WHY DO STUDENTS PERFORM POORLY IN MATHEMATICS AND SCIENCE? A STUDY OF ATTRIBUTIONS MADE BY HIGH SCHOOL TEACHERS, UNIVERSITY INSTRUCTORS, AND UNIVERSITY STUDENTS

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Why Do Students Perform Poorly in Mathematics and Science? A Study of the Attributions Made by High School Teachers, University Instructors, and University Students

by
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Abstract

This study was based on the premise that it is important to identify and clarify the attributions that students and teachers make about their performance in school. These attributions underlie the expectations that students and teachers hold for each other and may influence how students perform academically.

The investigation focused on the attributions for poor performance by students in mathematics and science made by the participants in the transitional stage between secondary and tertiary levels of the educational system. High school teachers, university instructors, and first year university students were administered surveys containing a set of statements attributing poor performance by students to a variety of causes. Measures of student performance were the marks students obtained from local high school evaluation, provincial public exams, and university exams in mathematics and science courses.

Factor analysis of the attribution statements from the surveys provided an indication of how each group of respondents distinguished between various types of attributions. This analysis also allowed the attributions to be grouped into categories. Mean response scores on the attribution statements were used to determine the relative emphasis given to different attributions. Finally, the relationships between attributions and achievement were examined in light of the results of a regression analysis of and correlations between scores on the attributional measures and students' marks on the achievement measures.

University instructors and high school teachers identified lack of student effort, lack of student ability, teacher/instructor characteristics, and situational characteristics as distinct categories of attributions. Both groups emphasized lack of student effort as the major cause of poor performance by students at the secondary and post-secondary levels. However, instructors gave equal emphasis to inadequacies of the high schools and the high school teachers in preparing students for university. Students did not distinguish between lack of ability and lack of effort attributions. They identified effort and ability of students in general, personal effort and ability, teacher/instructor characteristics, and situational characteristics as categories of attributions. At the beginning of their first semester at university, students echoed their high school teachers in emphasizing lack of effort by students in general as a major cause of poor performance. At the end of the semester, students echoed their instructors when they emphasized lack of preparation in high school.

Relationships between teachers' attributions and the marks they assigned students from high school evaluation were mostly negligible. This may have been due to the restricted range of response scores from the attribution survey. Negative correlations were obtained between students' attribution scores and their marks on all achievement measures. Particularly significant were those relationships between attributions pertaining to personal lack of ability and effort and achievement.

Several observations from this study may be made.

1. The attributions that students emphasize are influenced by those made by their high school teachers and university instructors.

2. Students seem to confuse the concepts of ability and effort. This suggests that they cannot decide whether lack of ability or lack of effort causes their poor performance.

3. Attributions to personal lack of ability and personal lack of effort are significantly related to students' achievement. These statements may be used to predict students' performance in university and their intentions to persist in mathematics and science at the post-secondary level.

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CHAPTER I

Purpose And Development Of The Study

Statement of the Problem

Attributions by students and teachers to the various factors that influence the teaching and learning of mathematics and science formed the focus of this investigation. The study was based on the premise that these attributions are important determinants of behaviour. The context of the study was the transitional stage between secondary and tertiary education. Research has shown that students' experiences at this stage can have long-lasting effects on their orientation and motivation throughout their academic careers (Beard & Senior, 1980). The subjects involved were high school teachers, university instructors, and students at the beginning and end of their first semester at university.

Specifically, the investigation had two principal objectives. First, it proposed to examine the attributions of teachers and students as to what constituted the major reasons for poor performance by students in mathematics and science. Second, it proposed to explore the relationships between these attributions and student achievement in these subjects. The importance of a study of these attributions lies in its potential contribution towards explaining how the expectations of teachers and students affect their behaviour and student achievement. Expectations are predictions about what will happen in certain situations. Those held by teachers and students are typically informal and often difficult to articulate. Attribution theorists propose that explanations of the causes for academic success or failure form a basis for the expectations that people hold. Therefore, a study of these attributions may provide a better understanding of how expectations influence student achievement.

An examination of the extensive research literature on teacher and student expectancies revealed many studies concerned with how expectations affect student achievement. Few studies, however, deal with whether different expectations actually exist at the high school and university levels and the influence this may have on student performance at these levels. Therefore, this became another important focus of this investigation.

Research Background and Theoretical Context

Attribution theory proposes that expectations in achievement related contexts are determined by perceived ability and planned effort expenditure relative to the perceived difficulty of the task (Heider, 1958). According to attribution theorists, the explanations that people give for their own or others' success or failure have a number of consequences. How they perceive the likelihood of alternative causal factors influences their emotional reactions to their performance, their expectations for future performance, their subsequent achievement behaviour, and their actual future performance (Weiner, 1980).

Thus, if teachers, instructors, and students have different expectations, this can be determined from the relative emphasis that they give to various attributions for problems in mathematics and science achievement. If the emphases are different for the various attribution categories, one can assume that expectations for student performance are different.

In the case of teachers' perceptions, researchers have suggested that the most important beliefs that teachers have about students are those that deal with teachers' perceptions of or attributions for the causes of students' performance (Darley & Fazio, 1980; Peterson & Barger, 1984). Studies by Cooper and Good (1983) have shown that "differing attributions have differing teacher-involvement implications" (p. 96). Attributions may influence teachers' behaviour towards students if teachers attribute different causes for failure to students for whom they hold different expectations.

That teachers do form expectancies for student performance is well documented in the literature. The issue of the extent to which these expectations influence student achievement, however, is both complex and controversial. Beginning with the publication of Pygmalion in the Classroom (Rosenthal & Jacobson, 1968), there have been more than 400 published reports relating to what has been referred to as the educational self-fulfilling prophecy; that is, whether students perform in accordance with how their teachers expect them to perform. Recent reviews of these studies by Brophy (1983), Cooper and Good (1983), Dusek (1985), Jussim (1986) and Wineburg (1987) illustrate the multidimensional aspects involved. These include: (a) consequences of induced expectations; (b) observations of naturally occurring expectations; (c) how teachers form expectancies for student achievement; (d) how expectancy effects are communicated to students; and (e) the ultimate impact of expectancies on student achievement. The ongoing interest in what has become a major area of research is an indication of both its theoretical and practical importance.

The original "Pygmalion" study described how students, whom teachers were led to believe were 'late bloomers', performed better on reading and IQ tests than a control group of students. This study has been criticized, particularly for its claim that students' IQ could be affected by teacher expectations. However, Wineburg (1987) does say that "One could grant the possibility that teachers' expectations affected student achievement, because expectations guided what teachers chose to teach and consequently what students learned" (p. 29). Other investigations in which teachers' expectations were experimentally manipulated have been criticized for lack of validity. Experienced teachers will form their own expectations regardless of what they have been led to believe.

Brophy and Good (1970) were among the first to study naturally occurring expectations. They asked teachers to rank students in order of expected achievement and then observed high and low expectation students. High expectation students initiated more contacts with teachers and volunteered more answers than low expectation students. When low expectation students gave right answers they were less likely to receive praise, and when they gave wrong answers they were less likely to receive specific feedback. These researchers suggested that high teacher expectations will lead to or sustain student achievement at high levels, while low expectations will diminish or support low student achievement.

In 1971, Gage noted that the research up to that point showed that teacher expectancies influenced what teachers try to teach and thus what students learn. Borg (1979) documented that students who are taught less difficult material and who are presented with less novel instruction will eventually show correspondingly weaker performance. Brophy (1983) concludes most differential teacher expectations are accurate and reality based and most differential teacher interaction with students represents appropriate response to differential student need. If this is true, then it is necessary to gain a better understanding of the basis on which these expectations are formed, especially if student performance is generally low. The implicit assumption is that if teachers fail to see a relationship between their behaviour and students' performance, they would be less likely to work to improve these students' performance (Clarke & Peterson, 1986).

In the case of students' perceptions, Parsons (1983) found that students' interpretations of events, i.e. attributions, self-concepts of abilities, and perceptions of the beliefs of parents and teachers, were more influential determinants of expectancies, values, and course plans than were objective indicators of events, such as previous grades and actual teachers' behaviours. In addition, self-concept of their ability was as powerful a predictor of subsequent grades as was their past performance in mathematics. Parsons proposed that expectancies were caused by self-concept of ability, and self-concept of ability was determined by perceptions of both the effort required to do well and the difficulty of the task.

Covington and Omelich (1981) have argued that self-perception of ability is the most important causal factor in most achievement behaviours. Expectations for the future are diminished when an individual does not feel capable of successful performance. This is particularly true in academic settings where academic achievement is so important and is so often perceived by students to be a measure of their personal value. To counteract the threat to their self-concept, students tend to blame the system, not themselves. In a series of studies, DeBoer (1985, 1986, 1987) found that students are apt to attribute success to effort and ability, but attribute failure to external factors such as difficulty of the task or poor instruction.

Local Aspects of the Problem

As well as attempting to contribute to a general understanding of the interaction of attributions, expectancies and achievement, this study has a particular focus on a problem within a specific school system. The study grew out of a broader investigation by a Task Force on Mathematics and Science Education established in June, 1988 by the Government of Newfoundland and

Labrador. The mandate of the Task Force was to examine all aspects of mathematics and science education throughout the provincial school system. However, the investigation was prompted by expressions of public concern over low levels of achievement by students in mathematics and science programs in first-year university.

For several years previous, a pervasive concern had been expressed in educational journals, in academic circles, and in the general population that a gap existed between secondary and post-secondary levels of education in Newfoundland. This gap was usually defined in terms of a discrepancy between what was expected of students in high school and what was expected of students in university. The assumption was that lower expectations at the high school level allowed students to obtain higher grades in high school exams, but did not prepare them for the more rigorous expectations of the university environment.

An analysis conducted by the School of General Studies at Memorial University of Newfoundland in the spring of 1986 compared the performance of students in high school and university courses in the same subject areas. The statistics showed that students' grades are generally lower in university (Shawyer, 1987). These findings were consistent with a national study carried out a few years earlier by the Council of Deans of Science of Ontario universities. However, as Table 1.1 shows, the Memorial study revealed that students who had taken the academic mathematics course (Mathematics 3203) in high school, that is the majority of students, had to have obtained a grade of 80% in that course in order to have obtained a passing grade of 50% in the first-year pre-Calculus university course. The implication is that the majority of students who had passed high school mathematics could expect to fail their first-year university mathematics course.

A view on science achievement is provided by the English Canadian part of the Second International Science Study carried out through the 1980's by the International Association for the Evaluation of Educational Achievement. The results of three specialized tests containing core items in Biology, Chemistry, and Physics, administered to samples of students in Grades 12 and 13, reveal scores of less than 50% for students in all Canadian provinces. As Figure 1.1 shows, however, Newfoundland students were from 10% to 15% lower than the highest ranking province in all three subjects, were lowest in Physics, second lowest in Chemistry, and third lowest in Biology. Yet, high school results do not reflect these low levels of achievement. Typically, as illustrated in Figure 1.2, the average grade of high school students graduating in these science courses is approximately 70%.

The picture that emerges from these and other studies is that there are problems in mathematics and science achievement at the high school and university levels for Newfoundland students. Clearly, there is a discrepancy between achievement levels in high school mathematics and science courses and achievement levels in first-year university courses. A similar discrepancy exists

Table 1.1

Comparison of High School and University Performance

HS Advanced 3201/Mathematics 150A/B

Sample Size - 286 Correlation Coefficient - 0.66

High School Mark		Expected MUN Mark	
HS	90%	MUN	78%
HS	80%	MUN	58%
HS	77%	MUN	50%
HS	70%	MUN	38%
HS	60%	MUN	18%

HS Advanced 3201/Mathematics 1010

Sample Size - 184 Correlation Coefficient - 0.50

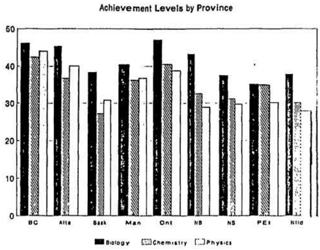
High School Mark		Expected MUN Mark	
HS	90%	MUN	76%
HS	80%	MUN	68%
HS	70%	MUN	60%
HS	59%	MUN	50%
HS	60%	MUN	52%

HS Academic 3203/Mathematics 1010

Sample Size - 1143 Correlation Coefficient - 0.70

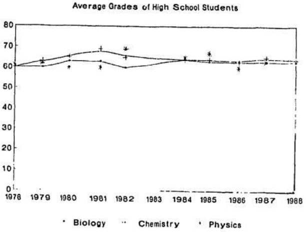
High School Mark		Expected MUN Mark	
HS	90%	MUN	65%
HS	80%	MUN	50%
HS	70%	MUN	35%
HS	60%	MUN	20%

Source: Shawyer, 1987



Source Crocker, 1989

Figure 1.1 Achievement Levels by Province



Source Crocker, 1989

Figure 1.2 Mean Scores

between high school grades and performance on national standardized normative tests.

Accounting for this discrepancy would require an investigation of a variety of factors inherent in the educational system at the high school and university levels. These factors would include training and experience of teachers and instructors, ability and effort of students, and a variety of situational circumstances such as class size or instructional time lost. In other words, to which factors can the poor performance of students in mathematics and science be attributed?

These factors are major influences on how teachers expect students to perform and how students themselves expect to perform. Students, teachers and instructors obviously have had different kinds of training and experience. This affects how they judge students' abilities and efforts relative to the difficulty of a course and expect a certain level of performance. These expectations may be quite different for teachers and students at different levels of the system. A pamphlet designed by the Department of Mathematics and Statistics at Memorial University for students entering first-year mathematics courses states:

> First, you must realize that the expectations of your university instructors are perhaps different from the expectations of your high school teachers. Next, you must make adjustments in order to cope with this. You must determine what these different expectations are and try to make any necessary changes in order to survive. (Shawyer & Williams, 1986)

Obviously, university instructors in mathematics believe that their expectations for students are different from those of high school teachers.

The findings of the mathematics/science Task Force emphasized the contrast between secondary and post-secondary expectations. Crocker (1989) states:

> Most of those in the high school system believe that the university ... is expecting far too much of students in their first semester. Post-secondary officials, on the other hand, feel that their expectations are at best barely adequate, and that high school standards leave much to be desired. ... The comparative data tend to support the latter view. (p. 137)

This contrast between the attributions of teachers and instructors as to what constitutes the major reason for the poor performance of students, and the potential influence on that performance thus demands further study.

Purpose of the Study

The purpose of this investigation was to determine how much emphasis students, teachers, and instructors give to various attributions for poor student performance, and to explore the relationships between the attributions of teachers and students and student achievement in mathematics and science.

The study attempted to answer three questions. First, to which attributions for poor performance in mathematics and science do high school teachers, university instructors, and first-year university students in mathematics and science give the most emphasis? Second, is there a relationship between teachers' and students' attributions and students' performance in mathematics and science? Third, can students' performance in mathematics and science be predicted from a measurement of the attributions expressed by teachers and students?

Method

Four separate surveys were developed and administered to all high school mathematics and science teachers in the province, all university instructors of first-year mathematics and science courses at Memorial University and Grenfell College, all first-year university students at the beginning of their first semester at Memorial University and Grenfell College, and a random sample of these same students at the end of the first semester. Each survey contained a set of statements attributing poor performance by students in mathematics and science to a variety of causes. The survey items were of the conventional Likert scale form. This study drew on these surveys as sources of items having to do with attributions.

In this study, factor analysis was carried out on the attribution statements in each survey. The extracted factors were then examined in terms of the underlying attribution categories provided by attribution research (Cooper & Good, 1983; Frieze, 1976; Weiner, 1979). Mean response scores were calculated for each group of respondents on each attribution statement to determine the relative emphasis given to different types of attributions. Finally, the relationships between attribution and achievement were examined.

The dependent measures of student achievement were the marks students obtained from local high school evaluation, provincial public exams, and university exams in mathematics and science courses. Teachers' and students' scores on the attributional measures were correlated with these students' marks. Regression analysis was carried out to investigate further the relationships between the attributions that teachers and students emphasize and students' achievement. This analysis also provided a means of determining if students' performance could be predicted from a measure of their teachers' and their own attributions.

Judging from previous research in this area, strong relationships were not expected. However, it is important to continue to identify and clarify the network of attribution variables that underly and moderate expectancy effects, particularly negative expectancy effects. This is especially true if these effects influence students' performance.

Organization of the Report

An overview of expectancy research, especially as it relates to attribution theory, is presented in Chapter II. Chapter III provides a description of the subjects, the data sources and the procedures used in this study. The attribution variables are described in Chapter IV based on the results of factor analysis on the attribution statements for each group of respondents. Respondents' scores on the attribution measures and relationships between the attribution variables and the achievement measures are examined in Chapter V. The report concludes with a summary and discussion of the findings in Chapter VI.

CHAPTER II

Review of the Literature

Definitions of the Expectancy Construct

An important, though not easily measured, component of any academic setting is the existence of expectancy effects, that is, the effects on teacher and student behaviour of the expectations they hold concerning both themselves and the educational setting. The expectancy construct has a long history in the psychological literature and is usually defined in terms of probability, rather than an all or none belief. Thus, an expectation is a prediction about what will happen in a given situation, a probability judgement based on previous learning. "People enter situations with expectations for self as well as the setting, and these expectations in turn can affect their behaviour and outcomes in the situation" (Gigliotti, 1987). For example, the expectations of high school teachers, students, and post-secondary instructors quite likely affect their behaviour and thus the success or failure of the students in high school and post-secondary institutions.

According to Zuroff and Rotter (1985), psychological constructs require three types of definition. First, the operational definition contains an objective, reliable set of operations. Second, these operations are logically related to an ordinary language or "ideal" definition that explicitly states the referents contained in the construct. Third, the systematic definition then describes how the particular construct is related or linked to other constructs which together comprise a well-developed theory.

A review of the literature on expectancy research reveals that different investigators have different definitions of expectancy and expectancy effects. At the same time, many different methods have been used in the research, resulting in a large mix of variables, methods, and outcome measures. For example, in some studies of teacher expectancies, the expectancy effect is defined operationally in terms of the teacher's behaviour towards certain groups of students, such as the amount of praise or criticism the teacher directs at the students. In other studies, the expectancy effect is defined in terms of changes in students' achievement, and the teacher's behaviour is seen as a mediational variable, but not an effect.

Another factor in expectancy research is the lack of agreement between supporters of experimental methods of investigation and those involved in naturalistic studies. Experimental studies are those in which fictitious information is supplied to subjects whose expectations are thus manipulated. Such studies have been criticized for lacking external validity (Mitman & Snow, 1985), and generally do not provide strong support for expectancy effects. Dusek (1975) has concluded that they should more appropriately be called "biasing effects". Naturalistic studies involving teachers and students dealing with real information, do generally show a relation between teacher or student expectations and their behaviour and/or student outcomes. However, a weakness of these correlational studies is the uncertainty of causal inference. It is always possible that unobserved variables underlie the correlation among variables observed. All alternative plausible hypotheses can not therefore be ruled out. Rosenthal (1985), one of the original investigators of teacher expectancy effects, claims that when expectations are simply measured, rather than varied experimentally, it is impossible to distinguish between the effects of interpersonal expectations and the effects of attributes of the expectee, such as gender, ability, and status. His original study (Rosenthal & Jacobson, 1968) described how students, whom teachers were led to believe were "late bloomers", performed better on reading and IQ tests than a control group of students.

It is also apparent from the research that an emphasis on an achievement or aptitude based set of outcomes or dependent variables may underestimate the effects of expectancies. Meyer (1985) suggests that a more important question is how students learn to adapt to school demands as a function of the expectancies under which they perform in the school environment. Of particular interest to this investigation were the results of a cross-sectional and longitudinal study of students in the fifth through twelfth grades, their parents, and teachers by Parsons and her associates (Parsons, 1983). Using path analyses and cross-lagged panel analyses as their statistical techniques, the investigators tested the contribution of various psychological variables to the students' intention to take additional mathematics courses. Parsons reports that

> ... students' interpretations of reality (i.e., attributions, self-concepts

of abilities, and perceptions of the beliefs of parents and teachers) were more influential determinants of expectancies, values, and course plans than were objective indicators of past reality (i.e., previous grades and actual teachers' behaviours). (p. 137)

In this study, expectations of teachers and students are defined operationally in terms of their scores on the attribution measures. Ideally, this would mean that if negative attributions are emphasized, then expectations that students will perform well are low. The effects of low expectations would then be poor performance, as measured by scores on the achievement measures.

Theoretical Background and History of Expectancy Research

Two theoretical bodies of literature are relevant to educational applications of expectancy research. Social learning theory applies basic psychological findings regarding learning processes to human learning in social contexts. Attribution theory studies how people make decisions about how to describe an event, assign causality for it, and determine responsibility.

Social Learning Theory

Tolman (1932) first discussed the term expectancy in the context of learning theory. He believed that learning consists of the acquisition of information (expectations) concerning the outcome of various responses, and that behaviour is determined by an organism's goals and knowledge of paths towards those goals. A similar view of humans as cognitive goal-seeking organisms was held by Lewin (1935) who did research on how level of aspiration is related to goal-setting.

Tolman's (1932) and Lewin's (1935) theories led to the development of the social learning theories of Rotter and Bandura. Rotter (1954) distinguished between specific expectancy which is "based on past experiences in situations perceived to be the same" and generalized expectancies "for the same or similar reinforcements to occur in other situations for the same or functionally related behaviours" (p. 166). He feels that to obtain a better understanding of the effects of expectancies one must understand the values teachers and students place upon various reinforcements or goals. These values may vary considerably depending upon the situation (Zuroff & Rotter, 1985). The situational parameters in an academic setting will of course include a variety of factors ranging from the nature and difficulty of a course to the personal characteristics of teachers and students. Of relevance here is the significance of how much control teachers and students feel they have over particular features of the situation. The locus of control construct as described by Rotter, Chance and Phares (1972) serves to distinguish between whether people expect that their own skills and efforts will affect the outcome (internal locus of control), or whether they expect external factors outside of their control will mainly determine the outcome (external locus of control). Locus of control expectations have been associated with a variety of behaviours that underlie successful achievement, such as persistence at tasks and preference for tasks (Findley & Cooper, 1983).

Of interest to this investigation is the evidence that the relationship between generalized reinforcement expectancies and actual achievement outcomes is usually lower for college students than for younger children (Stipek & Weisz, 1981). Rotter (1975) offers several explanations for the age difference. First, achievement situations are least novel and least ambiguous for college students. Consequently, the predictive power of generalized reinforcement expectancies should be lower for this group. Second, Rotter believes that those people whose achievement behaviour is affected by external attitudes are less likely to go on to college. Finally, he suggests that many college students who appear to believe that external factors affect their achievement are "defensive externals", that is, their claim that reinforcements are externally controlled is only a defensive mechanism and not a reflection of their true attitudes.

Bandura (1977) made an important distinction between outcome expectation and efficacy expectation. The first is a person's expectation that a given behaviour will lead to certain outcomes, while the second is a person's expectation that he or she can successfully perform the behaviour required to produce the outcome. The latter construct, referred to as self-efficacy, is described by Bandura as the ability to process information about an event, weigh all the elements of a prospective situation, and then make judgements about how to deal with that situation (Bandura, 1981). Thus, efficacy expectation is relevant to the sense of personal control over a situation. As with locus of control expectations, efficacy expectations have also been found to show a relationship to academic performance, task persistence, and task choice (as reviewed by Meece, Parsons, Kaczala, Goff & Futterman, 1982). Bandura (1979) points out that efficacy expectation can be enhanced or undermined by the interpretations and experiences provided by both teachers and parents.

Attribution Theory

Attribution theory deals with the perceived likelihood of alternative causal factors as explanations of observed behaviour. Heider (1958) proposed that the attributions a person makes depend upon factors within the person (perceptions) as well as factors within the environment. Expectancies in achievement related contexts are determined by perceived ability and planned effort expenditure relative to the perceived difficulty of the task. Heider made the distinction between internal and external attribution in that a person's behaviour may be attributed to some disposition of the person himself or to some external factor. Heider's view is that attributions are affected by "what ought to be" (value belief), "what one would like to be" (self-worth belief), as well as "what is" (perception of the situation) (p. 120-121). Also, since causal judgements are usually made when the event in question is one calling for evaluation, as is the case in this investigation, attribution theories provide evidence that causal judgements are not evaluatively neutral (Heider, 1958; Jones and Davis, 1965; Kelley, 1967, 1973).

Thus, attributions may be positive or negative in their evaluative implications as well as internal or external in their control implications.

On the basis of Heider's analysis of personal and impersonal causality, Kelley (1967, 1971, 1972, 1973) has also discussed some of the ways in which outcomes are attributed to various factors present in the situation. Kelley suggested two major principles of causal attribution. The first is the principle of covariation in which the covariation of potential factors is examined across situations, persons, time, and modalities. Kelley defined three major factors or types of information that people use in making attributions.

1. Consistency is the degree to which a person performs the same behaviour toward an object on different occasions. The more consistent his behaviour, the more likely it is that an internal attribution will be made.

2. Distinctiveness is the degree to which a person performs different behaviours with respect to different objects. The lower the distinctiveness, that is, the more the person performs the same behaviour with respect to different objects, the more likely it is that an internal attribution will be made.

3. Consensus is the degree to which other people perform the same behaviour toward a given object. The higher the consensus, the less likely it is that an internal attribution will be made.

Kelley's theory, therefore, predicts that under conditions of high consensus, high distinctiveness, and high consistency, external attributions to the situation are most likely to be made. In conditions of low consensus, low distinctiveness, and high consistency, internal attributions to the person are most likely to occur.

Kelley's (1967, 1971, 1972, 1973) second principle refers to multiple plausible causes for a particular behaviour. He proposed that the greater the number of plausible explanations, the lower the certainty of any given attribution.

Attribution categories in the academic setting.

In the academic setting the perceived causes or attributions of students' success or failure are closely allied with expectations, and are influential determinants of expectancy effects. The original conceptualization concerning academic attributions and their underlying dimensions was provided by Weiner and his associates (Weiner, Frieze, Kukla, Reed, Rest, & Rosenbaum, 1971). Following Heider (1958), these researchers suggested that four attribution categories (ability, effort, task difficulty, and luck) were the most common and general of the perceived causes of success and failure. Ability is the capability of an individual to perform a task. Ability attributions usually depend upon consistent past information. Effort refers to how hard one tries to perform a given task. Task difficulty as a cause of success or failure usually depends upon performance of others on that task. If most fail, then the individual's failure is most likely to be seen as due to the task being very difficult. Luck inferences are usually made when the task is perceived as involving chance.

Two dimensions were said to underlie these categories: internal (ability and effort) versus external (task difficulty and luck), and stable (ability and task difficulty) versus unstable (effort and luck). Weiner (1974) stated that he and his associates recognized "a number of deficiencies in the classification scheme" (p. 6). For example, they felt that a stable-effort category and a category which allowed for ability improvements were missing. Considering these deficiencies, Frieze (1976) presented an inductively based coding scheme for open-ended responses. The causal explanations used were generated by fifty-one college students who were asked to explain success and failure at academic and non-academic tasks for both self and others. From this and other studies, Weiner (1979) presented a three dimensional classification of causal attributions for success and failure as illustrated in Table 2.1.

Cooper and Good (1983) carried out a number of studies to determine how teachers attributed the success or failure of their students. Their attribution categories implied differences in the role played by teachers in the performance of their students within the internality and stability dimensions. Table 2.2 presents their classification showing the relations between attributions and the teacher-involvement dimension.

Student attributions.

According to attribution theorists, the explanations that people give for success or failure in achievement settings affect their emotional reactions to that performance, their expectancy for future performance, subsequent achievement behaviour, and future performance itself (Weiner, 1980). People who attribute

Table 2.1

Causes of Success and Failure, Classified According to Locus Stability, and Controllability

	Internal		External	
Controllability	Stable	Unstable	Stable	Unstable
Uncontrollable	Ability	Mood	Task Diff.	Luck
Controllable	Typical Effort	Immediate Effort	Teacher Bias	Help from Others

Source: Weiner, 1979

their failure to unstable causes such as effort and luck, which may change, are more likely to persist at a task than those who attribute their failure to stable causes such as ability and task difficulty, which will not change. Dweck (1975) and others have had success in changing students' attributions of failure from lack of ability to lack of effort and, consequently, increasing their persistence in task situations.

An important observation made by Parsons (1983) is that some students may assume too soon that their low performance reflects lack of ability which can't be modified when, in fact, more accurate attributions might be lack of sufficient skills and/or knowledge, inadequate teaching, or insufficient effort. On the other hand, Covington and Omelich (1979) have shown that attributing failure

Table 2.2

Predicted Relations Between Attributions and the Teacher-Involvement Dimension

	High Teacher Involvement	Low Teacher Involvement
Internal Stable	Acquired characteristics Typical effort Interest in the subject	Ability Previous experience
Internal Stable	Interest in the subject Immediate effort Attention	Physiological processes
External	Task Teacher	Other students Family

Source: Cooper and Good, 1983

to lack of effort is the preferred attribution among college students. In this way, they maintain a high self-concept of ability. This is a reasonable strategy as long as individuals believe they are not trying hard. However, if they try harder and still fail, the only conclusion they can draw is lack of ability. Covington and Beery (1976) argued that many students do not try hard in potential failure situations in order to avoid this very conclusion. Attributing failure to lack of effort is all right if additional effort allows one to succeed. The implication is that individuals may need more than attribution retraining, they may also need skill training. Without this skill training, increased efforts will not lead to an enhanced sense of competence because increased efforts will not lead to an increase in success.

In studies with high school students, Kukla (1972, 1978) observed similar effects of lack of effort attributions. He suggested that the amount of effort assumed by students to be needed for success may be a key determinant of achievement behaviour. He argued that students calculate the minimal amount of effort required to succeed on a task based on their estimates of their own ability and the difficulty of the task. Each student will then exert that minimal amount of effort. Uncertainity of success leads to the common practice of avoiding courses that might lower one's grade point average. For example, able students planning to attend post-secondary institutions know they need high grade point averages and may avoid courses that will lower these grades. Also, students who view themselves as competent may feel that the amount of effort needed to do well is excessively high. These students adapt by avoiding courses, or by exerting the minimal level of effort necessary to get by. This provides the students with a face-saving attribution for their lack of success, namely, 'I didn't do better because I didn't try as hard as I could.' This is psychologically less costly than attributing one's difficulties to lack of ability.

Teacher attributions.

Teachers' attributions for the causes of students' performances have been shown to be related to teacher expectancy effects and to certain teacher behaviour patterns (Brophy & Rohrkemper, 1981; Darley & Fazio, 1980). These include the types of goals that teachers set for students, the ways in which teachers control students' behaviour, and the helping behaviour of teachers. Cooper and Good (1983) have sugested that teachers who hold lower expectations for their classrooms as a whole will teach easier lessons, spend less time on rigorous academic activity, and accept less than perfect performance.

From the model by Darley and Fazio (1980), Brophy (1982) noted that teachers use information on students' past performances in making attributions about their present performance so as to maintain a consistent picture. Teachers' expectancies cause them to behave in a certain way. Students' behaviour and performance are interpreted by teachers. If their performance is consistent with teachers' expectation, teachers attribute behaviour to students' disposition. For example, an expected outcome, such as success by a student perceived as high in ability, is likely to be attributed by the teacher to a stable factor, such as ability. If their performance is inconsistent with teachers' expectation, teacher attributes behaviour to the situation. An unexpected outcome, such as success by a student perceived as low in ability, is likely to be attributed to an unstable factor, such as luck.

Teachers' attributions also appear to be affected by the fact that they are involved in the process leading to the students' performance. The degree to which they feel they have some control over this process influences the kinds of attributions they tend to make (Cooper & Good, 1983).

Finally, there is a significant relationship between teachers' attributions to effort as the cause of students' performance and teachers' feedback to students.

For example, teachers evaluate high effort students more positively than low effort students, regardless of ability or performance. Teachers place a high premium on student effort, and in most of the studies done, failures are almost universally attributed by teachers to lack of effort by students.

Summary

Previous research has indicated that students and teachers hold expectations for each other and these expectations influence student performance. Expectations, though, are difficult to define in concrete terms and probably more difficult to measure. The perceived causes or attributions that students and teachers express for poor performance by students, however, are closely allied with their expectations and may be measured more easily. These attributions may vary considerably depending upon the situation and have varying effects. If it is found that high school teachers, university instructors and students emphasize different attributions, this must present a conflicting situation for those students on first entering university. It may also affect how they adapt to different demands as a function of the expectancies under which they perform in these different situations.

CHAPTER III

Research Methodology

Populations and Samples

The targetted subjects for this investigation were high school teachers of mathematics and science courses, university instructors of first-year mathematics and science courses, and university students enrolled in first-year mathematics and science courses.

High School Mathematics and Science Teachers

From a survey of Newfoundland schools in October, 1988, it was determined that there were 1087 teachers teaching high school mathematics or science courses during the school year, 1988-89. It was decided to administer The High School Teacher Survey (Appendix A) to the entire population since the target population was relatively small.

The survey was mailed to schools in November, 1988. The overall response rate from the schools was 91%, and from individuals was 74%. Sixty-four percent of the respondents were teaching Mathematics, 21% Chemistry, 31% Biology, 24% Physics, and 15% Earth Science/Geology.

First-Year Mathematics and Science University Instructors

Because of the relatively small number of science and mathematics instructors at Memorial University and Grenfell College, it was decided to send The University Instructor Survey (Appendix A) to the entire population. The names of the instructors teaching first-year courses in mathematics and the sciences were obtained from the respective departments and 78 surveys were mailed out in November, 1988. 60 surveys were returned for a 77% response rate overall. Of these instructors, 53% taught Mathematics, 20% Chemistry, 10% Biology, and 17% Physics.

University Students

Two separate surveys of university students were carried out, the first at the beginning of the university semester and the second at the end of the semester. All students who enrolled in first-year mathematics courses at Memorial University and Grenfell College in September, 1988 were targetted for the initial First Year Student Survey (Appendix A). These students were requested to complete a diagnostic mathematics inventory when they enrolled. With the cooperation of the two institutions, the student survey was administered at the same time. From a target population of 2948 students at Memorial, 1945 or 66% answered the survey, and from 502 students at Grenfell College, 396 or 79% responded.

To determine if there was any difference between those students who had answered the survey and those who had not, their marks on the high school public exams in Academic/Advanced Mathematics were compared. This comparison indicated that those students who answered the survey had achieved a slightly higher average mark in Mathematics (Academic: 65.7%, Advanced: 68.6%) than those who did not answer the survey (Academic: 61.9%, Advanced: 66.5%).

There were two versions of the initial survey, one containing questions concerning mathematics and one containing similar questions concerning science. Students were randomly given one or the other version. Overall, 49% answered the questions concerning mathematics and 51% answered the questions pertaining to science.

A random selection of 39 (50%) first-year English classes at Memorial University and all the English classes at Grenfell College yielded the students for the follow-up First Year Student Survey (Appendix A). This survey was administered during the last week of November, 1988, just prior to the end of term. English classes were selected, rather than mathematics or science classes, to ensure that students who had dropped mathematics or science courses would not be omitted from the survey. Preliminary interviews with focus-groups of students at Memorial in October, 1988 had indicated that a number of students did intend to drop mathematics or science courses, but not English courses. The number of students responding to the survey at Memorial was 906 or 32% of the first-year student population, and at Grenfell, 300 students or 63% completed the survey.

Table 3.1

Comparisons of Initial and Follow-Up Survey Students

Background	Percentage Initial Survey	Percentage Follow-Up Survey
1988 Graduate	87	80
Educated in Newfoundland	95	94
Larger Size School	71	72
University Graduate Parents	23	28
Professional Parents	31	26

As a check on possible bias in the follow-up survey, respondents were compared on selected variables. As can be seen from Table 3.1, the similarities between the students responding to the initial survey and those responding to the follow-up survey are high. Similarly, as can be seen from Table 3.2, the percentage enrollment of the sample in the various mathematics and science courses corresponds to that of the university population.

Sampling Error

All data derived from sample surveys are subject to sampling error. Sampling error is defined as the difference between the characteristics of a sample and the characteristics of the population from which the sample was

Table 3.2

Comparison of Follow-Up Sample with Population Course Enrollment

Course	Sample Percentage	Population Percentage
Biology 1001	29.5	29
Chemistry 1000	21	20
Chemistry 1800	10	9
Physics 1050	3	3
Physics 1200	18	19
Physics 1000	1	1
Mathematics 1000	16.5	13
Mathematics 1050	13	8
Mathematics 1080	48	51

drawn. The size of such error depends on sample size and on the particular features of the sampling design. In the case of the high school teachers, university instructors, and the initial group of students, the entire target populations were surveyed. Since the response rates were high, there is no evidence of bias from these groups. In the case of the follow-up group of students, the intent of this study was to select a simple random sample from the target population of first-year students. The technique actually used departed from simple random sampling procedure in two ways. First, intact English classes were surveyed. Second, the classes were those taught by English instructors who had agreed to allow their students to participate in the survey. Thus, there were two possible sources of error: a cluster effect and a potential bias because of the instructors. Both of these were judged insignificant, since the students involved would have been randomly distributed across mathematics and science classes at the two institutions. Therefore, simple random sampling assumptions were used in calculating sample error. Percentage sampling errors for selected sample sizes appropriate to this study are presented in Table 3.3. For responses expressed in percentage terms, the sampling error for a simple random sample is given by the relationship:

$$D = 1.96 \sqrt{\frac{PQ}{n} \left(1 - \frac{n}{N}\right)}$$

where D is the percent error, P and Q are the percentages in the two categories of response, assuming a response/no response dichotomy for any choice within an item, n is the sample size, N is the population size, and 1.96 is the constant representing the number of standard error units for a confidence interval of 0.95. The error may be interpreted as meaning that the percentage response for the entire population would be expected to be within plus or minus D of the sample value, 95 times out of 100. For example, if D is 2.8 percent for a given sample, we can say with 95 percent confidence that the population value will lie within plus or minus 2.8 percent of the sample value given in a table of data.

Table 3.3

Percentage Sampling Errors for Various Sample Sizes

Sample Size	Percentage Error (.95 Confidence Level) P = 90	P = 50
900	1.7	2.8
800	1.8	3.0
500	2.4	4.0
300	3.4	5.6

Description of the Survey Instruments

The four surveys used in this study were constructed in basically the same format. Information was collected from high school teachers and university instructors about their teaching workload, teaching and evaluation practices, and their teaching experience and academic qualifications. From the first-year university students, information was collected about their home and school backgrounds, high school experiences, and their workload and programs in university.

The information for this study, however, was obtained from a section in each survey which concentrated on problems that those involved in the educational system often identify in mathematics and science teaching and learning. Using a Likert scale, respondents were asked to indicate the extent of their agreement or disagreement with statements that attributed poor performance by students in mathematics and science to a variety of causes. Although the statements were tailored to the particular group of respondents, they generally referred to the same types of attributions: lack of student ability, lack of student effort, lack of qualified teachers/instructors, lack of attention to students by teachers/instructors; and a variety of situational circumstances.

The High School Teacher Survey contained 21 such statements whereas the University Instructor Survey contained 33 statements. There were two versions of the initial University Student Survey, one containing 26 statements pertaining to problems in mathematics and the other with a similar set of questions but in reference to science. The follow-up University Student Survey contained 13 statements to be answered by all respondents and a set of 25 questions each concerning Mathematics, Biology, Chemistry, and Physics to be answered by students who were taking courses in these subjects.

It must be noted that the surveys used in this study were not constructed specifically as attribution instruments. Rather, they were developed as part of a broader investigation attempting to identify the extent of the problems in the educational system which would account for the poor performance of so many students in mathematics and science. From a combination of submissions from individuals and groups in the educational field, and interviews and focus-group discussions with teachers, instructors students, and administrators, an extensive inventory of items was built up reflecting a variety of perceived causes for poor performance by students. From this inventory were drawn the items which were eventually used in the surveys.

Since the focus was on identifying problems, this led to most of the items being stated in negative format. Consequently, unlike most attribution research which attempts to identify teachers' and students' perceived causes for both success and failure, this study concentrated mainly on the reasons for failure.

There has been considerable discussion and controversy concerning supposed differential expectancies that high school teachers, university instructors, and students have towards what is required of students for academic success. Much of the expectancy research that has been carried out in the twenty years since the publication of Rosenthal and Jacobson's (1968) Pygmalion in the Classroom has focused on the effects of differential expectations on student achievement with varying results.

The original purpose of this study was to determine if different expectations for success or failure are held by teachers, instructors, and students, and if so, to what extent they might influence student performance in mathematics and science. Review of the research, however, revealed that teachers' and students' attributions for the causes of students' performance are influential in the process that leads to expectancy effects. Also, many researchers, including Cooper (1985) pointed out that further work needed to be done in describing how and on what factors teachers and students come to formulate expectancies.

For these reasons, and because it was felt that the measurement of attributions is more readily determined by survey research than the more nebulous construct of expectancy, it was decided to concentrate on the measurement of attributions.

Two important factors to be considered when developing survey instruments are the validity and the reliability of the instruments.

Validity

A commonly used definition of validity is that it is the degree to which an instrument measures what it purports to measure (Talmage, 1976). There are several different approaches to determining whether an instrument is measuring what it is supposed to measure. However, the main aspect of validity of interest here is construct validity.

Construct validity refers to the degree to which scores have been derived from or can be used to support a theoretical base. If an instrument has construct validity, scores will vary according to the predictions of the theory underlying the construct. To test for construct validity it is necessary to use correlational, experimental and logical evidence to determine if the results are consistent with the theoretical predictions. In this study, three validation procedures provide evidence for the construct validity of the survey instruments.

First, factor analysis of each of the surveys was used as a means of establishing construct validity. The underlying construct system of this study was derived from attribution theory which deals with the perceived likelihood of alternative causal factors as explanations of observed behaviour. Drawing from the proposals of Heider (1958), Kelley (1967), Weiner and his associates (1971), and Cooper and Good (1983), it was hypothesized that certain attribution categories would be identified by the respondents to the surveys.

As detailed in Chapter IV, the factor analysis results supported this hypothesis. Distinct types of attributions were delineated by high school teachers, university instructors, and university students. Although the students did not distinguish between the predicted attribution categories as clearly as did the teachers and instructors, their responses supported Kelley's second principle. Kelley (1967) proposed that the greater the number of plausible explanations, the lower the certainty of any given attribution. Overall, the results of the factor analysis were consistent with the theoretical predictions.

Second, previous attribution research has provided evidence that teachers and students have preferred attributions for failure by students (Brophy & Good, 1970; Covington & Omelich, 1979; DeBoer, 1987; Kukla, 1972, 1978). The results of this study support that evidence.

In the case of the high school teacher and university instructor surveys, it was predicted from the research that teachers and instructors would attribute poor performance by students mainly to lack of effort on the part of the students and least to teacher characteristics. The results were consistent with this prediction. The highest mean scores were obtained for statements that attributed poor student performance to students not working hard enough and wasting time. The lowest mean scores were obtained for statements that attributed poor student performance to factors such as teachers/instructors not paying enough attention to students and teachers/instructors expecting too much from students.

In the case of the student surveys, it was more difficult to predict students' attributions based on the research available. However, it could be predicted that in the initial student survey students' expectations of university courses being more difficult than high school courses would be high. This proved to be the case, as highest mean scores were obtained on both the mathematics and science versions of the survey for statements that alluded to these expectations. In the follow-up survey, it was predicted, again from the research, that students who attributed their poor performance to lack of ability or the difficulty of the courses would be less likely to persist in these courses. This also proved to be the case, as statistically significant correlations were obtained between responses by students in the various subject areas to the statement "I would never take another course" and statements such as "I find math/science difficult, even though I study hard" and "Only the best students can be expected to do well".

Finally, several other factors may be considered as contributing to the validity of the survey instruments. The items were constructed by persons with extensive experience in survey construction in conjunction with high school science and mathematics teachers with approximately fifteen years teaching experience each. Also, a preliminary version of the follow-up student survey was submitted to a group of first-year university students to determine their interpretation of the meanings of the various attribution statements. As a result, minor adjustments were made to the wording of various statements for the final version. In addition, throughout the Fall of 1988, prior to and concurrent with the development of the surveys, focus-group discussions were held with random samples of high school teachers, university instructors and first-year university students. From these discussions were obtained an estimation of their attributions or perceived causes of poor performance by students in mathematics and science at the high school and university levels.

Reliability

A reliable instrument gives measurements which are consistent and repeatable. Reliability is defined alternatively as the level of internal consistency or stability of the measuring device over time (Talmage, 1976; Bartz, 1979). Time constraints and cost were just two of the logistic considerations which limited the administration of the four surveys used in this investigation to the one occasion. Because the surveys were part of a policy study, the emphasis was placed on producing instruments that would supply information on which firm recommendations for policy changes could be made in a reasonable amount of time.

Thus, in this investigation, reliability has to be assessed from a single application of an instrument. An internal estimate is thus required. The most obvious solution is to split the instrument into two comparable halves, and then to correlate scores on these. This was not possible in this case. A decision was made during the construction of these surveys to eliminate redundant items that could have been used for such a reliability estimate. This was done in the interest of producing concise instruments from which as much information as possible could be obtained, without imposing a lengthy document on the various groups of respondents. Also, although lengthening a questionnaire tends to increase the associated reliability, this can mask the effect of unsuitable items (Youngman, 1979).

Despite these limitations, it was possible to obtain an estimate of the reliability of the sections in each survey containing the attribution statements that were used in this study. Internal consistency refers to the degree to which each item in an instrument contributes to the measurement of some aspect of that which is being measured (Talmage, 1976; Bartz, 1979). Evidence of this aspect of reliability may be obtained from the results of the various factor analyses that were carried out on each of the surveys. These results are described in more detail in Chapter IV, so a brief summary is presented here.

For both the High School Teacher Survey and the University Instructor Survey, factor analysis produced definite groupings of attribution statements that referred to various aspects of a particular attribution. This is evidence that the teachers and instructors responded to these items in a consistent manner. For example, statements such as: students not capable of understanding mathematics concepts, students select courses they cannot handle, and students cannot handle challenging problems, had their highest loadings on the same factor for each of these surveys, indicating high correlations between similar attribution statements.

Although this may seem to merge the concept of reliability with that of construct validity discussed earlier, there is a difference in how factor analysis supports both concepts. In the case of construct validity, the grouping of the statements into definite categories was consistent with the theoretical predictions of attribution theorists. In the case of reliability, the consistency of response to various logically similar statements provide evidence for reliability.

For the initial and follow-up University Student Surveys, although the response pattern was quite different from that obtained from high school teachers and university instructors, factor analysis highlighted the consistency of the students' responses. Factor analysis was carried out on seven different sets of attribution statements: the mathematics version and the science version of the initial survey, and the general, mathematics, biology, chemistry, and physics sections of the follow-up survey. Whereas inconsistent or random responses would have produced low loadings on the factors generated by the analysis, quite the contrary results were produced. For each set of attribution statements, many of the statements had very high loadings on one factor and most had high loadings across the factor matrix. The communalities (h^2) were thus generally high for each statement and, indirectly, this can be taken as a measure of the reliability of the statements. The unique variance ($1-h^2$) is the sum of specific and error variance (or unreliability), and if this total variance is low, then the unreliability is also low. As the results presented in Chapter 4 indicate, this is evidence of internal consistency in the responses by students to the attribution statements.

Research Design and Procedures

The first part of this investigation was designed to determine the degree to which high school teachers, university instructors, and first-year university students attribute various causes for problems in mathematics and science achievement in high school and university. For this purpose, separate questionnaires were developed for and administered to each group. Each questionnaire contained statements, with which individuals could agree or disagree, which could theoretically be classified into four attribution categories: inadequacies in student ability; inadequacies in student effort; inadequacies in characteristics of teacher/instructor ; inadequacies in the situation. With the exception of the situation category, these categories were derived from attribution research. Students and/or teachers were asked to give causal explanations for academic success or failure, and their open-ended responses were coded (See Frieze, 1976; Weiner, 1979; Cooper & Good, 1983).

Factor analysis was carried out on selected statements from each survey to determine if the four hypothesized categories were in fact distinguished by the various groups of respondents. The factor analysis also allowed for a more in depth investigation of the relationships among the attributions as perceived by the different groups of respondents. As described in the literature review, attribution theory suggests that people who express different attributions for success or failure in an academic setting, may have different expectations and exhibit different behaviours. It may thus be conjectured that if the various respondents in this study do express different attributions, their expectations and behaviours are also different.

High School Teacher Attributions and School Marks

The second part of the investigation was designed to explore the relationship between the attributions of high school teachers and the marks they assign students, and the relationship between university student attributions and their academic performance in high school and university.

One of the ways in which teachers express their expectations of students is by the grades they assign. Grades reflect a teacher's interpretation of the degree to which students have demonstrated their mastery of the subject matter. To assess the relationship between teachers' attributions and the grades they assign, the school marks submitted by teachers for each student were used in the analysis.

The process of matching teachers and students by school and subject for analysis involved building a series of files. From the High School Teacher Survey file seven groups of teachers were identified as teaching those mathematics or science courses which are the final courses offered in those subjects in high school. These courses are Advanced Mathematics 3201, Business Mathematics 3202, Academic Mathematics 3203, Biology 3201, Chemistry 3202, Geology 3203, and Physics 3204. Each group of teachers was selected out of the main file and placed in a separate file. A public exam file, containing the school marks submitted by teachers for each student in June, 1988, was obtained from the provincial Department of Education. From this file, students having school marks in each of the seven subjects listed above were identified and selected. Each group of students was then aggregated to the school level, resulting in a separate file for each subject containing the school marks of students in that subject for every high school in the province. Finally, the students' school marks in each subject at each school were matched to the teacher of that subject at that school. This produced a file for each group of teachers containing their attribution response scores and the school marks that they had assigned to students the previous school year.

Because student grades and teacher surveys were conducted in different school years, a possibility exists of a mismatch between teachers and students. That is, teachers responding to the survey in October, 1988 may not have been teaching at the same school or teaching the same subject in June, 1988. There is no direct measure of the degree of mismatch. However, 84% of the teachers who responded had been teaching more than five years, so the majority, if not all, of the teachers had been teaching the previous year. Since mobility of teachers is very limited, it is likely that they were teaching at the same school. Also, since teachers were identified according to the subject that they usually teach, it is probable that they were teaching the same subject or subjects in the previous year. In most cases, only one teacher is assigned to a subject in a school, making within-school mismatches unlikely.

For the analysis, scattergrams were plotted and product-moment correlations computed between students' school marks in each subject and their teachers' attribution scores. Multiple regression analysis of teacher attribution scores on school marks was done to determine if any attribution statements or combinations of statements by teachers would prove useful as possible predictors of students' school marks.

Student Attributions and Academic Performance

Since students' perceptions of the probable causes for their success or failure may influence their academic performance and their expectations of future performance, product-moment correlations were computed between their attribution scores and scores on the following achievement measures: (a) public exams in high school mathematics and science courses, and (b) final grades in first-year university mathematics and science courses.

Multiple regression analysis was also done of students' attribution scores on their final grades in first-year university mathematics and science courses to determine if any attribution statements or combinations of statements would prove useful as possible predictors of student performance in these courses. Students' public exam marks in their high school mathematics and science courses were also entered into the regression as an indicator of student ability. The percentage of variance in university achievement accounted for by student ability could then be determined and the extent to which students' attributions explained the residual variance predicted from the analysis.

The description of the attributional data collected from the surveys is discussed in Chapter IV. The relationships between the attribution scores and student achievement are discussed in Chapter V.

CHAPTER IV

Description of the Attribution Variables

Factor Analysis of the Attribution Statements

Attribution research has identified a variety of categories, ranging anywhere in number from four (Weiner et al, 1971) to seventeen (Cooper & Burger, 1980), of attributions or causes of student academic success or failure as perceived by teachers and/or students. Although similarities and differences exist between the various coding schemes used by different researchers, the most common categories, accounting for the highest percentage of references, were ability of students, effort exerted by students, and teacher characteristics.

Classification of the attribution statements in each of the four surveys used for this investigation led to a logical reduction of those statements into the three main categories identified in the research literature. A fourth category was added to include those statements that referred to a variety of situational characteristics such as class size, school facilities, and influence of external public exams. It was thus hypothesized that the statements pertaining to problems in student performance and achievement in mathematics and science could be reduced to four attribution categories: ability, effort, teacher, and situation.

Initial exploratory factor analysis using principal components analysis and rotation of the extracted factors by the varimax technique was carried out on the selected statements in each of the four surveys. Crawford's (1975) recommendations that a factor matrix have few factors, account for a large proportion of the overall variance, and have at least three high loadings per factor in conjunction with a large number of near zero loadings were generally observed, for a good resolution of the dimensionality issue. The factor matrices produced indicated that the approximately fifteen to twenty statements in each survey could be reduced to a smaller number of factors, based on eigenvalues >1, which represented different attribution dimensions.

Simple confirmatory factor analysis, which set the number of factors to be extracted at four, was then carried out to determine if the four hypothesized attribution categories would be confirmed. The varimax factor rotation matrices produced by the confirmatory factor analysis for each of the four surveys are tabulated in Tables 4.1 to 4.6. In each table the highest loading on a factor for each variable as well as any loading greater than or equal to .30 are given. Traditionally, loadings of over .50 are taken to define a factor while those over .30 can be used to add detail (Youngman, 1979).

High School Teacher Survey

Table 4.1 gives the factor loadings of attribution statements in the High School Teacher Survey. The four extracted factors accounted for 39% of the common variance. The six selected statements attributing poor performance by students to lack of ability had their highest loadings on Factor 1; the two

Table 4.1

High School Teacher Survey Varimax Factor Matrix

Attribution Item	Factor 1	Factor 2	Factor 3	Factor 4
Ability				
students not capable understanding concepts	.71			
students weak in basic concepts	.42			
students can't handle courses	.51			
students can't handle problems	.40			
students can't do homework	.49			
students lack math skills for science	.63			
Effort				
students don't work hard enough		.53		
students waste time in class		.48		
Teacher				
teachers marks are too high			.38	
teachers expect too much		-.63		
teachers not attentive to students			.57	
teachers are not qualified to teach			.38	
Situation				
classes too large		.38		
university requirements have too much influence				.72
public exams have too much influence				.70
too much class time is lost			.46	

selected statements attributing poor performance by students to lack of effort had their highest loadings on Factor 2; and three of the four selected statements attributing poor performance to deficient teacher characteristics had their highest loadings on Factor 3. Only two of the four situation statements loaded highly on Factor 4, whereas two statements had their highest loadings on other factors.

Thirteen of the sixteen selected statements may thus be reduced to four distinct attribution categories.

It was not surprising that the four situation statements did not load highly on the same factor as they represent diverse characteristics of the high school setting. External influences on teaching, namely that of public exams and university requirements, are seen as comprising a separate category, but large class size is associated with students wasting time in class and time lost on non-instructional activities is identified with teacher behaviour. The high negative loading of the statement 'teachers expect too much' on the student effort factor is reasonable in that if teachers agree that students do not work hard enough, it is logical that they will disagree that teachers expect too much.

<u>University Instructor Survey</u>

Table 4.2 gives the factor loadings for the attribution statements in the University Instructor Survey. The four extracted factors accounted for 50% of the common variance. The four selected statements attributing poor student performance to lack of ability had their highest loadings on Factor 1; the three selected statements attributing poor performance by students to lack of effort had their highest loadings on Factor 2; three of the five selected statements attributing poor student performance to deficient teacher characteristics had their loadings on Factor 3; and five of the seven selected statements attributing poor performance to situational characteristics had their highest on Factor 4. Fifteen

Table 4.2

University Instructor Survey Varimax Factor Matrix

Attribution Item	Factor 1	Factor 2	Factor 3	Factor 4
Ability				
students not capable succeeding	.51			
students should have entrance requirements	.76			
students can't handle courses	.60			
students can't handle exams	.49			
Effort				
students don'twork hard enough		.62		
students have poor study habits		.77		
students can't keep up pace		.58		
Teacher				
high school teachers not trained	.44			
instructors lack time for students			.50	
instructors not prepared to teach			.76	
instructors expectations too high			.57	
high school teachers not prepared to teach	.66			
Situation				
high school inadequate preparation for university				.61
university should adjust courses				-.54
high school inadequately prepares students				.74
high school marks are too high				.68
university classes are too large			.72	
more classes needed	.74			
university content should match high school				-.52

of the nineteen selected statements may thus be reduced to four distinct attribution categories.

It is interesting to note that the two teacher statements that did not have their highest loadings on Factor 3 referred to insufficient training and preparation of high school teachers to teach mathematics and science, whereas the other three statements in this category referred to university instructor deficiencies. Obviously, university instructors associate students' lack of ability more with high school teacher deficiencies than with deficiencies of instructors at the university level.

The two negative loadings on Factor 4 refer to inadequate features of the university setting, whereas the high positive loadings refer to the high school setting. This indicates that while references to both situations have a common factor, university instructors tend to agree that high school situational characteristics contribute to poor performance by students, but tend to disagree that the university situation may also contribute to this outcome.

As was the case with the high school teacher survey, the two situation statements referring to large class size and the need for more class time did not load highly on the situation factor. In this case, large class size was associated with university instructors lacking time to deal with individual students, and the need for more class time was associated with lack of student ability.

Initial University Student Survey

Tables 4.3 and 4.4 give the factor loadings for the attribution statements in the mathematics and science versions respectively of the initial University Student Survey. The attribution items are the same in both versions. The four extracted factors accounted for 68% of the common variance for the mathematics version and 43% of the common variance for the science version.

What seems to emerge from this factor analysis is a distinction between general and personal attributions to lack of ability and effort rather than a distinction between ability and effort. Personal claims of finding math/science difficult, giving up on hard problems, never taking another course, finding classes dull, concepts too advanced, and public exams too difficult formed one dimension on Factor 1. General statements about student lack of ability and lack of effort tended to load on Factor 2 and attributions to teachers loaded on Factor 3. A fourth factor containing the situational items also emerged, although students tended to link those statements about task difficulty more closely with personal ability and effort.

A pattern of four attribution categories is thus supported by the factor analysis. Students' attributions, however, were somewhat different from those of teachers and instructors. Students did not distinguish between ability and effort statements pertaining to them personally. These attributions, along with task difficulty, shared a common factor. The four attribution categories that may be derived from factor analysis of the initial student survey are, personal ability and effort; general study ability and effort; teacher characteristics; and situation characteristics.

Table 4.3

Initial University Student Survey (Math Version) Varimax Factor Rotation

Attribution Item	Factor 1	Factor 2	Factor 3	Factor 4
Ability				
students not capable understanding concepts	.37	.61		.31
only best students should do math	.59	.43	.40	
I find math difficult	.34			
Effort				
students don't work hard enough		.77	.40	
students satisfied to barely pass			.81	
I give up on hard problems easily	.71			
I would never do another math	.82			
Teacher				
teachers don't know subject well	.44	.67		
teachers not attentive to students				.77
high school classes dull	.45		.54	
students allowed pass with little understanding			.70	
teachers can't keep order in class	.42	.36	.49	
Situation				
facilities inadequate		.69		.38
time for course inadequate				.72
concepts too advanced	.64	.33		.35
public exams too difficult	.59		.30	.39

Follow-Up University Student Survey

Factor analysis was carried out on attribution statements contained in five sections of the follow-up student survey: a general section referring to university courses overall which was answered by all students, and a section each for Mathematics, Biology, Chemistry, and Physics to be answered by students taking courses in these subjects. The varimax factor rotation matrix produced by the

Table 4.4

Initial University Student Survey (Science Version) Varimax Factor Rotation

Attribution Item	Factor 1	Factor 2	Factor 3	Factor 4
Ability				
students not capable understanding concepts	.41			
only best students should do science	.31		.33	
I find science difficult	.74			
Effort				
students don't work hard enough		.70		
students satisfied to barely pass		.68		
I give up on hard problems easily	.71			
I would never do another science	.70			
Teacher				
teachers don't know subject well			.69	
teachers not attentive to students			.61	
high school classes dull	.59			
students allowed pass with little understanding		.54		
teachers can't keep order in class		.36	.56	
Situation				
facilities inadequate				.66
time for course inadequate				.75
concepts too advanced	.65			
public exams too difficult	.57			.38

confirmatory factor analysis for the general section is presented in Table 4.5. Since none of the statements in this section referred to lack of student effort, the criterion set for the factor analysis of this section was for the extraction of three factors. These three factors accounted for 44% of the common variance.

As with the initial student survey, personal statements of ability and estimates of task difficulty are loaded on Factor 1, indicating an ability dimension. Three of the five statements referring to instructors may be said to form a teacher dimension. However, students associated higher expectations of instructors with their own lack of ability rather than with the other attributions to instructors. The statements under Factor 3 form a general situational category.

The varimax factor matrix for the Mathematics section is presented in Table 4.6. The four factors extracted accounted for 75% of the common variance, with Factor 1 alone accounting for 59%. Although not as distinct as those of the other surveys, the pattern discernible from this matrix illustrates three categories. An ability dimension loaded on Factor 1, teacher attributions on Factor 2 and an effort dimension on Factor 3. Because most of the statements had loadings of .30 or greater on Factor 1, it is likely that students associated these attributions with lack of ability. It may be that students perceive that many of the problems attributed to poor performance in mathematics and science are oriented around their inability to do well, for whatever reason. The fact that the statement 'would never take another course' had it highest loading on the same factor as the ability attributions indicates that students associated not persisting in the course with lack of ability rather than lack of effort. This is consistent with attribution theory which links lack of ability attributions with lowered expectations of students.

Table 4.5

Follow-Up University Student Survey (General Section) Varimax Factor Matrix

Attribution Item	Factor 1	Factor 2	Factor 3
Ability			
harder to get good marks in university	.71		
only best students expected to do well	.50		
difficult to keep up with assignments	.63		.31
Teacher			
courses better taught in university			-.75
university classes dull		.57	.36
instructors' expecations higher than teachers'	.48		
not enough help outside class time		.71	
instructors not tolerant of students' problems		.75	
Situation			
not prepared in high school	.58		
math/science reputation of being more difficult	.53		
situation so bad, I feel like quitting	.39		.47

The correlation matrices produced by the factor analysis of each of the science sections indicated that many of the intercorrelations among the attribution variables were highly significant. These intercorrelations were also evident in the factor matrices where all of the statements had moderate to high loadings on at least three of the factors. This was likely due to the fact that relatively smaller percentages of students responded to these particular sections. Thus, distinct categories of attributions could not be identified from these sections of the follow-up survey.

Table 4.6

Follow-Up University Student Survey (Math Section) Varimax Factor Matrix

Attribution Item	Factor 1	Factor 2	Factor 3	Factor 4
Ability				
difficult to keep up pace	.71	.39		
concerned I might fail	.78			
only best students expected to do well	.55	.52		
Effort				
time spent studying	.32	.31	.72	
time seeing instructor			.77	.32
time attending tutorials			.36	.83
I would never do another course	.75			
Teacher				
instructor expects students to fail	.38	.68		
instructor difficult to understand	.55	.50		.42
university grading severe	.62	.46	.34	
tests don't represent course	.30	.80		
Situation				
more difficult in university	.78		.33	
high school does not prepare for university	.68	.31	.35	

Summary of Factor Analysis Results

The factor-analytic techniques used in this study proved to be quite useful. The aims of summarizing the interrrelationships among the variables in a concise manner as an aid in conceptualization of categories of attributions, and of identifying the differences between the various groups of respondents were generally achieved. The results indicated that instructors, teachers and students identified distinct categories of attributions. They also illustrated that the views of the associations between specific attributions were sometimes quite different.

High school teachers and university instructors made a definite distinction between categories of attributions for poor performance in mathematics and science by students. They were student ability, student effort, teacher/instructor characteristics, and situation characteristics. However, instructors associated students' lack of ability with inadequate training of high school teachers in mathematics and science. Inadequacies of instructors formed a separate category not related to effort or ability of students. In the situation category, the negative loadings of university deficiencies compared with the positive loadings of high school deficiencies on the same factor, showed that instructors associated the latter attribution, but not the former, with poor performance by students. A difference between high school teachers and university instructors was the way they viewed large class size as an attribution. High school teachers associated this variable with lack of student effort. University instructors, on the other hand, associated large class size with attributions to their own deficiencies. This seems to indicate that they see large classes as one possible reason for any attributions that may be made to their own performance. High school teachers, on the other hand, see large class size as contributing to lack of student effort such as students wasting time in class.

University students, unlike their teachers and instructors, did not distinguish between ability and effort attributions. The results of the factor analysis indicated that students associated personal lack of ability with lack of effort and also with the difficulty of the task. They did not differentiate between these attributions as separate contributors to poor performance in mathematics and science. As would be expected, intention not to take another mathematics and/or science course were associated with these personal attributions.

Statements about lack of ability and effort of students in general were also linked, but formed a separate category from the personal attributions. This suggests that students make different assumptions about other students than they do about themselves. Attributions to teachers and attributions to various situational characteristics also formed separate categories. Thus, four attribution categories were derived from factor analysis of the student survey. They were personal ability and effort, general student ability and effort, teacher characteristics, and situation characteristics.

CHAPTER V

Relationships Between Attributions and Achievement

Attribution Scores

The attribution statements corresponding to perceived causes of poor performance by students in mathematics and science represent deficiencies in several areas: ability of students, effort exerted by students, behaviour and qualifications of high school teachers and university instructors, and characteristics of the high school and university settings. Higher mean scores indicate a greater agreement that a perceived deficiency is a cause of poor performance by students in mathematics and science. Factor analysis on the high school teacher survey and the university instructor survey identified underlying dimensions that corresponded with the proposed categories of attributions. Essentially, the items were combined to form scales, each with a mean score. The mean scores of the respondents to the group of statements under each of the categories identified from the factor analysis are given in Table 5.1 for teachers and instructors.

The data in Table 5.1 suggest that university instructors and high school teachers attributed poor performance by students in mathematics and science somewhat differently. Given the size of the standard error, these differences are statistically significant. Instructors tended to give greater emphasis to the

Table 5.1

Mean Response Scores on Attributions for Teachers and Instructors

Attribution Cagegory	University Instructors (n=60)		High School Teachers (n=809)	
	X	SE	X	SE
Student Ability	3.01	.05	2.81	.02
Student Effort	3.17	.07	2.90	.02
High School Teacher	3.15	.08	2.20	.01
High School Situation	3.21	.06	2.56	.01
University Instructor	2.38	.08		
University Situation	2.26	.05		

insufficiencies of high school preparation of students and teachers' training than did teachers. Instructors' attributions to university situational and instructor characteristics and teachers' attributions to high school situational and teacher characteristics were given least emphasis. Both instructors and teachers, however, indicated that lack of student effort is more a cause of poor performance than lack of ability.

Although the attributional statements in the student surveys were reduced to distinct categories by the factor analysis technique, it is perhaps more interesting to consider student responces to individual statements. For the initial survey, the scale ranged from 1 (strongly disagree) to 5 (strongly agree). For the follow-up survey the scale ranged from 1 (strongly disagree) to 4 (strongly agree). Tables 5.2 and 5.3 outline the mean response scores on attribution statements of students responding to the initial and follow-up student surveys respectively. The statements have been grouped under the categories identified by the factor analysis: general student ability and effort, personal ability and effort, teacher characteristics, and situational characteristics.

To determine if there were any differences across subject areas, students are identified in the tables according to which mathematics and/or science courses they took in high school. Math 3201 is also referred to as advanced math and is considered to be a more university oriented program, designed for more capable students. Math 3203 is referred to as academic math and is taken by the majority of high school students. The course numbers describe each course as the final one in a sequence offered by the school in that particular subject.

Students in all the subject areas agreed most strongly that they expected university courses to be difficult. At the same time, students did not find their high school courses difficult. As identified by the factor analysis, students distinguished between attributions to lack of student effort and ability in general and attributions to personal ability and effort. The results indicate that attributions to lack of student effort in general were high, but students did not attribute personal lack of effort to be a problem.

Table 5.2

Students' Mean Attribution Scores (Initial Survey)

Attribution Statement	Math 3201 n=197	Math 3203 n=565	Biol 3201 n=237	Chem 3202 n=352	Phys 3204 n=392
General Ability and Effort					
students can't understand math/ science concepts	2.74	2.88	2.45	2.48	2.47
students allowed pass with little understanding	2.91	2.94	3.19	3.11	3.15
students don't work hard enough	3.14	3 03	3.11	3.26	3.17
students satisfied to barely pass	2.84	2.83	3.06	3.06	3.08
Personal Ability and Effort					
I find math/science difficult	2.54	2.84	2.69	2.44	2.68
I give up on hard problems easily	2.38	2.48	2.18	2.29	2.14
I would never take another math/ science	2.17	2.40	2.23	2.16	2.14
I expect university math/science more difficult	3.66	3.73	4.05	4.03	4.10
Teachers					
teachers don't know subject well	1.99	2.04	1.86	1.91	1.90
teachers don't pay attention to students	2.48	2.64	2.51	2.56	2.46
teachers can't keep order in class	2.42	2.58	2.67	2.61	2.59
Situation					
facilities in high school inadequate	2.53	2.55	3.34	3.17	3.43
time to cover course inadequate	2.92	3.14	3.17	3.20	3.32
concepts covered too advanced	2.11	2.31	2.17	2.16	2.18
public exams too difficult	2.45	2.57	2.65	2.63	2.75
math/science not important for career	2.22	2.36	2.39	1.98	2.22
high school math/science classes dull	2.68	2.58	2.30	2.55	2.59

Mathematics students gave more emphasis to lack of student ability in general than did science students, but estimates of personal ability were mixed. Academic mathematics students were least confident of their ability whereas chemistry students were most confident. All students emphasized the inadequacy of time to cover the course in high school, and science students attributed the inadequacy of facilities in high school with equal importance. Attributions to teacher deficiencies were accorded least emphasis by all students, indicating that students do not tend to blame teachers for their poor performance. Finally, all these students were aware of the importance of mathematics or science for their career plans.

Students responding to the follow-up survey emphasized the difficulty of their courses in university and the higher expectations of their instructors compared with those of their high school teachers. However, attributions to instructors were not emphasized to any great extent. There was overall agreement by students that they were not prepared for university while in high school. Although certain groups of students expressed a concern about failing, few students agreed that they would like to quit. As in the initial survey, students emphasized the importance of mathematics and science for their career plans. However, there was more agreement than in the earlier survey that they would never take another course in mathematics or science. The indication is that these students don't want to quit university, but many will probably not continue in mathematics or science beyond this first semester.

Table 5.3

Students' Mean Attribution Scores (Follow-Up Survey)

Attribution Statement	Math 3201 n=223	Math 3203 n=554	Biol 3201 n=201	Chem 3202 n=305	Phys 3204 n=341
Personal Ability and Effort					
concerned I might fail	2.24	2.90	2.27	2.51	2.78
I would never take another course	2.32	2.85	2.07	2.31	2.61
difficult to keep up pace	2.70	2.98	2.53	2.72	3.12
difficult to keep up with assignments and study	2.78	2.79	2.83	2.83	2.75
more difficult in university than high school	2.91	3.41	2.62	3.06	3.44
General Ability and Effort					
only best students expected to do well in math	2.53	2.64	2.58	2.58	2.57
Instructors					
instructors not tolerant of students' problems	2.37	2.49	2.39	2.42	2.40
instructor seems to expect many students to fail	2.52	2.67	2.26	2.49	2.76
expectations of instructors higher than teachers	3.10	3.20	3.27	3.11	3.16
not enough help outside class from instructors	2.29	2.40	2.37	2.36	2.36
tests do not represent course	2.31	2.45	2.34	2.61	2.62
university classes dull	2.53	2.47	2.43	2.45	2.44
instructor difficult to understand	2.22	2.36	2.06	2.40	2.74
grading more severe in university	2.75	3.09	3.11	2.96	2.98
Situation					
situation so bad I'd like to quit	1.96	2.06	1.96	2.04	1.92
high school course does not prepare students for university	2.67	3.16	2.05	2.39	2.88
not important for career plans	2.11	2.20	2.09	1.90	2.06
courses have reputation more difficult	3.14	3.35			

High School Teachers' Attributions and School Marks

The measure of student achievement most closely associated with the high school teacher is the school mark assigned by the teacher at the end of the school year. Each teacher of a 3000 level course submits a mark for each student in that subject to the provincial Department of Education. This mark, based on in-school evaluation by the teacher, provides fifty percent of the student's final grade. The other fifty percent is based on a provincial public exam which each student writes at the end of the school year. For this study, the mean school mark for students in each course at a particular school was matched with the teacher of that course.

To determine if there is a relationship between the attributions that teachers express and the marks that they assign students, product-moment correlations between each attributio: statement and the school mark, and each hypothesized attribution category and the school mark were calculated for each group of teachers.

Correlations tend to be low in this type of comparison study, since so many variables may influence the school marks that students obtain, not the least of which would be a student's actual ability and effort. Other factors may intervene between teachers' attributions for poor student performance and the school marks that are eventually given to students, such as school administrative policies regarding marking practices. Also, there exists some possibility of a mismatch between teachers and students' school marks since the teachers were surveyed in the school year following that from which the school marks were obtained. However, as described in Chapter III, there are a number of reasons why the degree of mismatch is probably very slight. Table 5.4 presents the mean school marks given by each group of teachers overall, and the product-moment correlations between these marks and teachers' mean response scores in the various attribution categories.

Relationships between the four attribution categories and school marks were generally low or marginally significant for all groups of teachers. In this study, the null hypothesis that there is no relationship between teachers' attributions for poor performance and the marks that they give students, cannot be rejected by the statistical data.

However, one point may be made. Chem 3202 teachers, who gave the highest school marks overall and who tend to teach the more academically able students, had all positive correlations between their attributions and school marks. Math 3202 teachers, who gave the lowest school marks overall and who tend to teach the less academically able students, had all negative correlations between their attributions and school marks. This is possibly an example of differential behaviour of different groups of teachers towards "slower" versus "brighter" students in terms of marking practices of the teachers.

Table 5.4

Correlation of Teachers' Attributions with School Marks

Teacher Group	Mean School Mark %	Ability r	Effort r	Teacher r	Situation r
Math 3201 (n=103)	74.17	-.13	.00	.05	-.24**
Math 3202 (n=175)	62.16	-.14**	-.11*	-.01	-.09
Math 3203 (n=503)	64.75	-.03	-.05	.05	-.04
Biol 3201 (n=180)	63.20	.07	.07	-.11*	.02
Chem 3202 (n=97)	70.31	.09	.04	.12	.23**
Geol 3203 (n=57)	62.20	-.33**	-.16	.23*	.00
Phys 3204 (n=137)	68.21	.08	-.04	.02	.04

**p<.05 *p<.10

When individudal attribution statements were correlated with school marks, for each group of teachers approximately 14% were significantly correlated at the .10 level of significance with school marks, which is about what would be expected to occur by chance. It would appear that the attributions that teachers make concerning poor student performance have little influence on the marks that they give students.

A possible exception to the above observation occurred with the Math 3202 and Geol 3203 teachers. Table 5.5 illustrates that for both groups of teachers there were significant correlations between school marks and the same three attribution statements.

Since generally Math 3202 and Geol 3203 are taken by less academically able students and since teachers gave these students the lowest marks overall, this may illustrate differential behaviour of teachers towards "slower" students.

Multiple regression analysis was also carried out to determine if any combination of attribution statements would prove useful as a possible predictor of teachers' marking practices. Since the correlations of the individual attribution statements and the attribution categories with school marks were generally low, this analysis did not yield much further information about the relationships between these variables. When the attribution categories were used for the regression analysis, neither category met the initial entry requirement that the probability associated with the F test be less than or equal to .05. Thus, the attribution categories have low predictive power in determining how teachers assign school marks.

When individual attribution statements were entered in the stepwise regression analysis, certain statements did prove to have some predictive power for certain groups of teachers. However, the proportions of variance were generally low. The frequency data from the survey show that 95% of the teachers felt that students do not work hard enough and 86% of the teachers

Table 5.5

Correlation of Math 3202 and Geol 3203 Teachers' Attributions with School Marks

Attribution Statement	Math 3202 r	Geol 3203 r
students do not have mathematical concepts necessary to do science	-.18*	-.51***
students waste time in class	-.18**	-.29*
math and science courses are not challenging enough	.11*	.39**

***p<.001 **p<.01 *p<.10

felt that students graduate without the basic skills and concepts in mathematics and science. This restriction of range in the response scores suggests a probably reason for the low correlations and lack of variance obtained.

First-Year University Students' Attributions and Achievement

Three measures of university student achievement were used in this study: the school mark and the public exam mark of each student in a particular high school mathematics or science course, and the mark obtained by each student in a first-year university mathematics or science course. Two measures of student attributions were obtained through the initial and follow-up student surveys.

Mean attribution response scores for each survey and mean marks for the selected courses were calculated for each group of students. Product-moment correlations were computed to determine the extent of the relationships between student attributions and their achievement. Multiple regression analysis of student attributions on university course marks was also carried out to determine if any combination of attribution statements would prove useful as a predictor of achievement in first-year university mathematics and science courses. Table 5.6 shows the mean marks for each of the student groups in the three achievement measures and the correlation of school and public exam marks in a high school course with the marks in the corresponding course in university. The correlations are significant at the $p<.001$ level. As might be expected, these correlations are quite high. This suggests that, whatever problems students might have in adjusting to university life, there remains a strong link between high school performance and performance at higher levels.

Table 5.7 presents a summary of the correlations of students' mean response scores on selected attribution statements from the initial survey with both public exam marks and university marks in corresponding subjects. The most significant correlations occurred between students' attributions to personal lack of ability and effort and their marks in both high school and university courses. As expected, students who found mathematics and science difficult (lack of ability) and gave up on hard problems easily (lack of effort) had the

Table 5.6

Correlations of Students' High School and University Marks

Student Group	School Mark	Public Exam Mark	University Mark
Math 3201 (n=447)	78.72 r=.54	68.17 r=.58	63.62
Math 3203 (n=1198)	75.40 r=.57	65.23 r=.60	46.16
Biol 3201 (n=453)	81.90 r=.67	66.12 r=.71	59.36
Chem 3202 (n=656)	74.47 r=.54	64.94 r=.59	58.74
Phys 3204 (n=732)	75.18 r=.42	63.24 r=.56	57.18

lowest marks. As indicated by the results of the factor analysis, there was no clear-cut distinction between attributions to lack of ability or lack of effort as having the greater relationship.

Although many of the other correlations were not statistically significant, there is an obvious pattern of negative correlations. Approximately 80% of students' attributions to teachers and 90% of the attributions to the high school situtation were negatively correlated with their marks, not only in high school, but also in university, Clearly, students who agreed with statements pertaining to inadequacies of teachers and of the high school, were those who had achieved

Table 5.7

<u>Correlations Between Student Attributions (Initial Survey) and Achievement</u>

Attribution Statement	[1]Math 3201 [2]Math 1000	Math 3203 Math 1080	Biol 3201 Biol	Chem 3202 Chem	Phys 3204 Phys
General Ability and Effort					
students can't understand math/	-.03	.01	-.11	-.09*	-.12*
science concepts	-.03	.05	-.14	-.06	-.01
students allowed pass with little	.09	.10**	-.08	-.08	-.01
understanding	.11	.05	-.15	.06	.01
students don't work hard enough	-.01	.02	-.01	.03	.02
	-.07	.03	.04	.07	.01
students satisfied to barely pass	.05	-.04	-.09	-.01	-.08*
	.04	-.03	-.14	.01	.02
Personal Ability and Effort					
I find math/science difficult	-.28**	-.45***	-.12	-.36***	-.29***
	-.21*	-.44***	-.27	-.16	-.12
I give up on hard problems easily	-.32**	-.29***	-.20*	-.25**	-.17*
	-.35**	-.29***	-.09	-.19***	-.18
I would never take another math/	-.13*	-.21***	-.19**	-.26***	-.27***
science if not required	-.12	-.17***	-.22*	-.28***	-.12
I expect university math/science	-.08	-.03	.03	.02	-.08
to be more difficult	-.07	-.03	.02	.14*	-.11
Teachers					
high school teachers don't know	-.10	-.12**	-.08	-.15**	-.00
subject well	-.09	-.03	-.07	-.16*	-.10
teachers don't pay attention to	-.12*	-.09*	-.09	-.10***	-.03
students	-.12	-.11*	.03	-.15*	.10
teachers can't keep order in class	.02	-.07	-.03	-.07	.06
	.03	-.05	.04	.04	-.04

Attribution Statement	[1]Math 3201 [2]Math 1000	Math 3203 Math 1080	Biol 3201 Biol	Chem 3202 Chem	Phys 3204 Phys
Situation					
facilities in high school inadequate	-.07 -.11	-.05 -.04	.06 -.00	.05 -.00	.06 -.03
time to cover course inadequate	-.12* -.07	-.14*** -.07	-.05 -.07	-.08 -.20**	-.13** .15
concepts covered too advanced	-.13* -.08	-.10** -.05	-.21** -.13	-.23*** -.13*	-.21*** -.22**
public exams too difficult	-.30*** -.24***	-.23*** -.09*	-.23*** -.29**	-.21*** -.14*	-.23*** -.08
high school math/science classes dull	-.24*** -.15*	-.04 -.05	-.12* -.20*	-.13** -.06	-.10* -.04
math/science not important for career	-.09 -.18	-.16* -.08	-.13 -.11	-.22*** .09	-.24*** -.10

[1]high school course ***p<.001 **p<.01 *p<.10
[2]university course

the lower marks on their public exams and would achieve the lower marks on their university exams.

In the follow-up student survey, all of the student responses to attribution statements were negatively correlated with students' achievement in university. From 50% to 80% of the correlations for each group were statistically significant. This indicates a close relationship between these students' attribution perceptions and their achievement in university. A summary of statements that were significantly correlated with achievement in university mathematics and science courses is presented in Table 5.8.

Generally, students who felt that their high school course did not prepare them for university, had difficulty with the university course, felt that the testing and grading procedures were severe, and had little confidence in their ability to pass performed less well in their university course. Since these attributions also correlated in the same direction, although not to the same degree, with their school and public exam marks in the same subjects, it may be presumed that students' high school achievement influences their attributions which, in turn, influence their university achievement.

Multiple Regression Analysis of Students' Attributions on University Achievement

Multiple regression analysis of students' attributions on their marks in university courses was carried out using the stepwise procedure. Public exam marks, which correlate highly with university marks in the same subjects and tend to be the best predictors of university achievement, as well as a measure of student ability, were also entered to determine if attribution statements improved on this prediction.

Table 5.8

Correlations Between Student Attributions (Follow-Up Survey) and Achievement

Attribution Statement	Math 1080	Math 1000	Biol	Chem	Phys
concerned might fail	-.51***	-.56***	-.60***	-.36***	-.53***
never take another course	-.35***	-.37***	-.38***	-.17*	-.23**
difficult to keep up pace	-.31***	-.32***	-.12	-.11*	-.13*
more difficulty in university	-.27***	-.34***	-.21*	-.14*	-.17**
tests do not represent course	-.27***	-.17**	-.25*	-.06	-.11
instructor difficult to understand	-.26***	-.30***	-.14	-.08	-.20**
situation so bad I'd like to quit	-.23***	-.36***	-.34***	-.27***	-.44***
grading more severe in university	-.20***	-.23***	-.25*	-.06	-.28**
university classes dull	-.06*	-.14*	-.31**	-.07	-.30***
high school course does not prepare students for university	-.17***	-.28***	-.17*	-.15*	-.26**

***p<.001 **p<.01 *p<.10

The process of constructing the best regression equation begins by identifying the predictor variable that has the highest correlation with the criterion, in this case university achievement. Since the public exam mark was entered as the best predictor, the attribution statements would be considered as subsequent predictors. To be a good second predictor, a variable must correlate highly with the criterion, but not with the first predictor, as most of its contribution would then already be included. It proved difficult to select a good second predictor from the attribution statements since generally, those that correlated highly with the university mark also correlated highly with the public exam mark. The results of the regression analysis for each group of students are given in Table 5.9 for the initial student survey and in Table 5.10 for the follow-up survey.

Table 5.9

Regression of Student Attributions (Initial Survey) on University Achievement

Student Group		Predictor	Beta	R^2	R^2 Increment
Math 1080	1.	public exam mark	.69	.41	
	2.	teachers don't know subject well	.08	.42	.01*
Math 1000	1.	public exam mark	.66	.38	
	2.	only best students should take math	-.14	.40	.02*
Biology	1.	public exam mark	.85	.57	
	2.	teachers don't pay attention to students	.17	.62	.05*
Chemistry	1.	public exam mark	.58	.36	
	2.	time to cover course inadequate	-.24	.41	.05*
	3.	science not important for career plans	.38	.47	.06*
	4.	never take another science	-.25	.51	.04*
	5.	I give up on hard problems easily	.17	.54	.03*
Physics	1.	public exam mark	.57	.29	
		no statements entered stepwise			

*F ratio significant at <.05 level

Table 5.10

Regression of Student Attributions (Follow-Up Survey) on University Achievement

Student Group		Predictor	Beta	R^2	R^2 Increment
Math 1080	1.	public exam mark	.48	.43	
	2.	concerned I might fail	-.38	.55	.12*
Math 1000	1.	public exam mark	.47	.40	
	2.	concerned I might fail	-.37	.51	.11*
Biology	1.	public exam mark	.56	.45	
	2.	concerned I might fail	-.20	.47	.02
Chemistry	1.	public exam mark	.54	.36	
	2.	concerned I might fail	-.25	.42	.06*
Physics	1.	public exam mark	.42	.29	
	2.	situation so bad, I'd quit	-.35	.47	.18*
	3.	concerned I might fail	-.27	.53	.06*

*F ratio significant at <.05 level

Several significant increments were observed. What is interesting is that these attributions do provide a statistically significant increase in the proportion of variance outside that contributed by high school achievement. Thus, they provide a certain amount of prediction of university achievement that is not obtained from the students' achievement in high school. Their effect is not due to at least this measure of students' ability. This lends support to the theory that students' attributions are related to their achievement.

Summary of the Results

High school teachers emphasized lack of effort by students as the most important cause of their poor performance in mathematics and science. Teacher and high school deficiencies were given least emphasis. This was echoed by their students who had just completed high school and were embarking on their first semester at university. Notably, although their attributions to lack of student effort in general were high, students did not tend to agree that they personally did not work hard enough. Thus, both teachers and students emphasized lack of effort by students, but students did not attribute this factor to themselves personally. Students also emphasized inadequacies in time and facilities in high school as factors influencing poor performance. Although university instructors also emphasized lack of effort, they gave greater emphasis to inadequacies in the high school system and in the training in mathematics and science of high school teachers. Least emphasis was given to deficiencies in instructor and university characteristics. In a similar manner, their students who had just completed their first semester at university, attributed poor performance to lack of preparation for university in high school. These students were also concerned about lack of ability, in contrast to their responses on the initial survey where not much emphasis was accorded this particular attribution. More students in this survey than in the earlier survey indicated that they would never take another course in mathematics or science.

There was little evidence of any relationship between the attributions of high school teachers and the marks they assigned students. Except for certain instances mentioned earlier, correlations between these variables were mostly negligible. The most important reason for this was the lack of variation in the attribution scores of teachers. There were significant correlations between students' personal attributions to lack of ability and effort and their marks in high school public exams and university exams. Although not statistically significant, the majority of correlations between attributions to teachers and to the high school situation and students marks were negative. Generally, the more students agreed with these attributions, the lower their marks tended to be. Multiple regression analysis procedures found that specific attributions had a certain amount of predictive power in determining students' marks in university mathematics and science courses.

CHAPTER VI

Summary and Discussion

Research Problem

The purpose of this study was to focus on how teachers and students perceive their own and one another's performance in the teaching and learning of mathematics and science. Attribution theory proposes that the explanations that people give for their own or others' success or failure, the perceived likelihood of alternative attributions, affect their expectancies for future performance and their performance itself (Weiner, 1980).

Studies of teachers' attributions and expectations for student performance have suggested that high teacher expectations will support high student achievement, while low expectations will support low student achievement (Brophy & Good, 1970; Darley & Fazio, 1980; Peterson & Barger, 1984). Attributions may influence teachers' behaviour towards students, as different causes are attributed by teachers to failure by students for whom they hold different expectations. Studies of students' attributions and expectations for their own performance have suggested that students' perceptions of their ability and the effort required to do well are important causal factors in their performance (Beard & Senior, 1980; Covington & Omelich, 1981; Parsons, 1983).

At the local level, this study grew out of an investigation by a Task Force on Mathematics and Science Education established in June, 1988 by the

Government of Newfoundland and Labrador. This investigation was prompted by growing evidence of low levels of achievement by students in mathematics and science, particularly at the post-secondary level. Studies had shown that students' performance in these subject areas was consistently lower than that of their counterparts in other provinces and other countries (Crocker, 1989; MUN School of General Studies,1986).

One of the reasons suggested for this was that lower expectations of students at the high school level did not prepare them for the allegedly more rigorous expectations of the university environment (Shawyer & Williams, 1986). The findings of the Task Force supported this suggestion (Crocker, 1989). Consequently, this study evolved to investigate these findings in more detail. If high school teachers, university instructors, and students have different expectations, this may be determined from the relative emphasis that they give to various attributions for problems in mathematics and science achievement. If the emphases are different for the various attributions, one can assume that expectations are different.

The study attempted to answer three questions. First, to which attributions for poor performance in mathematics and science do high school teachers, university instructors, and first-year university students in mathematics and science give the most emphasis? Second, is there a relationship between teachers' and students' attributions and students' performance in mathematics and science? Third, can students' performance in mathematics and science be predicted from a measurement of the attributions expressed by teachers and students?

Method

To obtain information about teachers' and students' attributions, four separate surveys were administered to high school teachers, university instructors, and first-year university students at the beginning and end of their first semester at university. These surveys contained a variety of attributional statements pertaining to problems in mathematics and science education with which respondents could agree or disagree on a Likert scale.

The statements were factor analyzed to determine if they could be reduced to a smaller number of attribution categories, to distinguish between different attributional dimensions, and to clarify the interrelationships among the various attributional statements. Mean scores on various attributions were calculated as a measure of the emphasis given to a particular attribution by the groups and sub-groups of mathematics and science teachers, instructors, and students.

Three measures of student achievement were obtained. School marks and public exam marks in final high school mathematics and science courses were obtained from the provincial Department of Education, and final marks in first-year university mathematics and science courses were obtained from

Memorial University. Mean scores of groups of students in each of these courses were calculated.

Relationships between students' and teachers' attributions and students' achievement were examined by calculation of product-moment correlations between scores on the attribution measures and students' marks in the three achievement measures. The school mark was selected as the measure of student achievement most closely associated with high school teachers since, presumably, it is the one over which they have most control. Students were matched with their high school teachers at the various schools and correlations between their school marks and their teachers' attribution scores were calculated. Relationships between students' attributions and achievement were examined by calculation of correlations between their scores on the attribution measures and their public exam marks in the high school mathematics and science courses as well as their final marks in first-year university mathematics and science courses.

To investigate the attribution measures as potential predictors of student achievement, selected statements were entered into a regression analysis for each group of teachers and students. The school mark was used as the criterion for teachers' attributions and the final university mark as the criterion for students' attributions.

Factor Analysis Results

Because a variety of attribution statements was used in the four survey instruments, it was deemed necessary to factor analyze these statements to uncover the underlying themes or attribution categories suggested by previous attribution research. The pattern of results produced from the high school teacher and university instructor surveys did identify four major factors that could be labelled as distinct attribution categories. High school teachers and university instructors differentiated between statements attributing poor student performance to lack of student ability, lack of student effort, teacher inadequacies, and situational circumstances.

A pattern of four attribution categories also emerged from the factor analysis of the initial student survey. Unlike their teachers and instructors, however, students did not distinguish between ability and effort statements. These attributions, along with task difficulty, shared a common factor. They did differentiate between statements that referred to the ability and effort of students in general as opposed to statements about their own personal ability and effort. The four attribution categories that were identified from this survey were: personal ability and effort; general student ability and effort; teacher characteristics; and situational characteristics.

The pattern produced from the factor analysis of the various sections of the follow-up student survey was not as clear as those from the other surveys.

Many of the attribution statements appeared to revolve around an ability dimension. However, in addition to the ability category, a separate teacher category was discernible as well. When statements referring to the amount of time spent studying and seeing the instructor for help were included in the analysis, a third effort category was identified.

Thus, factor analysis supported the reduction of a rather large variety of statements into categories representing definite dimensions of attributions identified by the different groups of respondents. It also illustrated that the various respondents associated different attribution statements in different ways.

Attribution Response Scores

Mean scores of high school teachers on the attribution categories showed that teachers emphasized lack of student effort as the most important cause of poor performance by students in mathematics and science. Least emphasis was given to teacher characteristics and behaviour.

University instructors emphasized inadequacies in the high school situation and in high school teacher training in mathematics and science as important causes of poor performance by students. As was the case with high school teachers, lack of student effort was also emphasized. Least importance was attributed to university situational and instructor characteristics.

The mean scores of students on the attribution statements in the initial survey pointed to an emphasis by students on lack of student effort in general as a reason for poor performance by students in high school mathematics and science courses. Importance was also attributed to lack of time to cover the course and lack of facilities for science courses. Difficulty of the courses and teacher inadequacies were attributed least emphasis. Although students did not attribute much emphasis to lack of ability, especially in science, they placed the greatest emphasis on expecting to find university courses difficult, which presents somewhat of a conundrum.

The responses of students to the attribution statements in the follow-up survey illustrated that students' expectations concerning the difficulty of university courses had been confirmed. Unlike high school, emphasis was given to the difficulty of the courses and the high expectations of the instructors. Although attributions to lack of ability were high, equal emphasis was attributed to lack of preparation for university in high school. Attributions to instructors, as was the case with attributions to high school teachers, were not stressed.

Relationships Between Attributions and Achievement

Correlations between high school teachers' attributions and the school marks assigned to students in the various mathematics and science courses were mostly negligible. There was little evidence of any relationship between the emphasis that teachers attribute to factors such as lack of ability or lack of effort on the part of students and the marks that they give those students. Multiple regression analysis of high school teachers' attributions on students' school marks served to emphasize the lack of relationship between the attributions that teachers express and the marks that they give students. These attribution statements had little predictive power in determining how teachers assign marks. Part of the reason for this was the lack of variation in the attribution response scores. The range of response scores to the various attribution statements from high school teachers was rather restricted.

Correlations between students' attributions in the initial survey and their marks in high school public exams and university exams were overwhelmingly negative. This means that the more students agreed with a particular attribution, the lower their marks were. Significant correlations were found mainly between personal attributions to lack of ability and difficulty with the high school course or personal lack of effort and students' marks.

As was the case with the initial survey, correlations between students' attributions in the follow-up survey and their final marks in university courses were all in a negative direction, and many were statistically significant. Students' attributions to personal lack of ability and difficulty with the course and attributions to lack of preparation in high school were significantly related to their achievement in university.

Multiple regression analysis of students' attributions from the initial survey on their final marks in university mathematics and science courses found that certain attributions did have a limited amount of predictive power above that already contributed by students' achievement in high school. Attributions from the follow-up survey proved to have somewhat greater predictive power.

Summary

In contrast to the Pygmalion effect, it has been suggested by Brophy (1983) and others that teacher expectations of students are generally accurate and based on the reality of the classroom situation. If teachers perceive that students do not work hard enough, for example, their expectations for them are lowered. This link between teacher expectations and student effort is borne out by the results of the factor analysis. The statement that teacher expectations are too high had a high negative loading on the factor encompassing statements referring to lack of student effort. This means that teachers associated their low expectations of students with the perception that students do not work hard enough. This fits in with Brophy's contention that teacher expectancy effects on students are more accurately construed as student effects on teachers. It also supports Weiner's (1979) conclusion that student effort is of greater importance than ability in affecting teachers' expectations.

Another attribution that teachers associated with lack of student effort was that class sizes are too large. Class size has often been suggested as a factor influencing student achievement. The association in this factor analysis seems to indicate that teachers feel that if there are too many students in a class they will not exert the necessary effort required to do well.

On the instructor survey, statements attributing poor performance by students to high school teacher inadequacies were closely associated with attributions to lack of student ability. This indicates that university instructors perceive a relationship between the ability of students to handle university courses and the training of high school teachers, but not their own training. Another distinction between high school and university attributions occured on Factor 4 with the bipolar nature of the variables. Situational inadequacies in the high school are seen as contributing to poor student performance, but there is the opposite perception of attributions to university circumstances.

The results of the factor analysis of the university student surveys indicated that, unlike their teachers and instructors, students did not perceive attributions to lack of ability and attributions to lack of effort as representing different dimensions. Evidence from other studies (Kun, 1977; Nicholls, 1978; Nicholls & Miller, 1984) suggests that the constructs of ability and effort can be correlated or confused by children in lower grades, and this may be what is happening here as well with these older students. One of the reasons suggested for students' confusion of these concepts is that it is because teachers usually attribute failure to lack of effort rather than to lack of ability (Blumenfeld, Pintrich, & Hamilton, 1986). In this study, teachers did give greater emphasis to lack of effort, but whether this contributes to students' confusion of the concepts and concomitant confusion of expectations requires further study.

One relationship that was obvious from the factor analysis of each section of the student surveys was that the intention to take another mathematics or science course was most closely associated with the student's perception of having difficulty with the course. This indicates that a student's attributions to his own ability or effort have a greater influence on his expectations than external attributions to other causes of poor performance.

Mean response scores of high school teachers and university instructors on the various attributions supported previous research results that teachers tend to stress lack of student effort more than lack of student ability, and attribute least emphasis to their own teaching behaviour and training. University instructors were more negative overall in their attributions than high school teachers, and emphasized inadequacies in high school programs and teachers. These results serve to illustrate some of the different perceptions of high school teachers and university instructors that are likely to contribute to a lack of cooperation between secondary and tertiary levels of education. This must surely be detrimental to the students making the transition from one level to the other, and further study of this issue is warrented.

In discussing the results of the initial student survey, it must be borne in mind that these students have just graduated from high school. They are the successful students, and most have probably not experienced failure in their high school career. When attributing poor performance in high school to students not working hard enough, they are probably echoing their teachers' attributions. Also, since they perceived themselves as not giving up on hard problems easily, this may be why they attribute other students' poor performance to lack of effort. A question arises, though, as to why these successful students who did not find mathematics and science difficult in high school, expect university courses in these subjects to be much more difficult. This perception may also be a reflection of their teachers' perceptions.

With the follow-up student survey, we are dealing with students who have almost completed their first semester at university. Some of them have experienced failure for the first time in their academic career, and their perceptions of the causes are negative overall. They reiterate their earlier expectations of greater difficulty of the courses and attribute their poor performance to not being prepared in high school. Again, this perception may reflect that of their instructors. It is probably not a coincidence that in the initial survey, students' attributions mirrored those of their high school teachers, and in the follow-up survey, those of their university instructors.

What has also changed, though, is the confidence that students felt in their own ability to do well. In high school, there was little emphasis given to personal lack of ability and the reason other students did not do well was because of lack of effort. After one semester at university, students are no longer confident of their ability and attribute their failure to not being prepared in high school. As Covington and Omelich (1981) have argued, their expectations for the future must be diminished when they do not feel capable of successful performance. But also, as DeBoer (1987) found, they attribute their failure to an external factor such as not being prepared in high school.

There was no evidence of any pattern of relationships between the attributions that high school teachers expressed and the marks that they gave students. This means, for example, that teachers who agreed that students are not capable of understanding mathematics and science concepts gave just as high marks to their students as those teachers who did not agree. There are a number of possible explanations for this. First, what teachers believe about the causes of poor student performance really does not influence their marking practices. Second, school administrative policies regarding marking practices may intervene between the marks that teachers would prefer to give and the marks that students actually receive. Third, students and teachers in this study were not matched as confidently as they may have been if students' marks from the present school year had been used for the analysis. Finally, teachers' attributions were about students in general. There would likely be a closer relationship between teachers' attributions about individual students and the marks that they gave those students. These latter possibilities represent weaknesses in the research design of this study that further studies of potential relationships would have to take into account.

Significant negative correlations between students' attribution scores and their marks did evidence a relationship between students' perceptions of the causes of poor performance and their achievement. Although these correlations are fairly small, which is predictable according to Stipek and Weisz (1981), they do support the main thesis of attribution theory that perceived causes or attributions of students' success or failure are allied with achievement. In particular, personal attributions or self-efficacy statements about finding mathematics and science difficult, giving up on hard problems, and concern about failing were most closely related to achievement. Certain external attributions to teachers and instructors also showed a significant relationship.

The higher correlations of attributions from the initial survey with public exam marks than with university marks may indicate a greater influence of past achievement on attributions than that of attributions on subsequent achievement. However, it is evident the influence operates in both directions, and has a negative effect.

Finally, multiple regression analysis indicated that students' attribution responses measured at the beginning of their university semester did not substantially improve on the power of their public exam marks in predicting their achievement in university. This is, of course, partly because these responses correlated highly with both achievement measures. Concern about failing, measured at the end of the semester, did significantly improve the prediction, but, although understandable, this is not especially helpful for practical purposes.

Questions for Further Study

In identifying categories of attributions, researchers such as Weiner (1980) and Frieze (1976) have proposed that students make distinctions between lack of ability and lack of effort. Other researchers such as Parsons (1983), Covington and Omelich (1979), Kukla (1978) have based their studies of high school and university student behaviour on the premise that students make these distinctions. They suggest that changing students' attributions from lack of ability to lack of effort will improve their self-concept and subsequent performance. But do high school and university students distinguish between attributions to lack of ability and lack of effort as distinct factors affecting their performance? The answer from this study would appear to be no. If this is the case, then further study is necessary to determine how extensive this confusion of concepts is among students and to what extent it influences their academic performance. If students do not know whether lack of ability or lack of effort is the main contributor toward poor performance, then how do they make decisions about improving that performance?

A distinction that students in this study did make was between attributions to lack of ability and effort of students in general and attributions to themselves personally. How does this dichotomy influence their performance if they rationalize that they personally are capable and work hard but not other students? It is likely that they hear their teachers say that students do not work hard enough, but do not apply this to themselves. When asked to explain their poor performance in university, they make other attributions such as lack of preparation by their teachers in high school. How can they take personal responsibility now in university and make adjustments to improve their performance if they have not done so before? The whole area of personal responsibility for behaviour is one that requires further investigation. This is also true for the other participants in the educational process, the teachers and instructors. Both groups attributed least emphasis for their own inadequacies as causes for poor performance by students. Does this lack of responsibility affect their behaviour toward students and thus students' performance? Does the fact that they attribute poor performance to lack of effort by students mean that they feel they can do nothing themselves to improve that performance?

To conclude, it is evident from this study that high school teachers, university instructors, and students making the transition from high school to university attribute causes for poor performance in mathematics and science differently. It is also evident that students' perceptions are not immune to teacher influence. Research will need to determine how expectations of different teachers of the same students at the secondary and post-secondary levels interact and conflict, and the degree to which students perform differently in response to conflicting expectations.

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APPENDIX A

Surveys

Government of Newfoundland and Labrador

TASK FORCE

ON

MATHEMATICS/SCIENCE ACHIEVEMENT

HIGH SCHOOL TEACHER SURVEY

PURPOSE

This survey is intended to provide some information about how mathematics and science are being taught, and to allow teachers to give their opinions on matters of mathematics/science teaching. All responses will be kept confidential, and individuals or schools will not be identified in any reports of the survey.

INSTRUCTIONS

Please answer each question as carefully as possible by placing your response in the boxes at the right of the page. For responses which require estimates, please give the closest estimate possible without having to look things up or go back over records.

SECTION A

TEACHING ASSIGNMENTS AND WORKLOAD

1. How many students are in the largest class that you teach?

2. How many students are in the smallest class that you teach?

3. Do you teach more than one course or grade in the same room at the same time?

   1. yes
   2. no

4. How many different courses do you teach altogether?

5. How many different classes (sections or groups) do you teach in the following areas?

   Biology (2201 & 3201)

   Chemistry (2202 & 3202)

   Geology or Earth Science

   Mathematics (all courses)

   Physics (2204 & 3204)

   Other sciences (e.g computing, general science)

6. How many days are in a teaching cycle in your school?

7. How many class periods are in each teaching cycle?

8. How many class periods do you actually teach in a cycle?

9. Does your school have homeroom periods separate from classes where courses are being taught?

   1. yes
   2. no

10. If so, how many minutes per day are occupied by homeroom periods?

11. Are the homeroom periods counted as part of the instructional day?

    1. yes
    2. no

12. In your school, how many minutes are allocated for class changes between periods?

13. In your opinion, is the amount of time allowed for class changes adequate?

    1. yes
    2. no

14. **If any time is allowed for class changes, is this counted as part of the instructional day?**

    1. yes

    2. no

15. How many school days each year do you estimate are spent in your school on the following activities?

    1. Formal examinations

    2. Sports days/field days/winter carnivals/etc.

    3. Snowstorms/furnace problems/etc. (average over several years

    4. Teacher workshops (count only days school is closed)

    5. Days students generally stay home so that no instruction can occur (last days before holidays, examination periods, etc.)

SECTION B

EVALUATION PRACTICES AND EXPECTATIONS

16. On average, how many unit or chapter tests do you assign in science courses in a year? ☐

17. On average, how many unit or chapter tests do you assign in mathematics courses in a year? ☐

18. On average, how many class periods would you estimate are spent in reviewing for and going over each chapter or unit test? ☐

19. On average, how frequently do you assign written homework in science courses? ☐

    1. after most classes
    2. about once a week
    3. less than once a week

20. On average, how frequently do you assign written homework in mathematics courses? ☐

    1. after most classes
    2. about once a week
    3. less than once a week

21. For each of the following science courses listed that you teach, how many laboratory periods do you usually have in a year? (Count only periods in which students work individually or in groups using apparatus. Count any double periods as two periods.)

KEY

1 = none

2 = 1 - 3

3 = 4 - 7

4 = 8 - 12

5 = more than 12

Biology 3201

Chemistry 3201

Geology 3203

Physics 3204

22. Teachers sometimes express concern about the amount of marking they have to do. On average, how many hours per week would you estimate you spend in marking student tests, homework, lab reports, etc?

1. 2 or less
2. 3 - 5
3. 6 - 10
4. more than 10

23. Which of the following is the most common way in which you correct homework assignments?

1. Go over the work in class, with students marking their own or others' work

2. Collect and mark all papers

3. Spot check

4. Other (please specify) ________________

Omit item 24 if you do not teach mathematics.

24. On average, what percentage of students' final school mark in mathematics is contributed by each of the elements give below? (Percentages should add up to 100.)

Chapter or unit tests

Homework assignments

Major projects

Class attendance/participation/effort

Other (please specify) ____________________

Omit item 25 if you do not teach any science courses.

25. On average, what percentage of students' final school mark in your science courses is contributed by each of the elements given below? (Percentages should add up to 100.)

Chapter or unit tests

Homework assignments (other than lab reports)

Major projects

Laboratory reports

Class attendance/participation/effort

SECTION C

COURSE DIFFICULTY, TIME, AND CONTENT

26. Please rate each course that you teach, or have taught, as to its difficulty for the students who generally take the course, and the time available to cover these courses.

Difficulty Key

1 = too difficult 2 = about right 3 = too easy

Time Key

1 = too little 2 = about right 3 = too much

	Difficulty	Time
Advanced Mathematics 3201	☐	☐
Business Mathematics 3202	☐	☐
Academic Mathematics 3203	☐	☐
Biology 3201	☐	☐
Chemistry 3202	☐	☐
Geology 3203	☐	☐
Physics 3204	☐	☐

27. Please rate the adequacy of the textbook, the teaching guides, and other materials supplied by the Department of Education for each of the courses that you teach or have taught.

KEY: 1 = poor 2 = fair 3 = good 4 = excellent

	Textbook	Other Department Materials
Advanced Mathematics 3201	☐	☐
Business Mathematics 3202	☐	☐
Academic Mathematics 3203	☐	☐
Biology 3201	☐	☐
Chemistry 3202	☐	☐
Geology 3203	☐	☐
Physics 3204	☐	☐
	☐	☐

28. **Please rate the adequacy of other materials in your school to support the teaching of the courses listed. "Print materials" would include supplementary texts, library books and the like. "Non-print materials" refers to laboratory equipment and other manipulatives, audio-visual aids, and the like.**

KEY: 1 = poor 2 = fair 3 = good 4 = excellent

	Print Materials	Non-print Materials
Advanced Mathematics 3201	☐	☐
Business Mathematics 3202	☐	☐
Academic Mathematics 3203	☐	☐
Biology 3201	☐	☐
Chemistry 3202	☐	☐
Geology 3203	☐	☐
Physics 3204	☐	☐

29. Please rate the overall appropriateness of topics and the depth of treatment of the topics covered in the courses listed. In considering these questions, think of the objectives of the courses and the type of students who typically take the course in your school.

Appropriateness Key

1 = inappropriate 2 = somewhat appropriate 3 = very appropriate

Depth of Treatment Key

1 = too shallow 2 = about right 3 = too deep

	Appropriateness	Depth of Treatment
Advanced Mathematics 3201	☐	☐
Business Mathematics 3202	☐	☐
Academic Mathematics 3203	☐	☐
Biology 3201	☐	☐
Chemistry 3202	☐	☐
Geology 3203	☐	☐
Physics 3204	☐	☐

SECTION D

PROBLEMS IN MATHEMATICS AND SCIENCE

TEACHING AND LEARNING

The statements given below are about problems that people sometimes identify in mathematics and science teaching and learning. Please complete each item by indicating the degree to which you agree or disagree with the statement. In responding to the items, please think of your own experiences in teaching these subjects.

KEY: 1 = strongly disagree 2 = disagree 3 = agree 4 = strongly agree

30. Many students are not capable of understanding the mathematical concepts expected of them in high school. ☐
31. Teachers tend to give marks that are too high. ☐
32. The academic mathematics course is quite adequate to meet the requirements of first year university mathematics courses. ☐
33. High school students are weak in the basic mathematics concepts learned in earlier grades. ☐
34. High school teachers expect too much of their students. ☐
35. Students often select courses they are not capable of handling. ☐
36. High school teachers do not pay enough attention to the problems of individual students. ☐
37. Many high school students do not work hard enough. ☐
38. The classes I teach are generally too large. ☐

KEY: 1 = strongly disagree 2 = disagree 3 = agree 4 = strongly agree

39. University requirements have too much influence on high school teaching. ☐

40. Teachers fail to assign the most challenging problems in a course because most students cannot handle such problems. ☐

41. Public examinations have too much influence on teaching. ☐

42. Many high school teachers are assigned science and mathematics courses which they are not well qualified to teach. ☐

43. Too much time is lost during the school year on non-instructional activities. ☐

44. Many students are allowed to graduate from high school without mastering basic skills and concepts. ☐

45. Students often cannot do assigned homework on their own. ☐

46. The parents of many students are not sufficiently interested in their children's school work. ☐

47. Many students do not possess the basic mathematics conncepts necessary to handle physics and chemistry courses in high school. ☐

48. More students should choose the advanced mathematics course. ☐

49. Students waste a good deal of time in class. ☐

50. High school mathematics and science courses are generally not very challenging to students. ☐

SECTION E

TEACHER BACKGROUND

51. How many university level semester courses or equivalent have you completed in each of the following subjects?

    Biology

    Chemistry

    Computer Science

    Earth Science/Geology

    Mathematics (including statistics)

    Physics

    Mathematics Education

    Science Education

52. At what level of teaching did you specialize in your teacher education program?

    1. Primary
    2. Elementary
    3. Secondary

53. What level of teaching certificate do you hold?

1. less than IV
2. IV
3. V
4. VI
5. VII

54. How many years teaching experience have you had, not including this year?

55. Are you female or male?

1. female
2. male

56. Have you completed any part of your university education outside of Newfoundland?

1. none
2. part
3. all

57. Is there anything else about mathematics and science teaching and learning that you would like to say?

THANK YOU FOR YOUR CO-OPERATION.

TASK FORCE ON MATHEMATICS AND SCIENCE EDUCATION

UNIVERSITY INSTRUCTOR SURVEY

Purpose

The mandate of the Task Force on Mathematics and Science Education is to examine student performance and participation in mathematics and science programs at the elementary/secondary and post-secondary levels. The purpose of this survey is to obtain information and opinions about the conditions of teaching and learning in mathematics and science within the public post-secondary institutions. Data from the survey will supplement other information gathered from interviews, submissions, institutional records,and other sources. All responses will be treated as confidential. No individuals will be identified in any reports of the survey.

Directions

Most items may be completed by placing the number or letter corresponding to your response on the lines to the right of the page. A few items are open-ended, allowing for a more elaborated response. Finally, space is provided on the last page for comments on matters of specific concern to respondents. Please place the completed questionnaire in the return envelope provided and place in the ~~internal~~ mail.

SECTION A

TIME/WORKLOAD/TEACHING PRACTICES

Please place your responses on the line to the right of each question.

1. Please indicate the courses you are teaching this semester.

Department	Courses taught this semester
A. Mathematics	______ ______ ______ ______
B. Chemistry	______ ______ ______ ______
C. Biology	______ ______ ______ ______
D. Physics	______ ______ ______ ______

2. How many students do you teach in total this term? ________

3. How many students do you teach in first year courses? ________

4. How many hours per week of direct student contact do you have in each of the following areas?

   Regular lectures ________

   Laboratory sessions (in which your presence is required) ________

   Tutorials or other scheduled help sessions ________

   Other ________

5. How many hours per week would you say you have available to see individual students about problems with course content? ________

6. On average, how many first year students would present themselves in a week, to discuss matters of course work? (a typical week, excluding drop/add and exam periods) ________

7. On average, what proportion of your normal work week during a teaching term is spent on each of the following activities?

Scheduled classes (lectures, laboratories, tutorials, etc.)	________
Preparing for classes	________
Marking assignments, tests, etc.	________
Advising or helping individual students	________
Other teaching activities	________
Other (e.g. administration)	________

8. In your first year courses, what percentage of student final marks are contributed by each of the following elements?

Chapter or unit tests	________
Mid term tests	________
Projects or assignments	________
Laboratory reports	________
Final examinations	________
Other (please specify)________________	

9. Which of the following best describes how your regular class sessions in first year courses are usually conducted? __________

   A. uninterrupted lecture

   B. lecture/occasional student question or comment/occasional instructor question to students

   C. discussion (i.e. about as much student talk as instructor talk)

   D. lecture or discussion with student seatwork or practice exercises

   E. Other (please describe briefly)______________

   ____

10. How closely does the content of your first year course(s) as actually taught match the content of the assigned textbook or primary reference for the course? __________

   A. Text or reference material specifically designed for the course is available to students

   B. Commercial text is available which closely matches the content taught

   C. Commercial text is used but content is not a close match

   D. No textbook or other primary reference is used

11. On average, about what percentage of your students in first year courses attend each of your regular class sessions? ______

   A. 90 percent or more

   B. 80 - 89 percent

   C. 70 - 79 percent

   D. 50 - 69 percent

   E. less than 50 percent

12. Which of the following best describes how you provide time to see students outside of regular classes? ______

   A. Time provided immediately following class

   B. Students informed of regular office hours

   C. Available to students by appointment

   D. Open door, students can appear at any time

   E. Other (please describe briefly)____________

   ____

SECTION B

OPINIONS AND ATTITUDES

The following statements pertain to the expectations which instructors may have of students entering their courses, and the views of instructors on teaching and learning. For each statement, please indicate the extent of your agreement or disagreement by placing the number corresponding to the appropriate scale value on the line to the right.

Key: 1 = strongly disagree 2 = disagree 3 = agree 4 = strongly agree

13. Mathematics should be required for all first year university students. ______

14. Many students entering the university do not have the basic intellectual ability to succeed in mathematics and science courses. ______

15. High school courses for students planning to proceed to university should be designed specifically to prepare them for the appropriate university courses. ______

16. Mathematics and science are just as important for females as for males. ______

17. Students entering the various professional faculties in the university should have their mathematics and science courses specially designed to suit their needs. ______

18. Students should expect to work much harder in university than they do in high school. ______

19. Students should assume most of the responsibility for their own success or failure at university. ______

20. Most high schools are not adequately preparing students for university programs. ______

21. The university should adjust its first year courses to match the level of preparation of entering students. ______

22. Students should not be admitted to first year university courses unless they meet specific prerequisites established by university departments. ________

23. Most students who fail in first year courses do so because they do not work hard enough to succeed. ________

24. Most students who fail in first year courses do so because they have not been adequately prepared by the high schools. ________

25. High schools should not concern themselves much with preparing students for university. ________

26. High school marks are generally too high. ________

27. Most students entering university are intellectually capable of succeeding in first year mathematics courses. ________

28. Classes in first year mathematics and science courses are generally too large. ________

29. University entrance requirements have too much influence on high school teaching. ________

30. Many first year students are not capable of performing basic mathematical operations. ________

31. Many high school math and science teachers are not sufficiently well trained in their subject areas. ________

32. More classes per week are needed in first year courses. ________

33. University instructors do not have sufficient time to deal with the problems of individual students. ________

34. Many university instructors are inadequately prepared as teachers. ________

35. University instructors' expectations of first year students are too high. ________

36. The content of first year university courses should be modified to match the level of treatment found in high school courses. ________

37. Special courses should be offered to first year students who do not meet the prerequisites for regular first year courses. ________

38. The university should impose more stringent admission requirements. ______

39. The level of first year courses offered at this university is generally lower than that of similar courses at other Canadian universities. ______

40. Instructors of first year university courses should have some professional training as teachers. ______

41. Students often select courses they are not capable of handling. ______

42. Many high school teachers are inadequately prepared to teach mathematics and science courses at that level. ______

43. Many first year students do not have good study habits. ______

44. Most students have difficulty keeping up with the pace of instruction in first year mathematics and science courses. ______

45. Many students don't seem to understand what is being asked of them on tests and exams. ______

C. BACKGROUND INFORMATION

Please place the number of your response on the blank line to the right of each question.

44. Are you male or female? ________

    1. Male 2. Female

45. How many years have you taught at the university level (not counting this year)? ________

    1. Fewer than 3
    2. 3 - 5
    3. 6 - 9
    4. 10 - 14
    5. 15 or more

46. How many years have you taught at the first year level at Memorial? ________

    1. Fewer than 3
    2. 3 - 5
    3. 6 - 9
    4. 10 - 14
    5. 15 or more

47. What is your highest degree? ________

    1. Bachelor's
    2. Master's
    3. Doctorate

48. Please indicate the amount of professional teacher training you have had. ______

1. None

2. Short courses or workshops

3. Formal teacher training programs up to one year in length

4. Degree in education

5. Other (please specify)______________________

49. Have you ever taught in elementary or secondary schools?

1. Yes 2. No ______

GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

TASK FORCE
ON
MATHEMATICS / SCIENCE ACHIEVEMENT

FIRST YEAR STUDENT SURVEY

PART I

September, 1988

Purpose:

The purpose of this survey is to obtain information about the high school science experiences of students, and to provide the opportunity for students to express opinions about these experiences. Results will be used to help make decisions about how to improve science teaching in high schools and post-secondary institutions. Your responses are confidential, and will be used for statistical analysis only. Individuals will not be identified in any reports of the survey.

SECTION A

HOME AND SCHOOL BACKGROUND

1. In what year did you graduate from high school?

    A. 1988

    B. 1987

    C. 1986

    D. Before 1986

2. Did you complete any part of your high school education outside of Newfoundland?

    A. None

    B. Part

    C. All

*If you did not attend high school in Newfoundland, please go to Item 5.

3. In what area of the province, as shown by the map, did you attend high school?

    A. Avalon

    B. South

    C. Central

    D. West

    E. Labrador

4. What was the approximate size of the community in which you lived while attending high school? (Please give your home community if different from your school community.)

   A. More than 25,000 (St.John's, Mount Pearl, Corner Brook)

   B. 10,000 - 25,000 (Grand Falls/Windsor, Gander, Stephenville, Labrador City/Wabush, Happy Valley/Goose Bay, Conception Bay South)

   C. 2500 - 10,000 (e.g. Lewisporte, Carbonear, Springdale, Port aux Basques, etc.)

   D. 1000 - 2500

   E. under 1000

5. Approximately how many students were enrolled in grade 12 in your high school?

   A. Fewer than 10

   B. 10 - 24

   C. 25 - 49

   D. 50 - 99

   E. 100 or more

6. In what type of household did you live when in high school?

   A. With both parents (including step-parents)

   B. With one parent

   C. With grandparents or other relatives

   D. Other

7. Was there someone at home who was available to give you help with your science when necessary?

   A. There was no one who could really help me.

   B. Mother and/or father

   C. Other adult

   D. Brother and/or sister

   E. I did not need any extra help

8. What was the highest level of education of any of the adults with whom you lived while you were in high school?

   A. Less than high school graduation

   B. High school graduation

   C. Some post secondary education (university, trade school etc.)

   D. Trade, technical school or community college graduation

   E. University graduation

9. Which of the following best describes the kind of occupation of the main wage earner in your household?

   A. Professional (lawyer, doctor, teacher, high level management, etc.)

   B. Technical or middle management

   C. Skilled clerical, sales or service, tradesman, farmer or fisherman (owns farm or boat)

   D. Semiskilled clerical, service or manual

   E. Unskilled manual (laborer, fishing crew member, etc.)

10. How many hours per week, outside of regular school hours, would you say you spent at school work (written homework, study) when in Grade 12?

A. 0 - 2

B. 3 - 5

C. 6 - 10

D. 11 - 15

E. more than 15

11. How many school days would you say you missed in Grade 12 (not counting days school was closed or days lost during exams)?

A. 0 - 2

B. 3 - 5

C. 6 - 10

D. more than 10

12. What was the main reason you missed school days?

A. sick

B. Work or family reasons

C. Just did not bother to go

Which of the following science courses did you take in high school?

13.	Biology 2201	A. Yes	B. No
14.	Biology 3201	A. Yes	B. No
15.	Chemistry 2202	A. Yes	B. No
16.	Chemistry 3202	A. Yes	B. No
17.	Physics 2204	A. Yes	B. No
18.	Physics 3204	A. Yes	B. No
19.	Earth Science 2203	A. Yes	B. No
20.	Geology 3203	A. Yes	B. No

21. Which of the subject areas did you find most difficult?

A. Biology

B. Chemistry

C. Physics

D. Earth Science/Geology

22. What type of post-secondary program do you plan to pursue?

For students at Memorial

A. B.Sc (pure science: Physics, Chemistry, Biology, Psychology, Geology etc)

B. B.Sc (applied science: Engineering, Pharmacy, Health Sciences)

C. B.Sc (Math, Statistics, Computer Science etc)

D. B.Sc/BED (Science/Math teaching)

E. Other or Undecided

For students at the Cabot Institute

A. Engineering Technology (e.g. mechanical, electrical)

B. Medical Technology (e.g. X-ray, medical lab)

C. Business

D. Other

For students at the Marine Institute

A Food Technology

B. Mechanical or Electrical Technology

C. Nautical Science

D. Naval Architecture

E. Other

SECTION B

PROBLEMS IN SCIENCE TEACHING AND LEARNING

The statements given below are about problems that people sometimes identify in science teaching and learning. Please think about each item with refeience to the subject you identified in Question 21.

Please complete each item by circling the number on the answer sheeet which corresponds to the extent to which you agree or disagree with the statement.

		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
23.	Many students are not capable of understanding science concepts at the high school level.	1	2	3	4	5
24.	Most of the science teachers I had in high school did not seem to know their subject well.	1	2	3	4	5
25.	Students just do not work hard enough at science to do well.	1	2	3	4	5
26.	Facilities for teaching high school science are not adequate.	1	2	3	4	5
27.	There is not enough time in high school to cover the science course adequately.	1	2	3	4	5
28.	High school teachers do not pay enough attention to the problems of individual students.	1	2	3	4	5

29.	High school science classes are dull and boring places.	1	2	3	4	5
30.	Most students are satisfied with barely passing science.	1	2	3	4	5
31.	Concepts covered in the high school curriculum are too advanced.	1	2	3	4	5
32.	Public examinations in science are too difficult.	1	2	3	4	5
33.	Too many students are allowed to pass science with very little understanding of the subject.	1	2	3	4	5
34.	Science in high school should be taken only by the best students.	1	2	3	4	5
35.	It is easy to pass high school science without doing much work.	1	2	3	4	5
36.	High school teachers have difficulty keeping order in class.	1	2	3	4	5

SECTION C

PERSONAL ATTITUDES

The statements given below are about your own personal views of science. Please answer each item as before, but this time thinking only of your own feelings.

		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
37.	Studying science is just as important for females as for males.	1	2	3	4	5
38.	When I am faced with a hard science problem I give up easily.	1	2	3	4	5
39.	I expect post-secondary science to be much more difficult than high school science.	1	2	3	4	5
40.	Science is really difficult for me even though I study hard.	1	2	3	4	5
41.	Science is not very important for my career plans.	1	2	3	4	5
42.	I don't expect to get as much attention from my post-secondary science instructors as I did in high school.	1	2	3	4	5
43.	Science is a necessary subject for all students in universities and colleges.	1	2	3	4	5
44.	My parents have always encouraged me to work hard in school.	1	2	3	4	5

45.	I really did not have to work very hard at science in high school.	1	2	3	4	5
46.	I would never take another science course if it were not required.	1	2	3	4	5
47.	It is important to be good at science in order to be competitive in the job market.	1	2	3	4	5
48.	I always try for the highest mark possible, not just a pass.	[illegible]	[illegible]	3	4	[illegible]

Government of Newfoundland and Labrador

TASK FORCE

ON

MATHEMATICS/SCIENCE ACHIEVEMENT

FIRST YEAR STUDENT SURVEY

Purpose

The purpose of this survey is to examine some of the conditions of mathematics and science teaching and to obtain the views of students on the transition from high school to university. The survey is a follow up to a similar survey carried out at the beginning of the semester. All data from the survey will be treated as confidential. No individuals will be identified in any reports of the survey.

General Directions

Please respond to each item by filling in the appropriate circle on the answer sheet, according to the instructions given on the next page. There are no correct or incorrect answers. We are interested in what you do and in your opinions. Some sections of the questionnaire may not apply to you. Please follow the directions at the beginning of each section to determine if the section should be completed.

For this questionnaire you will need a soft pencil (HB or softer) and an eraser. You will record your answers on a separate answer sheet.

BEFORE YOU START ANSWERING THE QUESTIONS:

1. Please fill in your **birthdate, MUN Identification Number, and sex** at the bottom of the answer sheet as shown in the sample below. Please <u>OMIT</u> the section headed **Grade or Education** and the entire **Name** section.

If you want to change your answer, DO NOT CROSS IT OUT but erase your first answer and fill in the bubble for your new answer. Please do not make any other marks on the answer sheets.

2. Beginning with Question 1 in the questionnaire, fill in the bubbles starting with #1 on the answer sheet at the top of the right hand side. As you work through the questions **please make sure that the question number on the answer sheet and in the questionnaire are the same.** For those sections omitted please leave the corresponding bubbles blank.

Example:

5. In what year did you graduate from high school?

A. 1988 C. 1986
B. 1987 D. Before 1986

If you graduated in 1988, your answer sheet should look like this for question 5:

SECTION A

PROGRAMS AND WORKLOAD

1. How many courses are you now taking (not counting any you may have dropped earlier in the semester)?

   A. 3 or fewer   C. 5

   B. 4   D. 6 or more

2. In which university faculty are you registered or do you plan to register?

   A. Arts   C. Science or Engineering

   B. Education   D. Medicine or Nursing

   E. Other

3. In which subject areas do you intend to major in your undergraduate degree program?

   A. Biological sciences (biology, biochemistry, etc.)

   B. Physical Sciences (physics, chemistry, etc)

   C. Psychology

   D. Earth Sciences

   E. Other or undecided

4. About how many hours per week do you work at a paid job (including work within the university)?

   A. fewer than 5   C. 10 - 14

   B. 5 - 9   D. 15 or more

SECTION B

HOME AND SCHOOL BACKGROUND

5. In what year did you graduate from high school?

   A. 1988 C. 1986

   B. 1987 D. before 1986

6. Did you complete any part of your high school education outside Newfoundland?

   A. none C. all

   B. part

7. About how many students were enrolled in grade 12 in your high school?

   A. fewer than 10 C. 25 - 49

   B. 10 - 24 D. 50 - 99

   E. 100 or more

8. In what type of household did you live when in high school?

   A. with both parents (including step-parents)

   B. with one parent

   C. with grandparents or other relatives

   D. other

9. What was the highest level of education of any of the adults with whom you lived while you were in high school?

    A. less than high school graduation

    B. high school graduation

    C. graduation from trade/technical school or community college

    D. university graduation

10. Which of the following best describes the kind of occupation of the main wage earner in your household when you were in high school?

    A. professional / owns large business / senior management

    B. technical / owns small business / middle management

    C. skilled clerical, sales, service, or tradesperson

    D. semiskilled clerical, sales, service, or manual

    E. unskilled

11. Which of the following mathematics courses did you take in your last year of high school?

    A. Advanced Mathematics 3201   C. Other mathematics

    B. Academic Mathematics 3203

Which of the following science subjects did you take in high school?

12. Biology	A. yes	B. no
13. Chemistry	A. yes	B. no
14. Earth Science/ Geology	A. yes	B. no
15. Physics	A. yes	B. no

SECTION C

OPINIONS ON UNIVERSITY WORK

The following statements are about various aspects of university work. Please respond by filling in the bubble on the answer sheet which corresponds to the extent to which you agree or disagree with each statement.

KEY: A = strongly disagree B = disagree C = agree D = strongly agree

16. It is much harder to get good marks in university than in high school.
17. Only the very best students can be expected to do well in university mathematics courses.
18. The main reason I am going to university is to improve my chances of getting a good job.
19. My present situation is so bad I would like to quit university.
20. I find it difficult to keep up with assignments and study.
21. University courses are generally much better taught than high school courses.
22. University classes are generally dull and boring.
23. The expectations of university professors are much higher than those of high school teachers.
24. I am under a great deal of pressure to do well in university.
25. There is not enough help available for students outside of class time.
26. I was not really prepared in high school for the demands of university work.
27. Many professors are not very tolerant of students who are having trouble with their courses.
28. Mathematics and science courses generally have a reputation of being more difficult than other courses.

SECTION D

MATHEMATICS

This section should be completed if you are now taking a MATHEMATICS course or if you were registered in a mathematics course at any time during this semester. If you have not attempted a mathematics course this semester, please skip to SECTION E, page 8.

29. In which mathematics course are you now enrolled?

A. Mathematics 1000 or 1001

B. Mathematics 1050 or 1051

C. Mathematics 1080 or 1081

D. Other mathematics

E. Dropped mathematics earlier this semester

30. If you dropped a mathematics course this semester, what was the main reason for dropping?

A. having difficulty with the material

B. overall workload too great

C. conflicts or difficulties with professor

D. illness/family reasons

E. other

31. How often have you attempted this mathematics course?

A. first time

B. second time

C. third time

D. other

32. How many classes have you missed in mathematics this semester?

A. fewer than 3

B. 3 - 6

C. 7 - 10

D. more than 10

33. If you missed any classes, what was the main reason?

A. illness
B. pressure of university work
C. don't get much out of class
D. can learn material without going to class
E. other

34. About how many hours per week, outside regular class time, do you usually spend studying or doing assignments in mathematics?

A. fewer than 2
B. 2 - 5
C. 6 - 10
D. more than 10

35. How often have you gone to see the instructor for help in the mathematics course?

A. never
B. once or twice
C. several times
D. many times

36. If you have never gone to the instructor for help, why not?

A. no help needed
B. felt uncomfortable asking for help
C. instructor not available
D. other

37. How often have you attended tutorials or other organized help sessions in mathematics?

A. never
B. once or twice
C. several times
D. many times

The following statements are about various aspects of teaching and learning mathematics. Please respond by filling in the bubble on the answer sheet which best corresponds to the extent to which you agree or disagree with each statement.

KEY: A = strongly disagree B = disagree C = agree D = strongly agree

38. Mathematics is much more difficult in university than in high school.

39. University classes in mathematics are much better taught than in high school.

40. High school mathematics does not prepare students very well for university mathematics.

41. Mathematics is not very important for my career plans.

42. My mathematics instructor is quite concerned with student problems.

43. My instructor seems to expect that many students will fail in mathematics.

44. It is very difficult to keep up with the pace of work in the mathematics course.

45. I find the instructor in mathematics very difficult to understand.

46. More tutorial time is needed in mathematics courses.

47. Grading in university mathematics is more severe than in high school.

48. I would never take another mathematics course if it were not required.

49. I am quite concerned that I might fail mathematics.

50. More class time in mathematics should be devoted to practice exercises.

51. My mathematics instructor generally makes the subject seem interesting.

52. Tests and exams in mathematics do not fairly represent the course as taught.

53. Mathematics courses generally have the reputation of being more difficult than other courses.

54. Only the very best students can be expected to do well in university mathematics courses.

SECTION E

BIOLOGY

This section should be completed if you are now taking a BIOLOGY course, or if you were registered in a biology course at any time this semester. If you have not attempted a biology course this semester, please skip to SECTION F, page 11.

55. In which biology course are you now enrolled?

    A. Biology 1001 or 1002

    B. Another biology course

    C. Dropped biology earlier in the semester

56. If you dropped a biology course, what was the main reason for dropping?

    A. having difficulty with material

    B. overall workload too great

    C. conflicts or difficulties with instructor

    D. illness/family problems

    E. other

57. How often have you attempted this biology course?

    A. first time

    B. second time

    C. third time

    D. other

58. How many classes have you missed in biology this semester?

    A. fewer than 3

    B. 3 - 6

    C. 7 - 10

    D. more than 10

59. If you missed any classes, what was the main reason?

A. illness
B. pressure of university work
C. don't get much out of class
D. can learn material without going to class.
E. other

60. About how many hours per week, outside regular class time, do you usually spend studying or doing assignments in biology?

A. fewer than 2
B. 2 - 5
C. 6 - 10
D. more than 10

61. How often have you gone to see the instructor for help in the biology course?

A. never
B. once or twice
C. several times
D. many times

62. If you have never gone to the instructor for help, why not?

A. no help needed
B. felt uncomfortable asking for help
C. instructor not available
D. other

63. How often have you attended tutorials or other organized help sessions in biology?

A. never
B. once or twice
C. several times
D. many times

The following statements are about various aspects of teaching and learning biology. Please respond as before by filling in the bubble on the answer sheet which best corresponds to the extent to which you agree or disagree with each statement. A few of these statements require comparisons with high school biology. Please skip these statements of you did not take biology in high school.

KEY: A = strongly disagree B = disagree C = agree D = strongly agree

64. Biology is much more difficult in university than in high school.

65. University classes in biology are much better taught than in high school.

66. High school biology does not prepare students very well for university biology.

67. Biology is not very important for my career plans.

68. My biology instructor is quite concerned with student problems.

69. My instructor seems to expect that many students will fail in biology.

70. It is very difficult to keep up with the pace of work in the biology course.

71. I find the instructor in biology very difficult to understand.

72. More tutorial time is needed in biology courses.

73. Grading in university biology is more severe than in high school.

74. I would never take another biology course if it were not required.

75. I am quite concerned that I might fail biology.

76. My biology instructor generally makes the subject seem interesting.

77. Tests and exams in biology do not fairly represent the course as taught.

SECTION F

CHEMISTRY

This section should be completed if you are now taking a CHEMISTRY course, or if you were registered in a chemistry course at any time this semester. If you have not attempted a chemistry course this semester, please skip to SECTION G, page 14.

78. In which chemistry course are you registered this semester?

    A. Chemistry 1000 or 1001

    B. Chemistry 1800

    C. Another chemistry course

    D. dropped chemistry earlier in the semester

79. If you dropped a chemistry course this semester, what was the main reason for dropping?

    A. having difficulty with material

    C. conflicts or diffic- with instructor

    B. overall workload too great

    D. illness/family problems

    E. other

80. How often have you attempted this chemistry course?

    A. first time

    C. third time

    B. second time

    D. other

81. How many classes have you missed in chemistry this semester?

    A. fewer than 3

    C. 7 - 10

    B. 3 - 6

    D. more than 10

82. If you missed any chemistry classes, what was the main reason?

A. illness
B. pressure of university work
C. didn't bother to go
D. other

83. About how many hours per week, outside regular class time, do you usually spend studying or doing assignments in chemistry?

A. fewer than 2
B. 2 - 5
C. 6 - 10
D. more than 10

84. How often have you gone to see the instructor for help in the chemistry course?

A. never
B. once or twice
C. several times
D. many times

85. If you have never gone to the instructor for help, why not?

A. no help needed
B. felt uncomfortable asking for help
C. instructor not available
D. other

86. How often have you attended tutorials or other organized help sessions in chemistry?

A. never
B. once or twice
C. several times
D. many times

The following statements are about various aspects of teaching and learning chemistry. Please respond as before by filling in the bubble on the answer sheet which best corresponds to the extent to which you agree or disagree with each statement. Some of the statements require comparisons with high school chemistry. Please disregard these statements if you did not take chemistry in high school.

KEY: A = strongly disagree B = disagree C = agree D = strongly agree

87. Chemistry is much more difficult in university than in high school.

88. University classes in chemistry are much better taught than in high school.

89. High school chemistry does not prepare students very well for university chemistry.

90. Chemistry is not very important for my career plans.

91. My chemistry instructor is quite concerned with the problems students have in the course.

92. My instructor seems to expect that many students will fail in chemistry.

93. It is very difficult to keep up with the pace of work in the chemistry course.

94. I find the instructor in chemistry very difficult to understand.

95. More tutorial time is needed in chemistry courses.

96. Grading in university chemistry is more severe than in high school.

97. I would never take another chemistry course if it were not required.

98. I am quite concerned that I might fail chemistry.

99. My chemistry instructor generally makes the subject seem interesting.

100. Tests and exams in chemistry do not fairly represent the course as taught.

SECTION G

PHYSICS

This section should be completed if you are now taking a PHYSICS course, or if you were registered in a physics course at any time this semester. If you have not attempted a physics course this semester, please skip to page 17.

101. In which physics course are you registered this semester?

   A. Physics 1050 or 1051

   B. Physics 1200 or 1201

   C. Physics 1000 or 1001

   D. other physics

   E. dropped physics earlier in the semester

102. If you dropped a physics course, what was the main reason for dropping?

   A. having difficulty with the material

   B. overall workload too great

   C. conflicts or problems with instructor

   D. illness/family reasons

   E. other

103. How often have you attempted this physics course?

   A. first time

   B. second time

   C. third time

   D. other

104. How many classes have you missed in physics this semester?

   A. fewer than 3

   B. 3 - 6

   C. 7 - 10

   D. more than 10

105. If you missed any classes, what was the main reason?

A. illness
B. pressure of university work
C. don't get much from class
D. can learn material without going
E. other

106. About how many hours per week, outside regular class time, do you usually spend studying or doing assignments in physics?

A. fewer than 2
B. 2 - 5
C. 6 - 10
D. more than 10

107. How often have you gone to see the instructor for help in the physics course?

A. never
B. once or twice
C. several times
D. many times

108. If you have never gone to the instructor for help, why not?

A. no help needed
B. felt uncomfortable asking for help
C. instructor not available
D. other

109. How often have you attended tutorials or other organized help sessions in physics?

A. never
B. once or twice
C. several times
D. many times

The following statements are about various aspects of teaching and learning physics. Please respond as before by filling in the bubble on the answer sheet which best corresponds to the extent to which you agree or disagree with each statement. Some of the statements require comparisons with high school physics. Please disregard these statements if you did not take physics in high school.

KEY: A = strongly disagree B = disagree C = agree D = strongly agree

110. Physics is much more difficult in university than in high school.

111. University classes in physics are much better taught than in high school.

112. High school physics does not prepare students very well for university physics.

113. Physics is not very important for my career plans.

114. My physics instructor is quite concerned with the problems students have in physics.

115. My instructor seems to expect that many students will fail in physics.

116. It is very difficult to keep up with the pace of work in the physics course.

117. I find the instructor in physics very difficult to understand.

118. More tutorial time is needed in physics courses.

119. Grading in university physics is more severe than in high school.

120. I would never take another physics course if it were not required.

121. I am quite concerned that I might fail physics.

122. My physics instructor generally makes the subject seem interesting.

123. Tests and exams in physics do not fairly represent the course as taught.

Is there anything else you would you like to say about your high school or first year experiences in mathematics and science?

THANK YOU FOR YOUR CO-OPERATION.