliability = .789

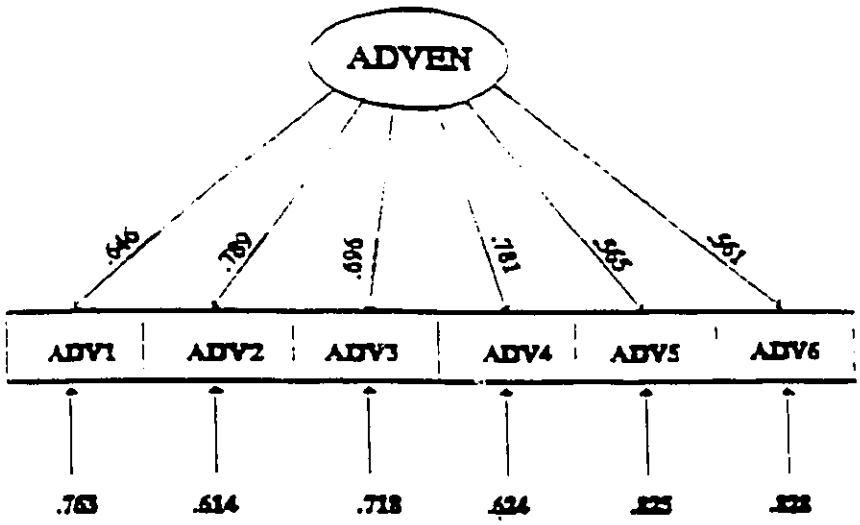
Student Identity Measurement Model



Factor Analysis for Construction of Student Attitudinal Measure for IDEN

	Means	S_D	Factor Matrix	Communality	Eigen Value	Pct. Variation	Fsc. Matrix
IDEN1	3.42		.691				
IDEN2	3.27		.721				
IDEN3	3.41		.741				
IDEN4	3.19		.797				
IDEN5	2.77		.991				
IDEN6	2.48		1.058				

The Adventure in Learning Measurement Model

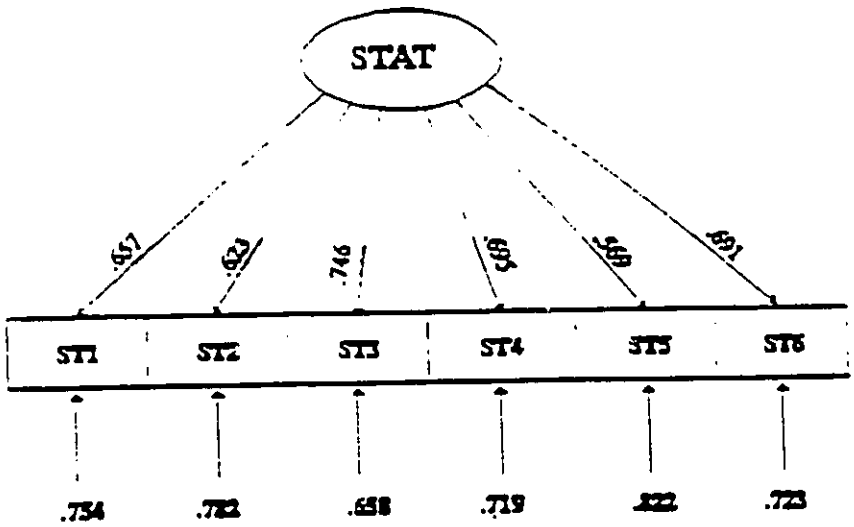


Factor Analysis for Construction of Student Attitudinal Measure for ADVEN

	Means	S_n	Factor Matrix	Communality	Eigen Value	Pct. Variation	Fsc. Matri
ADVEN1	3.41	.698	.646	.418	2.767	46.1	.234
ADVEN2	2.67	.814	.789	.622	.814	13.6	.285
ADVEN3	2.29	.910	.696	.484	.775	12.9	.251
ADVEN4	2.81	.783	.781	.610	.672	11.2	.282
ADVEN5	3.37	.728	.565	.319	.536	8.9	.204
ADVEN6	2.06	.952	.561	.314	.436	7.3	.203

Alpha Unweighted Reliability = .756

Status as Student Measurement Model

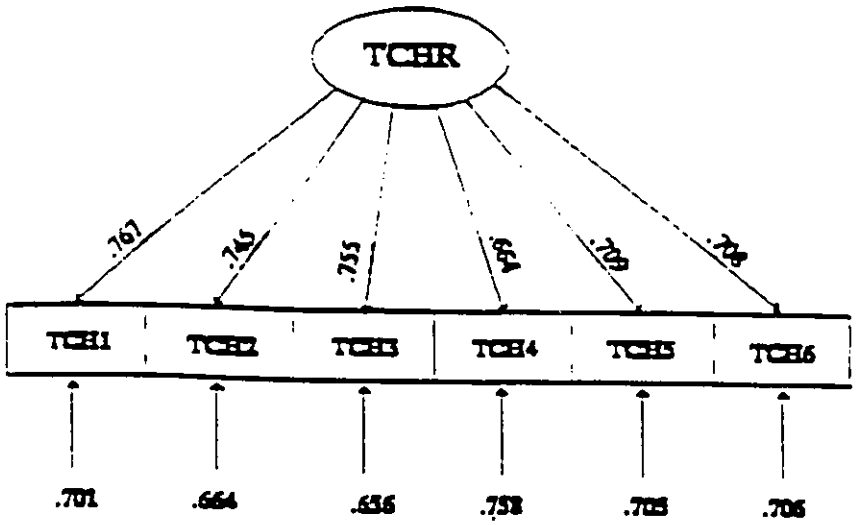


Factor Analysis for Construction of Student Attitudinal Measure for STAT

	Means	S_D	Factor Matrix	Communality	Eigen Value	Pct. Variation	Fsc. Matrix
STAT1	2.56	.792	.657	.414	2.662	44.4	.247
STAT2	2.41	.892	.623	.388	.833	13.9	.234
STAT3	2.67	.808	.746	.557	.719	12.0	.280
STAT4	2.94	.824	.695	.483	.659	11.0	.261
STAT5	2.69	.872	.569	.324	.607	10.1	.214
STAT6	2.76	.811	.691	.477	.520	8.7	.260

Alpha Unweighted Reliability = .744

Student Perception of Teachers Measurement Model

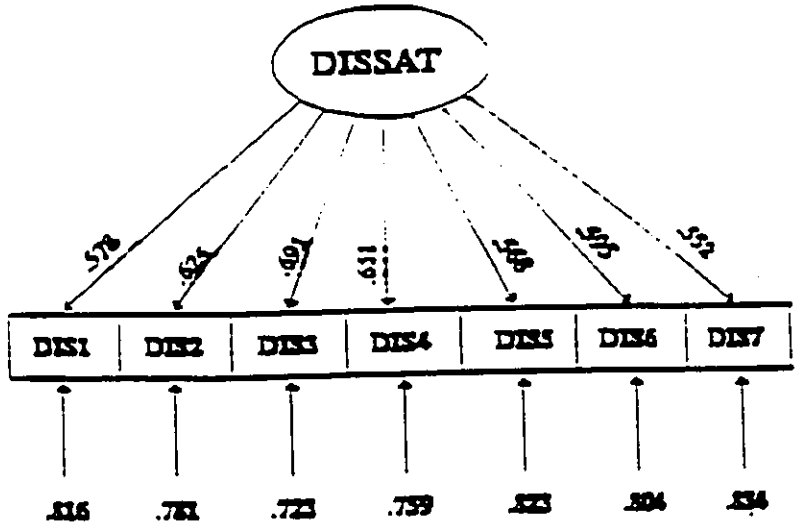


Factor Analysis for Construction of Student Attitudinal Measure for TCHR

	Means	S_n	Factor Matrix	Communality	Eigen Value	Pct. Variation	Fsc. Matrix
TCHR1	3.19	.839	.767	.588	3.158	52.6	.243
TCHR2	3.11	.842	.745	.555	.671	11.2	.236
TCHR3	3.10	.820	.755	.570	.612	10.2	.239
TCHR4	3.34	.793	.664	.440	.582	9.7	.210
TCHR5	3.36	.769	.709	.502	.517	8.6	.224
TCHR6	2,90	.811	.708	.501	.460	7.7	.224

Alpha Unweighted Reliability = .820

Dissatisfaction with Schooling Measurement Model

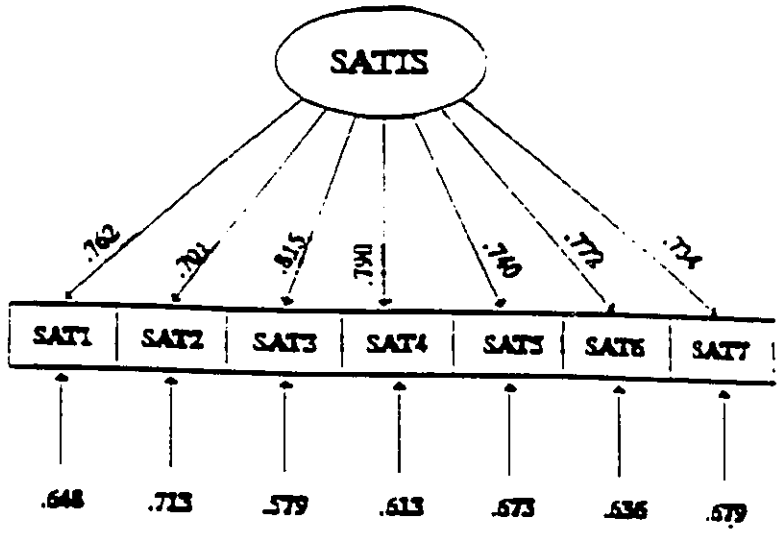


Factor Analysis for Construction of Student Attitudinal Measure for DISSAT

	Means	S_D	Factor Matrix	Communality	Eigen Value	Pct. Variation	Fsc. Matrix
DISSAT1	2.36	.876	.578	.334	2.607	37.2	.222
DISSAT2	2.14	.938	.625	.390	1.023	14.6	.240
DISSAT3	2.49	.953	.691	.477	.803	11.5	.265
DISSAT4	1.71	.802	.651	.423	.245	10.6	.250
DISSAT5	1.62	.834	.568	.323	.692	9.9	.218
DISSAT6	2.03	.844	.595	.354	.609	8.7	.228
DISSAT7	2.13	.972	.552	.305	.520	7.4	.212

Alpha Unweighted Reliability = .716

Satisfaction with Schooling Measurement Model

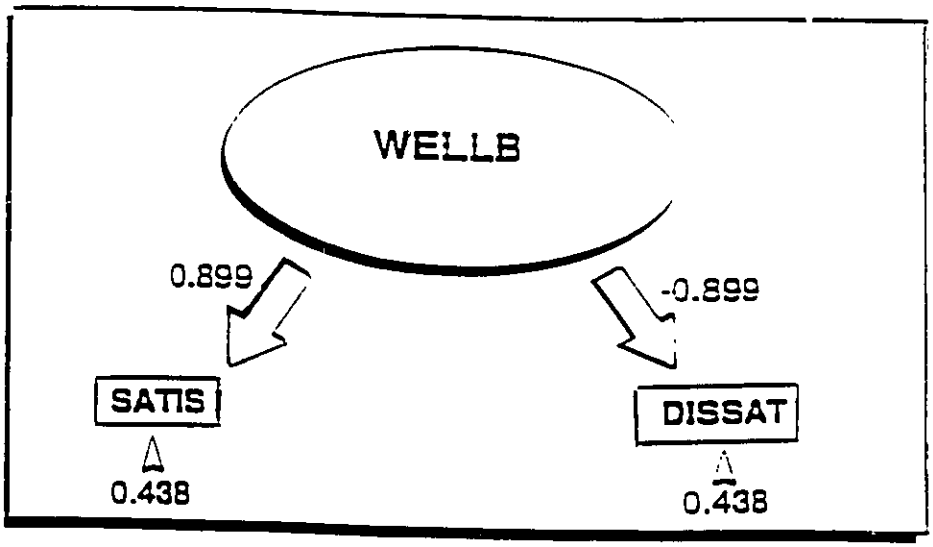


Factor Analysis for Construction of Student Attitudinal Measure for SATIS

	Means	S_D	Factor Matrix	Communality	Eigen Value	Pct. Variation	Fsc. Matrix
SATIS1	2.52	.845	.762	.581	4.043	57.8	.188
SATIS2	2.68	.866	.701	.491	.630	9.0	.173
SATIS3	2.43	.867	.815	.664	.570	8.1	.202
SATIS4	2.28	.943	.790	.623	.513	7.3	.195
SATIS5	2.64	.882	.740	.547	.465	6.6	.183
SATIS6	2.79	.837	.772	.600	.403	5.8	.191
SATIS7	2.84	.898	.734	.539	.377	5.4	.182

Alpha Unweighted Reliabilty = .877

Factor construction for Well-Being.



Factor Analysis for Construction of Student Attitudinal Measure for WELLB

Indicators	Means	S_D	Factor Matrix	Communality	Eigen Value	Pct. Variation	Fsc. Matrix
SATIS	.001	1.00	.899	.808	1.616	80.8	.556
DISSAT	-.003	.999	-.899	.808	.384	19.2	-.556

Alpha Unweighted Reliability =

Appendix F

Multiple regression analysis at the school level.

One of the difficulties referenced in the research design and presentation of data centred on the level of analysis appropriate for this study. Brown and Saks (1987) advocated analysis at the microlevel or student level of analysis. The Brown and Saks approach was employed in the main measurement approach in the present study. Bryk and Raudenbush (1993) cautioned about the problems of analyses at both the individual level and by aggregating data at the school level. However, Raudenbush (1994) pointed out that certain types of variables, such as socioeconomic variables, behave consistently on either level of analyses.

As mentioned in the text, hierarchical linear modelling techniques would likely be the most appropriate method of analyzing the data in this study. Since that method is not feasible in this study the researcher has conducted the data analyses at both the student (individual) level and at the school level. Data analysis at the individual level tends to be conservative in predicting the measurement capability of the resource model, whereas, measurement at the school level tends to overestimate the explanatory power of the model. This can be seen by the R^2 values

in the tables presented below.

Table 4.4-Sch.A is a presentation of the school level variables depicting the relationship between the LNGTOTNR and independent variables aggregated at the school level. The results in this table are not very different from those presented in Table 4.4 as presented in Chapter 4. Two independent variables, VOCNR and LCODE, contributed to the model at the student level. Only VOCNRM and LCODEM were substantive predictors when analyses were conducted at the school level. Coincidentally, even when direct, indirect, and total effects were estimated only those variables that were predictors at the student level using direct effects only proved to be strong predictors at the school level. As predicted by Bryk and Raudenbush (1993), the R^2 value at the school level was inflated.

Table 4.4-Sch.A
Direct, Indirect, And Total Effects of Indicator Variables on Reading Literacy with QSL as a Mediating Variable Aggregated at the School Level

Variable	Direct Effects	t	Indirect Effects	Total Effects	t
U_RM	-.0629	- 2.218	.0039	-.0590	.8766
REG2M	.0789	2.958	-.0048	.0741	1.1021
REG3M	.0462	1.686	-.0028	.0434	.6443
REG4M	.0613	2.237	-.0038	.0575	.8543
REG5M	.1034	3.594	-.0063	.0971	1.4470
SELM	-.0170	- .646	.0010	-.0160	.2374
SCHTYP3M	-.0223	- .821	.0014	-.0209	.3101
SCHTYP4M	.0389	1.542	-.0024	.0365	.5417
STRM	-.0252	- .885	.0015	-.0237	.3516
AGEMONTM	-.0006	- .024	.00003	-.0006	.0089
SEXM	.0726	3.089	-.0045	.0681	1.0124
VOCNRM	.1735	4.735	-.0106	.1629	2.4489
LCODEM	-.7928	-21.844	.0486	-.7442	16.5248
QSLM	-.0613	- 2.502			

R^2 = .8895 n = 222

Resource and endogenous variables used in the resource allocation model aggregated at the school level.

U_RM, size of community where school located;
REG1M, Avalon Peninsula; REG2M, South Coast;
REG3M, Central Newfoundland; REG4M, Western Newfoundland; REG5M, Labrador;
SELM, socioeconomic level of community where school located;
SCHTYP2M, secondary school; SCHTYP3M, all-grade school; SCHTYP4M, other type of multi-graded school;
AGEMONTM, age in months; SEXM, gender;
VOCNRM, raw vocabulary score on CTBS; LCODEM, student's measure of language discontinuity.

Table 4.5-Sch.A.
Direct, Indirect, And Total Effects of Indicator Variables on Mathematics Numeracy with QSL as a Mediating Variable Aggregated at the School Level

Variable	Direct Effects	t	Indirect Effects	Total Effects	t
U_RM	-.0638	-1.102	-.0027	-.0665	0.9885
REG2M	.0388	.708	.0017	.0405	0.6011
REG3M	.0863	1.529	.0037	.0900	1.3397
REG4M	.1490	2.711	.0039	.1461	2.1683
REG5M	.0645	1.087	.0002	.0647	0.9617
SELM	.0071	.131	.0003	.0074	0.1098
SCHTYP3M	.0812	1.454	.0035	.0847	1.2609
SCHTYP4M	.0183	.355	.0008	.0191	0.2834
STRM	-.0176	- .301	-.0008	-.0184	0.2730
AGEMONTM	-.0167	- .355	-.0008	-.0175	0.2596
SEXM	.0634	1.313	.0027	.0661	0.9822
VOCNRM	.2547	3.379	.0190	.2656	4.0862
LCODEM	-.5154	-7.144	.1356	-.4798	16.426
QSLM	.0427	.847			

R^2 = .5638 n = 222

Table 4.5-Sch.A depicts the relationship between MTHTOTNR and independent variables aggregated at the school level. Very similar comments can be made about the changes in values in this table as were made about the relationship between LNGTOTNR and independent variables. Three predictor variables at the student level were substantive indicators of mathematics achievement; SSEL, VOCNR, and LCODE. The indirect effects of GENDER on MTHTOTNR were meaningful. Only three predictors were substantively related to mathematics outcomes at the school level; REG4M, VOCNRM, and LCODEM .The R^2 value is increased from the individual to the school level.

Table 4.6-Sch.A
Direct, Indirect, And Total Effects of Indicator Variables on Student Well-Being with QSL as a Mediating Variable Aggregated at the School Level

Variable	Direct Effects	t	Indirect Effects	Total Effects	t
U_RM	.0155	.308	.0126	.0281	.4170
REG2M	-.1523	- 3.220	-.1237	-.2860	4.4270
REG3M	-.0085	- .176	-.0069	-.0155	.2299
REG4M	-.1149	- 2.363	-.0933	-.2182	3.3163
REG5M	-.0217	- .425	-.0176	-.0393	.5834
SELM	.0318	.684	.0026	.0344	.5105
SCHTYP3M	.0029	.059	.0024	.0053	.0788
SCHTYP4M	-.0134	- .704	-.0256	-.0670	.9960
STRM	.0174	.345	.0141	.0315	.4675
AGEMONTM	.0311	.769	.0253	.0564	.8379
SEXM	.0176	.423	.0143	.0319	.4734
VOCNRM	-.0391	- .602	-.0318	-.0719	1.0692
LCODEM	.0376	.585	.0305	.0681	1.0128
QSLM	.8124	18.716			

R^2 = .6742 n = 222

Table 4.6-Sch.A is a presentation of the relationships between independent variables and WELLB (student well-being). In the analysis at the student level GENDER was a substantive predictor of WELLB. At the school level two indicators proved to be substantive indicators of student well-being. These were REG2M and REG4M.

Differences between Student and School Levels

Models constructed at the student level of analysis identified more of the substantive relationships between the independent variables and the three achievement outcomes measures. This finding was consistent with the measurement suggestions offered by Brown and Saks (1987). On the other hand some relationships which were not substantive at the student level produced meaningful results at the school level.

In the model specified to measure the relationship between reading literacy and retained indicators, LCODE and VOCNR and their school level equivalents were the most powerful predictors at both the student level and the school level of analysis. This indicates that these variables were accurate predictors at both levels.

When analyzed at the student level SSEL had substantive meaningfulness as a predictor of MTHTOTNR. At the school level of aggregation this difference disappeared. Other variables which had not produced meaningful differences at the student level surfaced as being meaningful predictors at the school level. Students in REGION4, the West Coast, achieved substantially higher achievement in MTHTOTNR at the school level. VOCNRM and LCODEM produced substantial percentages of the variance of MTHTOTNR at the school level.

The relationships between WELLB and indicator variables at the school level produced meaningful relationships between REG2M, the South Coast, and REG4M, the West Coast and WELLB. The negative coefficients of both measures indicate that at the school level students in both these regions had less favourable attitudes toward school than students in REG1M, the Avalon Peninsula. This difference may have been caused because of the predominately rural nature of the West Coast and the South Coast. Many of the

schools in both regions would be more isolated and would likely offer less extra-curricular and co-curricular activities.

Appendix G

Correlation Matrix for Variables Used in Resource Allocation Model

	U.R.	Region1	Region2	Region3	Region4	Region 5	SSEL	SCH TYPE2	SCH TYPE3	SCH TYPE4	STR	Age Month	Gender	VOCN R	LCode	QSL	Math TOTNR	Lng Totnr	Well B.
U.R.	1.000																		
Region1	-.3246	1.000																	
Region2	.1667	-.2790	1.000																
Region3	.2633	.4776	-.1926	1.000															
Region4	.0517	-.3927	-.1583	-.2711	1.000														
Region5	-.1026	-.2096	-.0843	-.1447	-.1190	1.000													
SSEL	-.5026	.1628	-.1695	-.1452	-.0380	.2044	1.000												
SCHTYPE 2	-.0515	-.0599	-.0345	.0574	.0178	-.0142	.0002	1.000											
SCHTYPE 3	.3057	-.2299	.1881	.0178	.0251	.1275	.1100	-.4171	1.000										
SCHTYPE 4	-.1673	.2317	-.0998	-.0891	-.0698	-.0776	.0798	-.7558	-.2586	1.000									
STR	-.3668	.4030	-.1167	-.0517	-.2459	-.1929	.2506	.0555	-.3436	.1905	1.000								
AGE MONTH	.0022	-.0057	.0167	-.0099	.0131	-.0127	-.0062	.0063	.0009	-.0074	-.0082	1.000							
GENDER	-.0113	.0175	.0003	-.0197	-.0039	.0054	-.0089	-.0119	.0045	.0161	.0230	.0024	1.000						
VOCNR	-.2165	.1413	-.0628	-.0947	-.0212	-.0043	.1695	.0069	-.1078	.0712	.1561	-.0467	.0090	1.000					
LCODE	.1620	-.1528	.0292	.1063	.0477	.0071	-.1362	.0258	.0791	.0855	-.1474	.0694	-.2140	-.1676	1.000				
QSL	.0541	.0338	.0128	.0022	-.0063	-.0796	-.0715	-.0596	.0314	.0113	-.0348	-.0088	.1841	.0983	-.1939	1.000			
LNG TOTNR	-.1883	.1321	.0211	-.1066	-.0119	.0168	.1447	-.0202	-.0862	.0847	.1411	-.0601	.2541	.6791	-.8858	.1984	1.000		
MTH TOTNR	-.1811	.1282	-.0447	-.1162	.0013	.0020	.1467	-.0301	.0685	.0826	.1183	-.0483	.0817	.5996	-.6447	.1721	.7880	1.000	
WELL B.	.0436	.0458	-.0202	.0195	-.0206	-.0717	-.0608	-.0292	.0249	.0134	-.0268	-.0139	.1937	.0319	-.1289	.7341	.1273	.0084	1.000

Appendix H

Letters of permission to and from the Department of Education.

UNIVERSITÉ D'OTTAWA
UNIVERSITY OF OTTAWA

FACULTÉ D'ÉDUCATION
FACULTY OF EDUCATION

October 9. 1989

Dr. Lenora Perry-Fagan
Director of Evaluation and Measurement
Department of Education
Government of Newfoundland
Confederation Building
St. John's. NF

Dear Dr. Perry-Fagan:

I am presently completing studies towards a doctoral degree in educational administration at the University of Ottawa. As part of my degree program I wish to complete a doctoral dissertation which will examine the relationship between resource allocation and student achievement. I request permission from your department to use results of both your CTBS testing and your attitudinal questionnaires as developed by Dr. Jeffrey Bulcock.

If your department agrees to make the data available to me. I will ensure that student anonymity and individual test scores are kept confidential. I will happily meet with you to outline my research plans later in December when I visit your ministry.

Yours truly.

Noel P. Hurley

Appendix H

Letters of permission to and from the Department of Education.

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR
DEPARTMENT OF EDUCATION

P. O. BOX 4750
ST. JOHN'S. NFLD.
A1C 5T7
FAX #576-5896

1989 10 19

Mr. Noel P. Hurley
P. O. Box 82
Lamoureux Hall
135 Jean-Jacques Lussier
Faculty of Education
University of Ottawa
Ottawa, ON
K1N 6N5

Dear Mr. ~~Hurley~~ Noel:

I would be pleased to make the CTBS results available for your dissertation research. Of course, we shall have to ask that you insure student anonymity and that all results will be kept strictly confidential.

I shall discuss the attitude questionnaire further with you when we meet regarding your research.

Sincerely,

LENORA PERRY FAGAN, Ph.D.
Director
Evaluation and Research

LPF:rc

cc: Mr. R. Blagdon