INSTRUCTIONAL TIME AND ACHIEVEMENT IN HIGH SCHOOL MATHEMATICS AND SCIENCE

CENTRE FOR NEWFOUNDLAND STUDIES

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INSTRUCTIONAL TIME AND ACHIEVEMENT IN HIGH SCHOOL MATHEMATICS AND SCIENCE

BY

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A thesis submitted to the School of Graduate Studies in partial fulfillment of the requirements for the degree of Master of Education

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ABSTRACT

This study investigates time allocation and time use in mathematics and science classes in Newfoundland and Labrador high schools. It examines how much time is allocated for instruction in these courses, how much of this allocated time is actually used for instruction, and if the time allocation can be associated with achievement in mathematics and science courses.

Using self-reporting surveys administered to teachers and university students, it was found that approximately 75 percent of allocated instructional time in mathematics and science is used for instruction. The remaining time is used for non-instructional activities such as examinations and extra-curricular activities. There are also days in which no instruction occurs because of weather, teacher workshops or student absenteeism. The achievement data used in this study were compiled from the available data base supplied by the Government of Newfoundland and Labrador.

The correlation coefficients completed revealed that there are some weak, positive relationships between time allocations and achievement in mathematics and science courses at both the school level and the student

level. Regression analysis done on the student data indicated the time variable can be used to explain variation in student achievement for university level mathematics and science courses.

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THE PROBLEM AND THE CONTEXT OF THE STUDY

General Context

Common sense would suggest that the amount of time spent in learning is an important determinant of levels of educational achievement. Both theoretical models and empirical research can be found to support this common sense assertion. Time has been examined from many perspectives in these models. Some have focused on proximate measures of time such as engaged time or time-on-task (Bloom, 1973; Carroll, 1963); others have concentrated on more global measures such as allocated time (Wiley & Harnischfeger, 1974). Each model associates the amount of time spent learning with student achievement.

In addition to the theoretical base, there have been many research studies linking time spent learning to achievement. Some of these have found that allocated time is positively correlated with achievement (Schmidt, 1978; Wiley, 1974); others argue that it is engaged time or time-on-task not allocated time that correlates positively with achievement

(Karweit, 1976). Other researchers claim that since allocated time is directly related to engaged time, then increasing allocated time automatically increases engaged time (Walberg, 1983).

The present research base in this area indicates that the concepts for time are varied. These include allocated time - the amount of time a teacher allots for learning a particular content; engaged time or time on task - the amount of time a student is actively engaged in learning; and academic learning time - the combination of allocated time, engaged time and student success rate. Regardless of what concept of time is used, most research studies in this area agree that time is an important variable in learning.

Much of the research that has focused on time and learning has been carried out in a particular educational jurisdiction such as a school district. There is also, however, a comparative research base in which time allocation and use has been investigated both within countries and across countries.

The Newfoundland Context

The purpose of this study is to further develop the research base by examining time allocation and use in the context of high school mathematics and science programs, in a setting in which achievement in these areas has been a source of professional and public concern. In this research study, factors that may affect time allocation and use have been investigated by examining a variety of aspects of time use both within the school system and those external to the school system. This study is set within a much broader investigation of factors contributing to low levels of performance in mathematics and science at secondary and post-secondary levels. It is a part of and at the same time an extension of the work conducted by the Task Force on Mathematics and Science Achievement which was established by the Government of Newfoundland and Labrador in June, 1988. The present study being part of a policy study is set in a specific educational jurisdiction and does not make any comparisons to situations in other parts of Canada or other countries.

This study was conducted in the province of Newfoundland and Labrador during the 1988-89 school year. Newfoundland and Labrador is a small province of Canada with just over 200 schools offering the senior high school program. Of these schools, 157 are considered to be rural and the remaining schools urban (Banfield, 1989a). Many of these rural schools offer primary, elementary and junior high programs as well as the senior high program. Most of the high school graduates who pursue post-secondary education attend the one university in the province, Memorial University of Newfoundland, with the remainder attending one of the technical schools or community colleges, or universities outside the province.

In 1982, the province introduced a new high school program which added one year to the curriculum. This reorganized program aimed to organize the high school curriculum in Newfoundland so that it would be comparable to curricula found in the rest of Canada. It broadened the curriculum to include new courses and at the same time decreased the time allocations per year for other subject areas including mathematics. The purpose for this was to give the students the same amount of instruction in certain areas as they had received under the old system and at the same time broaden the spectrum of courses in other areas. The program has a tri-level mathematics program, with Basic Mathematics for those students not planning on post-secondary studies, and Academic and Advanced Mathematics for those who do plan on pursuing either college or university programs. The program also offers a wide range of science courses including Chemistry, Physics, Biology, Geology and General Science.

The reorganized program introduced the credit system for evaluation with a minimum of 36 credits required for graduation. The evaluation system in the final year of the senior high school program in the province of Newfoundland and Labrador is a shared system. Fifty percent of the students' mark is awarded by the school. The remaining fifty percent is obtained from the score that the students receive on a provincial examination administered in June. These examinations are written by all students across the province and are commonly referred to as public examinations. A student must complete a minimum number of these examinations in order to graduate.

Since the introduction of the reorganized high school program, a gradual reduction in success rate in the provincial post-secondary institutions has occurred. This problem reached such a level in recent years that in 1988 the Government of Newfoundland and Labrador established a Task Force, with a broad mandate to investigate problems in mathematics and science education.

Concerns of School and District Personnel

In the preliminary stages of its investigation, members of the Task Force conducted interviews with school and district personnel. This allowed the Task Force staff to ascertain the perceptions of people in the field concerning many facets of the school system including time use. These concerns are outlined below.

When the reorganized high school program was introduced in 1982, the number of courses available to students increased, as did the number of courses students were required to complete. This means that the amount of time required for evaluation - both formal examinations and in-class testing also increased. From preliminary discussions with district and school personnel, it was learned that people at both levels of the system were unanimous in their concern over the considerable loss of time associated with the scheduling of tests and midterm examinations. Those interviewed indicated that scheduling of examinations for the large number of high school courses requires anything up to three weeks (Banfield, 1989c).

It is not only evaluation that imposes restrictions on instructional time but also non-academic activities that occur within the school system. According to discussions with school and district personnel, most agree that although the school year in Newfoundland is officially 187 days long, in reality the number of instructional days is closer to 150 days because of disruptions due to weather, furnace breakdowns, professional development days, graduations, examinations and a variety of other factors. Many principals and administrators agreed that in many instances students in school were considered to be a captive audience for all sorts of agencies and groups, resulting in even further losses in instructional time (Banfield, 1989c).

The school schedule also affects the amount of instuctional time available. This study addresses two aspects of the school schedule that impinge on the instructional time available for mathematics and science - homeroom periods and class changes. Because of the way in which the high school program is set up, it is necessary for the schools to have homeroom periods in which attendance is recorded, announcements are made and other managerial tasks are performed. There is no one policy for allocating time for this class session so that schools can have it incorporated into the instructional time or can have a separate period for this purpose. If the homeroom period is incorporated into the instructional time, then some instructional time is lost for each homeroom period.

The second aspect of the school schedule which involves time is changing classes. Students and teachers generally change classes between periods but as is the case with homeroom periods, there is no set policy for this, so often no specific time allottments are in place. Therefore, instructional time is lost at the beginning of each mathematics or science class. If only one minute is required to change classes, that is approximately five minutes a day which is equivalent to 22 class periods throughout the year.

In addition to the instructional time lost because of factors within the school system, many external factors account for lost time by the students. Many students in the urban centres have part-time jobs which often interfere with their studies. This point was also brought forward during preliminary discussions with school and district administrators (Banfield, 1989c).

Besides work commitments, students lose instructional time in mathematics and science for a variety of reasons. In interviews with school and district personnel, many teachers expressed concern that absenteeism is a problem in many schools in the larger centres (Banfield, 1989c). For example, it is common for many students not to attend on days just before holidays or examinations. On such occasions, instructional time is lost because such high absenteeism makes it is impossible for any teaching to take place. On other occasions, individual students lose instructional time. Students miss classes throughout the day for many reasons including medical appointments, drivers' test and sometimes indiscriminately without reason.

Concerns Made Known Through Submissions

Another part of the data collection process of the Task Force was receiving submissions from individuals, special interest groups and educational agencies. There were 93 of these briefs presented to the Task Force for consideration. In many of these submissions, there was some reference to time. The main concerns of some of these groups as indicated in the briefs is outlined below:

1. Many of the teachers said they feel that it is extremely difficult to cover all the required topics in the time available and that there is no opportunity for enrichment or remediation.
2. The school districts expressed concern that the reduction in time allocation for mathematics contributes to poor student performance in that subject and that the time should be increased; this would permit enrichment, remediation, and review and reinforcement of basic concepts.

3. The instructors and administrators at many of the post-secondary institutions expressed their view that the time devoted to mathematics in senior high school be increased substantially. Professors and instructors also expressed concern over the quality of preparation of the students entering the various institutions.

Based on the submissions, it appears that time allocation and use is a concern of many groups and individuals. This research study will address many of the concerns expressed in these briefs.

Research Questions

The preliminary work done by the Task Force indicates that time allocation and use is a concern of many teachers, administrators, school district personnel and instructors at post-secondary institutions. It is evident from this work that the concerns exist but the question of whether or not they are justified remains unanswered. There has been no study done in Newfoundland and Labrador to determine how the allocated time in mathematics and science is used, or if the time use is a factor that affects achievement in these areas.

This research project is based on the following questions:

1. How much instructional time is lost throughout the year within the school system?
2. What are the perceptions of teachers and students of the effect of time lost?
3. How does this instructional time lost affect achievement in mathematics and science?

Overview of the Methods

This study is mainly concerned with examining the amount of instructional time spent on non-instructional activities and its relationship to achievement in mathematics and science. Data were gathered from two populations: high school mathematics or science teachers, and first-year post-secondary students. General purpose survey instruments were used for this study. The instruments included items on a range of conditions in the schools with time allocation and use being one of these. This study relied on survey reports rather than first-hand time measures. This approach supplied perceptions, rather than exact measures of time.

The questionnaires were administered when the Task Force on Mathematics and Science Achievement undertook to examine the factors that could contribute to lowered achievement in mathematics and science at the post-secondary level. The overall study dealt with a multitude of possible concerns including teacher assignment and workload, evaluation practices at the secondary and post-secondary levels, student expectations, and student preparation for post-secondary institutions. This study which utilizes a part of the data of the larger study relates only the amount of instructional time spent on non-instructional activities to achievement in mathematics and science. This study is based upon selected questions from the various surveys. If this study had been an independent one, the data collected on time allocation and use would have been more extensive. Other data collecting methods such as interviews and case studies could have been employed. Since the research done was part of a much broader investigation, it was not feasible to use these tools to collect data on one particular factor been examined.

CHAPTER 2

REVIEW OF THE LITERATURE

Historical Perspective

The concept of time and how it is used in the classroom has interested educators and researchers since the early part of the twentieth century. In the first half of this century, the focus of the research was on how time is allocated to the various subject areas (Holmes, 1915; Mann, 1928; Payne, 1905). These surveys distinguished between particular subject areas and the time that students are engaged in learning that particular subject.

In addition to the survey, Mann studied the school districts' records to determine if there were any prevalent trends in time allocation. The earliest record of time allocation by subject matter found was in 1855-56 in Cleveland, Ohio. These early studies indicate that more time was spent on academic subjects such as mathematics and reading and less time was spent on non-academic subjects such as physical education and music.

Carroll's Model

One of the earliest models that considers time as a variable to learning was proposed by Carroll (1963). Unlike the earlier surveys, Carroll conceptualized the influence of time on learning and laid a framework for many subsequent researchers and educators. In his theory, Carroll says that learners will succeed in learning a given task if they are given the time necessary to learn the task. Carroll defines time as that which is actually spent on the act of learning not that time which is allocated.

The essence of Carroll's model is that learning is a function of the ratio of time spent to time needed with the time needed being a function of aptitude, quality of instruction and ability to understand instructions. Time spent learning is a function of opportunity to learn and perseverance.

All of this is embodied in Carroll's well known functional relationship,

Degree of learning = f (time actually spent / time needed)

Each of the factors that Carroll presumes to affect the time spent in learning are described below:

1. Opportunity to learn - The amount of time a teacher allots for learning a particular content. Some programs present material at such a rapid pace that most students are kept under continual pressure and the slower students fall behind while others are so slow that the faster students lose some motivation for learning.

2. Perseverance - The amount of time the learner is willing to engage actively in learning the objective. Perseverance is characterized by behaviors such as working beyond the time required or continuing to work on the content even after negative feedback has been received.

There are also factors which determine how much time a person needs to spend in order to learn the task:

1. Aptitude - The amount of learning time necessary for a student to master an objective under ideal learning condition. Carroll says that the higher the learner's aptitude, the shorter the time needed for learning.

2. Quality of instruction - The clarity and organization of instruction which facilitates learning. If the teacher's instructions are not clear or precise, then the learner may need more time than would otherwise be required.

3. Ability to understand instructions - Verbal or general intelligence. Students with a high ability to understand instructions will be less affected by poor instruction than students with a poor ability to understand.

Adaptations of Carroll's Model

Other models that adapted Carroll's work include those of Bloom (1973), Wiley and Harnischfeger (1974), and Bennett (1978). Bloom (1973) argued that it is not allocated time but the amount of time that the learner is actively engaged in learning that is important for learning. In this model, the idea that allocating the same amount of time to each student will not bring about mastery of the learning task for many of them is emphasized. This model provides extra time so that the students can overcome errors and misunderstandings. Bloom claims that allocated time and achievement are not related but said that the learner's previous learning experiences, interests and motivation affect their learning and the amount of time in which they will actively participate in learning. Bloom defined schooling in terms of what is learned rather than how much time is spent. This concept is the basis for a wide body of research usually referred to as "mastery learning".

Two other researchers advocating that quantity of schooling is a major predictor of achievement are Wiley and Harnischfeger (1974). The central theme of the Wiley and Harnischfeger model is the idea that all student outcomes are a function of student pursuits, and that the quantity of schooling variable is an intermediate one which links student background and student performance. The model distinguishes between student time and teacher time with achievement being a function of both of these. Wiley and Harnischfeger argued that student achievement is determined by two variables: total time needed and the total time the student actually spends on the task. Like Carroll and Bloom, Wiley and Harnischfeger make the distinction between allocated time and active learning time.

Another model in which learning time is considered a critical determinant of achievement was proposed by Bennett (1978). As with the other models, Bennett defines learning time as that in which students are actively engaged in learning and views it as one component of quantity of schooling. This quantity of schooling also includes time allocated to curriculum, transition time between activities and time used for classroom management. Bennett argues that only the amount of time in which the student is actually comprehending the task is directly related to achievement.

These models are a sample of the many learning models that include time and which generally link instructional time and learning outcomes. From these learning models, it seems that time is perceived as a necessary component in learning.

Studies Conducted Relating Time and Achievement

Since the development of Carroll's model, many researchers have conducted investigations linking opportunity to learn with student achievement (Borg, 1980; Comber and Keeves, 1973; Rosenshine, 1980). Each of these researchers has found that there is a relationship between opportunity to learn and student achievement. The research findings often indicate that the time teachers allocate to learning is positively correlated with student achievement (Schmidt, 1978; Wiley and Harnischfeger, 1974; Wiley, 1976).

The research findings involving time are often inconsistent, with some studies showing that time is a good predictor of achievement, others showing small gains in achievement due to time (Karweit, 1976; Schmidt, 1978) and still others failing to find a relationship between allocated time and achievement (Smyth, 1976). Not only have the research findings been inconsistent but the methodology employed for the studies on time has also differed. Some of these procedures include classroom observation, teacher and student interviews, teacher, school and district records and teacher self-reports of time allocations. Ross (1984) noted that one of the consistent findings is that much time is spent in transitions and other non-instructional activities (Borg, 1980; Rosenshine, 1980).

One of the most comprehensive studies in education is the Equality of Educational Opportunity Study (Coleman et al., 1966). This was a national study of the school system in the United States conducted in 1966. One of its conclusions that prompted much discussion and debate was that schooling has no effect on achievement.

Wiley intended to refute Coleman's allegation that schooling has no effect on learning by reanalyzing the data from the Equality of Educational Opportunity Study. According to Wiley (1974) the important question is not "Does schooling have an effect?" but rather "What effect does schooling have?". Wiley defined quantity of schooling as the average number of hours of schooling for students in a particular school calculated by multiplying average daily attendance by the number of hours in a school day by the number of days in a school year. Wiley reanalyzed Coleman's data obtained from the Detroit metropolitan area sample and predicted the effect of changes in allocated time on student achievement in verbal ability, reading comprehension and mathematics. From the regression analysis that was conducted, Wiley concluded that increasing the number of days in the school year, the number of hours in the school day and the average attendance by twenty-four percent would bring about gains in achievement in mathematics by approximately one-third. The major limitation to the analysis was that quality of instruction, actual time on task or the amount of non-instructional time in the classroom was not considered.

Subsequent research (Karweit, 1976) re-examined Wiley's conclusions, and analyzed the data used by Wiley making adjustments for within school background differences. Data for this analysis were also part of the data from the Equality of Educational Opportunity Study, and included the data that had been obtained on central schools in Washington, Cleveland and Baltimore. The analysis from this study indicated small effects for quantity of schooling; no large positive effects such as those found by Wiley were evident. This study also did regression analysis for schools in Detroit, excluding the central schools but, again the effect of quantity of schooling was marginal. Karweit concluded that quantity of schooling should not be dismissed but that alternate measures of time spent should be considered.

In particular, emphasis should be given to proximate measures such as time-on-task as opposed to more global measures such as time allocated (Karweit & Slavin, 1981).

A study by Schmidt (1978) attempted to determine the effect that quantity of schooling has on student achievement in six subject areas at the high school level. Schmidt hypothesized that the more time spent in a given curricular area, the better the resulting achievement in that area, and that variations arise from differences in the course offerings available to students in different high schools as well as variation in course selections by students. In the study, quantity of schooling was defined as the number of hours of instruction received by the student during the last three years of high school. The data used were collected by the U.S. National Center for Educational Statistics as part of the National Longitudinal Study of the High School Class of 1972 and were obtained on 9 192 students in 725 schools throughout the U.S. For each student, Schmidt calculated the total number of periods taken by the student during the last three years of high school for all six curricular areas. The analysis indicated that major differences exist in the quantity of schooling a student receives in various areas of the curriculum. Major differences were also noted for achievement among the various curricular areas. Based on the research findings, Schmidt concluded that quantity of schooling is one of the determinants of academic achievement.

Schmidt (1983a; 1983b) did a second study using the same data source to determine if quantity of schooling was a determinant of academic achievement. This study differed from the previous one in that Schmidt controlled for student background characteristics such as race, sex, ability and socioeconomic status. In this study, Schmidt conducted a regression analysis and from the coefficients again found that quantity of schooling has a small and positive effect on academic achievement with the most significant effects found in mathematics and science.

Academic Learning Time

Fisher (1978) headed one of the most extensive studies concerning time, the Beginning Teacher Evaluation Study (BTES). This study was conducted in San Francisco by a group of researchers over a period of several years. This study introduced a further refinement of the concept of time use referred to as academic learning time (Fisher et al, 1978). As defined by Fisher and his colleagues, Academic Learning Time is comprised of three elements: (a) allocated time - amount of instructional time; (b) engaged time - time on task; and (c) student success rate -

percentage of correct responses. The researchers hypothesized that the large amount of academic learning time will be associated with higher achievement levels. The study investigated instruction in mathematics and reading in grades two and five, with a focus on basic skills. The data were collected from 50 grade two classrooms and 50 grade five classrooms using students who were of average ability being between the twenty-five and sixty-five percentile. The study intended to describe current teaching practices and classroom conditions that foster student learning.

Its main findings were as follows:

1. The amount of time that teachers allocate to instruction in a particular subject area is positively related to achievement.
2. The proportion of allocated time that students are engaged in learning is positively related to achievement.
3. The proportion of times that mathematics tasks are completed successfully is positively related to achievement.
4. Increases in academic learning time are not associated with more negative attitudes towards mathematics, reading or school.
5. When teachers' attention to academic instruction is decreased, student achievement is lowered.

The BTES found that, on the average, students were engaged 73 percent of the allocated time and that teachers who had more allocated time generally had higher engagement rates.

A more recent study of academic learning time and achievement supports the findings of the BTES project. Wilson (1987) observed classes of regular elementary students and special education elementary students. His conclusions concurred with what Fisher had found. Wilson found, however, that the special education students, on the average, were off task more often than the regular students and that their success rate was significantly lower.

Following up Fisher's findings, Rosenshine (1980) re-analyzed some of the data obtained in the BTES study to determine how allocated time is spent in the elementary classroom. In this study, how time is spent is divided into three types of activities: (a) academic activities - reading, mathematics, science, and social science; (b) nonacademic activities - music, art, storytime; (c) non-instructional activities - class business, transitions, waiting between activities.

Rosenshine found that almost 20 percent of the time is spent in non-instructional activities - waiting after finishing an assignment, going to and from lunch and recess, transition between activities. The study concluded that nonengaged time is inevitable. In all of the classrooms that were observed by the BTES staff, time was spent passing out and collecting books and papers. Students spent time waiting for help, corrections, or instructions. Rosenshine noted that seatwork and students working alone dominate mathematics classrooms with 75 percent of the class time being spent in these activities. It was concluded that students are less engaged when they are doing seatwork than when doing teacher-directed activities. He examined the correlations between allocated time and engagement rate in mathematics and reading and concluded that allocating more time to these subjects does not imply less engagement time.

Another study on academic learning time and achievement was done by Stallings (1980). Stallings investigated the distribution of time across activities in 87 secondary remedial classrooms. In this study, time was separated into interactive and noninteractive instruction. It was found that in classrooms where more-than-average time was spent on management or written work (noninteractive instruction), fewer gains were made. The off-task variables that were found to be negatively related to reading gain include social interaction, noninvolved students, and transition time (for example, the time taken to get papers passed out or collected). The study did find that the amount of time allocated to specific reading activities (interactive instruction) significantly affects student gain.

In 1981, a National Commission was created to examine the quality of education in the United States. The report of this commision has become one of the most well known critiques of education. One of the factors that the commission considered was time. The findings of the commission regarding time is summarized below:

> Evidence presented to the Commission demonstrated three disturbing facts about the use that American schools and students make of time: (1) compared to other nations, American students spend much less time on school work; (2) time spent in the classroom and on homework is often used ineffectively; and (3) schools are not doing enough to help students develop either the study skills required to use time well or the willingness to spend more time on school work (National Commission on Excellence in Education, p. 21).

The National Commission on Excellence in Education (1983) recommended "that significantly more time be devoted to learning the New Basics. This will require more effective use of the existing school day, a longer school day, or a lengthened school year" (p. 29).

Research indicates that there is a substantial amount of instructional time lost during the day and that the day could be used more efficiently and effectively (Hornberger, 1987; Lindsay, 1988; Lowe & Gervais, 1988; McIntyre et al., 1983). These studies conclude that allocated time is teacher controllable, therefore, teachers need to work efficiently to minimize lost learning time. These studies have found that when the classroom activity is instructional, it is dominated by seatwork and that schooltime is often spent in non-academic activities.

Comparative Studies

Before the Commission's report was even published in 1983, there had been several studies done comparing the performance of American students with the performance of students in other industralized countries (Comber & Keeves, 1973; Husen, 1967). Since that report was released, similar studies have been completed. Stevenson (1987) investigated mathematics classes in the United States, Japan and China. In this study, it was found that American students are not performing as well in arithmetic, algebra, and geometry as Asian students, and that, on the average, American teachers spend three hours a week on mathematics, while Japanese teachers spend eight hours a week and Chinese teachers spend twelve hours a week. Within the time devoted to mathematics classes, direct instruction is less for American students than for Chinese or Japanese students. From observations, it was concluded that 15 - 20 percent of classroom time in United States is spent in irrelevant activities such as talking, or being out of their seats. American students spend more time doing seatwork than their counterparts in China and Japan. Japanese and Chinese students are in class for more hours per week and for more weeks throughout the year.

Summary

The concept of time has been studied by many researchers for decades, dating back to the turn of the century. The researchers have investigated time in the classroom from many perspectives. They have studied allocated time, instructional time, time on task, time off task, engaged time, and academic learning time. They have also studied the relationships between time and achievement, and between time and learning. It has been examined within a single country and across different nations.

As we near the end of this century and analyze the work of previous researchers, it seems that there is still no solution on how time in the classroom may be used most effectively to facilitate learning. Research suggests that teachers should allocate more time to academic subjects. Students should be kept engaged in their learning tasks to obtain maximum benefits. Teachers should remember that student learning depends on how the available time is used, not just the amount of time available to them.

Many of the research studies concerned with time allocation and use were conducted in large schools in urban centres. This research study will further develop the existing research base by providing a study in what is primarily a rural setting in Canada.

CHAPTER 3

DESIGN OF THE STUDY

This chapter presents a description of the design of the study and includes information about the sample, the instrument, the method of data collection and the statistical procedures used to analyze the data.

Populations

The study is based on information gathered from two populations. The first consisted of 809 respondents who completed a questionnaire administered to high school mathematics and science teachers throughout the province of Newfoundland and Labrador during the school year 1988-89. The population size and response rate is summarized in Table 1.

Table 1

Population Sizes and Response Rates

for High School Teachers

Variable	Response
Population	1087
# Respondents	809
% Population	74.4
% Male Respondents	82.5
% Female Respondents	17.5

The second target population consisted of first-year students enrolled in mathematics courses at post-secondary institutions in the province of Newfoundland and Labrador during the fall of 1988. Students from four institutions were included: Memorial University and Grenfell College are two degree granting universities; Cabot Institute and Marine Institute offer technological and trades oriented programs. Approximately 72.7 percent of the total population of first year students at these four institutions responded to the first questionnaire that was administered in September. A breakdown of the response rate for the various institutions is given in Table 2.

Table 2

Population Sizes and Final Sample Sizes for Post-Secondary Students

September Survey			
Post-secondary Institution	Target Population	Achieved Sample	Percent
Memorial	2948	1945	66.0
Grenfell	502	396	78.9
Cabot	720	640	88.9
Marine	276	251	90.9
Total	4446	3232	72.7

There is one source of possible bias in the September survey. The lower response rate for Memorial University occurs because, students there completed the survey on a voluntary basis. When the first-year students registered at Memorial University, they were asked to write a diagnostic test in mathematics, and to complete the questionaire. Some loss of subjects occurred because the test was not mandatory. To determine if there was any difference between those students who answered the survey and those who did not answer the survey, marks on the high school public examinations in Academic/Advanced Mathematics were compared for respondents and non-respondents. 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%) (Mills, 1989).

Unlike the other surveys, the follow-up survey in November was administered to a sample of the first year students at the various post-secondary institutions. There are three sources of possible bias in the follow-up survey. First, to ensure that university students who had dropped mathematics would not be omitted, it was decided to administer the survey to students in first-year English rather than Mathematics classes at Memorial University and Grenfell College. Some unforseen difficulties were encountered when a number of English instructors at Memorial proved unwilling to allow the survey to be given in their classes so near the end of the semester. Second, the absentee rate in some of the classes surveyed was fairly high. Third, students who had dropped out of the institution were not surveyed. The latter two factors also affected sampling at other institutions. However, there are grounds to believe that these samples are reasonably representative of the total populations since the students in the 39 classes surveyed at Memorial and the students at the other institutions were from the same range of backgrounds and enrolled in the same range of programs as those responding to the initial survey. In as far as the students in the initial survey, where they constitute a high proportion of the population, are representative, so too are the students in the follow-up survey. See Table 3 for a profile of the various samples compared with the target populations. Table 3 indicates that the percentage of students from the University sample (Memorial and Grenfell combined) enrolled in the various courses correspond closely to those of the University population.

Table 3

Profile of Sample Compared With Target Population

Percentage Enrolment in Various Courses and Programs

Variable	Population*	Sample
Biol. 1001	29	29.5
Chem. 1000	20	21
Chem. 1800	9	10
Phys. 1050	3	3
Phys. 1200	19	18
Phys. 1000	1	1
Math. 1000	13	16.5
Math. 1050	8	13
Math. 1080	51	48

* Population Statistics were obtained from the Registrar's office at Memorial University.

Sampling Error

All data derived from sample surveys are subject to sampling error. Sampling error is the difference between the characteristics of a sample and the characteristics of the population from which the sample was drawn. The size of the error depends on sample size and on the particular features of the sampling design. In this study, although intact classes were used for the follow-up survey, these were not mathematics or science classes. Students would have been randomly distributed across mathematics and science classes at the university. Therefore, there is no cluster effect operating, as there might have been had intact mathematics or science classes been surveyed. Table 4 presents a summary of the percentage errors calculated for the sample sizes in the range used in this study, on the assumption that the samples do, indeed, constitute random sample from the population.

For responses expressed in percentage terms, the sampling error for a simple random sample is given by the relationship:

$$D = 1.96\sqrt{[(PQ/n)\ ((1\ -\ n)/N)]}$$

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.

Table 4

Percentage Sampling Errors for Various Sample Sizes

	Percentage Error	
	P=90	P=50
n	D	D
900	1.7	2.8
800	1.8	3.0
500	2.4	4.0
300	3.4	5.6

Confidence level = .95

Simple Random Sample

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 2.5 percent for a given sample, we can say with 95 percent confidence that the population value will lie within plus or minus 2.5 percent of the sample value given in a table of data.

Instruments

The instruments used to gather data for this study were those used by the Task Force on Mathematics and Science Achievement. These consisted of a questionnaire administered to high school mathematics and science teachers and a questionnaire administered to the post-secondary students. However, only a sub-set of the questions used in each questionnaire is analyzed in this study. Specifically, the questions from the teacher questionnaire used for this study are:

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

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?

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?

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

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.)

26. Please rate each course that you teach, or have taught, as to the time available to cover these courses.
 1. too little 2. about right 3. too much

Teachers' responses to the particular questions asked were indicated by completing each item with the appropriate number of class periods, minutes or days.

There were two versions of the student survey, one mathematics and one science. Students were randomly given one or the other version; approximately half answered each version. The questions from the September and the November post-secondary student surveys used for this study are:

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 C. 6 - 10
 B. 3 - 5 D. more than 10

21. There is not enough time in high school to cover the mathematics course adequately.
    A. strongly disagree
    B. disagree
    C. agree
    D. strongly agree

32. How many classes have you missed in mathematics this semester?
    A. fewer than 3 C. 7 - 10
    B. 3 - 6 D. more than 10

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

The last two questions were repeated for each of the biology, chemistry and physics courses. Students' responses to the particular questions were indicated by selecting the most appropriate answer from the choices given.

Validity and Reliability

A valid instrument measures what it is supposed to measure for a particular population. Of the four types of test validity (Borg & Gall, 1983) construct validity appears to be the one most appropriate for the design of this project.

The items on the teacher questionnaire were developed to glean as much information as possible from teachers concerning a variety of school events and conditions. The instrument was thus not devoted exclusively to the time issue. One purpose of the questionnaire was to get an overview of how the instructional time allocated to mathematics and science is actually utilized. It was not the intent of the present study to determine how time is actually spent in the classroom by teachers or students but rather to investigate how time is spent on various components of the school system such as evaluation, extracurricular activities, school closures and class changes.

The instrument exhibits construct validity to the extent that the questions asked are a direct reflection of the research questions of interest. The questions also reflect matters raised in preliminary discussions with school and district personnel and in discussion among experienced staff. Most questions dealt with matters of fact asking teachers to give estimates of time allocations while others dealt with hypothetical constructs such as teachers attitudes towards teaching and learning mathematics and science.

Other aspects of time such as interruptions in class time due to guest speakers, announcements or managerial tasks were deliberately omitted from the questionnaire because it was felt that any estimates of the time spent on these kinds of activities would be imprecise. This limits the interpretation of the data since interruptions of this type may be a major factor in some schools or classes.

A second important characteristic of research instruments that must be determined is their reliability. It is necessary to determine reliability to be confident that the responses obtained from the administration of the survey are essentially the same responses obtained if the survey were re-administered. More generally, the concept of reliability means that the values yielded by the instrument are close to true values for the variables measured. Since true values are rarely known, various indirect means must be imposed to determine the degree of reliability of an instrument.

Because this study was a part of a government policy study, with emphasis on obtaining information on which recommendations for policy changes could be made in a reasonable amount of time, the administration of the surveys were limited to one occasion. Thus, it was not possible to use any of the standard techniques for determining reliability (test-retest, redundant items, etc.). It was necessary to use a compromise technique, based on the idea that some variables would be expected to yield zero variance within a school. For example, all teachers within a school should be expected to agree on the length of a class period. To the extent that non-zero variance (or standard deviation) is found within a school, this is evidence of unreliability of response (though not of the specific source of unreliability). The results are summarized in Table 5.

Table 5

Analysis of Means and Standard Deviations

Variable	Mean	Standard Deviation
Time lost due to weather (days)	3.61	2.39
Time lost to teacher workshops (days)	1.70	1.16
Number of days in a teaching cycle	6.00	.31
Homeroom periods instructional time	1.35	.48
Class changes instructional time	1.42	.51

Based on these variance, one can be fairly confident that the teachers answered the items reasonably accurately. It is not surprising that the standard deviation for time lost due to weather is not zero because teachers were asked to estimate the average number of days lost over several years. A standard deviation of 2.39 is a good indicator that the teacher estimates are close to the actual time lost.

In addition to the analysis of variance, factor analysis on the teacher survey produced definite groupings of attribution statements that referred to various aspects of a particular attribution. The consistencey of response to various logically similar statements provide evidence for reliability (Mills, 1990).

For the student surveys, factor analysis was carried out on seven different sets of attribution statements. For each set of statements, many had high loadings on one factor and most had high loadings across the factor matrix (Mills, 1990). This gives some indication of the consistency of the students' responses.

Treatment of Data

The data analysis is divided into two sections. Chapter 4 contains descriptive statistics including frequency tables, means and standard deviations and correlation coefficients. These are intended to convey a picture of the extent of instructional time lost in mathematics and science. These statistics also give an idea of the variance in time lost among the schools. Chapter 5 focuses on the correlational design. Correlation coefficients are used at both the school level and the student level to determine if any relationships exist between time and achievement and if so, the degree of these relationships. The school level analysis is based on the responses from the teacher surveys while the student level analysis is based on responses from the student survey. This is followed up at the student level by multiple regression analysis, to determine if it is possible to use any of the time variables investigated in this study to predict achievement at the post-secondary level.

CHAPTER 4

HOW MUCH INSTRUCTIONAL TIME IS LOST?

This chapter addresses the following research questions: (a) How much instructional time is lost throughout the year within the school system? and (b) What are the perceptions of teachers and students of the effect of time lost? The data presented are descriptive in nature as the aim of this chapter is to report the extent of instructional time lost in the high schools and the perceptions of teachers and students as related to the amount of instructional time lost rather than to determine the relationship of any other variable to time. In subsequent chapters, there is discussion of the relationship between time and achievement. Other than the achievement data, the data were obtained from the teacher survey and the first year student surveys.

Analysis of Teacher and Student Surveys

The teacher survey examined a number of components in the school system related to time. These include transition time in the daily schedule, time spent evaluating students' progress, instructional time spent on non-instructional activities and teachers' perceptions of instructional time available. The student surveys examined the amount of time that individual students are absent from class both at the high school level and the university level as well as their perceptions of instructional time available in the high schools. The variables that were reported on in the teacher survey can be categorized into two sections: those that result in a break in the normal school routine and those that are part of the normal school routine.

The teacher survey investigated a number of activities that usually result in a break in the normal school routine including formal examinations, extra-curricular activities, school closures and teacher workshops. The time spent on examinations will be discussed separately from the other activities since its duration is much longer than the others as reported by the mathematics and science teachers. In addition, this is one of the more highly visible areas of public concern because students are seen as out of school during much of the examination period.

Time Spent on Examinations

Formal examinations are generally conducted twice throughout the school year: in January and in June. As discussed in Chapter 1, the

Ministry of Education sets final examinations in many of the courses. Therefore, all of the schools adhere to the same schedule in June. There is, however, variation in how much time is allocated to the examination period in January, since all of these examinations are school level.

An estimate of the time spent writing examinations was calculated from the teacher responses to the questionnaire. A summary of the total examination time throughout the year at the provincial level is shown in Table 6.

Table 6

Time Spent on Examinations Across the Province

Number of Days	% of Teacher Responses
≤ 5	4.5
6 - 10	19.3
11 - 15	34.8
16 - 20	29.8
> 20	11.6

As shown in the table, there is a wide range of examination periods among the schools. Most schools in the province spend between ten and twenty days on examinations. Provincially, the average number of days spent on examinations is 15.

One of the staff studies undertaken by the Task Force was an analysis of mathematics and science achievement. This analysis revealed that there are notable differences between school districts in achievement in mathematics and science. This analysis also showed that some districts are consistently high and others consistently low (Crocker, 1989).

With so much variation in examination time among the high schools and with differences in achievement at the district level, it is of interest to investigate the duration of examinations at the district level as well as the school level. There are thirty-five school districts in the province thirty-four of which had schools that responded to the teacher survey. Aggregating the responses on the teacher questionnaire to district level makes it possible to examine district variation in time spent on examinations. The data are summarized in Table 7.

Table 7

Time Spent on Examinations

at the District Level

Number of Days	Number of Districts
≤ 10	3
11 - 15	17
16 - 19	11
≥ 20	3

Examining the above distributions, it can be seen that there is substantial variation between districts. As indicated in Table 7, a small number of the school districts restrict the examination period in their schools to less than two weeks of the school year, whereas an equal number of other districts spend at least four weeks throughout the year completing examinations.

Not only is there variation among the school districts but there appear to be some differences within some school districts. Standard deviations were calculated to determine the extent of the variance within the school districts. The results revealed that 32.4 percent of the school districts had a standard deviation of more than 3.50 for the number of days spent writing examinations. The school district that had the highest variability had six schools that responded to the questionnaire and a standard deviation of 7.20.

Factors Affecting Length of Examination Period

There are many reasons that could possibly contribute to the differences in the length of the examination period in the high schools. Several of these factors were examined to determine the influence that each had on the amount of time spent on writing examinations. These included size ot school and whether the school was in an urban or rural community. For this purpose, schools were divided into three categories according to size adapting the definition used by Riggs (1987): small - population per grade is less than 25; medium - population per grade is between 26 and 100; and large - population per grade is greater than 100. In this study, schools were also divided into categories based on the size of the community in which they are located using a definition developed by the Department of Education: rural - population of the community is less than 5000 and urban - population of the community is equal to or greater than 5000. Frequencies were calculated to determine if there are any differences in the duration of the examinations based on size of schools. The results are summarized in Table 8.

Table 8

Time Spent on Examinations by School Size

Number of Days	Size of School		
	Small	Medium	Large
	Percentages		
≤ 5	6.2	0	0
6 - 10	16.8	20.1	0
11 - 15	57.0	46.0	13.0
16 - 20	16.9	32.6	52.1
> 20	3.0	1.1	34.7

As is shown in the table, there are differences in the time spent on examinations in the small, medium and large schools. Most of the small schools require a maximum of 15 days whereas most of the large schools require more than 15 days.

Frequencies and percentages were also calculated to look at the relationship between type of school and the time spent on examinations. The percentages are summarized in Table 9.

Table 9

Time Spent on Examinations by Type of School

Number of Days	Type of School	
	Urban	Rural
	Percentages	
≤ 5	0	2.8
6 - 10	0	20.3
11 -15	20.5	52.8
16 - 20	56.4	21.7
> 20	23.2	2.1

As with the size of school, type of school is associated with the duration of the examination period. As shown in Table 9, the urban schools generally spend at least 16 days writing examinations whereas the over one-half of the rural schools require less than 16 days to complete their examinations.

In order to determine whether the differences reported in the above tables are statistically significant, correlations between school size and time and between type of school and time were calculated. Since the urban-rural dichotomy is based on a continuous variable, namely population size, the biserial correlation coefficient is recorded for type of school. The results are summarized in Table 10.

Table 10

Correlations Between Time Spent Writing

Examinations and Demographic Factors

	Size	Type
Exam Time	.3415**	.6457**

n=177 ** p< .001

The correlation coefficients in Table 10 indicate that there is a statistically significant, relationship between the size and the type of the school and the time spent writing examinations. As suggested by the frequency tables, the larger, urban schools are more likely to spend more time writing examinations than the smaller schools. This pattern is to be expected since the larger schools have more students and are able to offer more courses thereby making the schedule longer.

Another factor which in recent years has affected the length of the examination period in some districts is the growing concern of the school district personnel over the amount of instructional time lost. Thus in many districts, new policies are being established. These policies include cutting out formal midterm examinations altogether or reducing the midterm examinations to in-class tests administered by individual teachers (Banfield, 1989c).

Time Spent On Unit Tests

In addition to the time spent on examinations in January and June, teachers were asked to report on the number of class periods spent on unit testing in mathematics and science. On the average, teachers reported that eight unit tests are given in mathematics and science throughout the year. For each of these tests, 20 percent of the teachers indicated that they spend one day, and 21 percent indicated spending two days reviewing the unit of work before administering the test.

Table 11

Frequency of Unit Tests

Number of Unit Tests	Percentage of Teachers	
	Science	Mathematics
< 4	2.0	2.4
4 - 6	36.7	34.7
7 - 9	37.7	34.9
10 - 15	21.9	25.6
> 15	1.7	2.4

As is shown in Table 11, approximately 37 percent of the science teachers reported that they assign between four and six unit tests in their courses throughout the year while 38 percent of them reported that they assign between seven and nine unit tests a year. Few teachers indicated that they administered less than four tests or more than 15 tests throughout the year. What is striking about this is the variability in testing frequency which seems to indicate there is no policy at any level of the system regarding the administration of unit tests. Table 11 also shows the number of unit tests administered by the mathematics teachers. These figures closely match those in science. Thirty-five percent of the mathematics teachers reported that they assign between four and six unit tests in a year while another 35 percent reported that they assign between seven and nine tests athroughout the year. The percentage of teachers who administer more than ten is slightly higher in mathematics than in science. The most frequently occurring number of tests is consistent with the science tests in that 24 percent of the mathematics teachers indicated that they administer six tests a year and 20 percent indicated that they administer eight tests a year.

Time Spent on Other Activities

In addition to estimating the number of school days spent on formal examinations, teachers were asked to report on the time spent on a variety of other activites.

Table 12

Time Spent on Other Activities

Number of Days	Extracurricular	Closures	Workshop	Absenteeism
0	6.3	0.9	7.6	20.7
1	19.8	5.4	42.2	6.7
2	30.0	27.9	34.2	21.0
3	18.8	28.7	9.8	16.0
4	6.3	11.1	3.0	9.5
5	11.1	13.3	2.4	10.7
>5	7.5	12.7	0.8	15.4

The first of these categories is extracurricular activities such as sports days, winter carnivals, and the like. As shown in Table 12, most of the teachers reported that there are no more than three days spent on these activities in their schools, but almost 20 percent reported that there is at least one week spent on activities throughout the year.

Another activity that teachers were asked to report on is teacher workshops. Again, this is an area of concern because of public perception of schools being closed. From the teacher responses, it seems that most teachers spend one or two days throughout the year at a workshop. This workshop includes all faculty members in the school and results in the school being closed. It does not include workshops in which only one or several faculty members may attend such as a Mathematics or Science Special Interest Council Conference. This one day seems to be consistent in all school districts throughout the province.

The third activity included is school closures caused by things such as snowstorms or furnace problems. It should be noted that this is a fairly local problem, which would not normally occur in more moderate climates. Sixty-two percent of the teachers reported that their schools are closed due to these problems between one and three days per year on the average. Because some areas of the province are usually harder hit with snowstorms than other areas, the provincial average is slightly higher than this, being four days.

The last item included in this category is student absenteeism. This category is different from the others in that it is a student-controlled factor as opposed to one that is school-controlled. The reason for including it with the school factors is that the absenteeism addressed here is that which is at sufficiently high levels to cancel a class session or close the school. The intent of the question was to determine the extent to which students are absent in large enough numbers to cause class cancellations. As is shown in Table 12, most teachers reported that their students miss approximately one to three days a year without valid reason. Table 12 also indicates that 15 per cent of the teachers reported that students missed more than five days of instruction a year and six percent of those teachers indicated that their students were absent between 10 and 14 days. On average, three days of instruction are lost due to student absenteeism. There is some variation in absenteeism among the school districts although most districts seem to be at or close to the provincial average. There are, however, some districts whose absenteeism is above the provincial average with some as high as seven to nine days.

It should be noted that these figures for student absenteeism do not include days that individual students are absent due to illness, home help or other legitimate reasons as set down by the Department of Education. These factors were also included in the student questionnaire. The students were asked to estimate the number of days that they missed while in Grade 12. The responses are summarized in Table 13.

Table 13

Total School Days Missed

Number of Days	Percentage of Responses
<3	14.1
3 - 5	32.7
6 - 10	24.9
>10	28.4

As is shown in Table 13, approximately 28 percent of the students reported that they are absent from school for more than two weeks. This two week time block is over and above the time that the students lose because of school related functions, therefore, for these students the instructional time in mathematics or science would be reduced by an additional seven hours or more.

Daily School Schedule

The second category involving time includes those aspects which are part of the daily school schedule. The teacher survey examined a number of the elements within the school schedule which result in a loss of instructional time including homeroom periods, and changing classes.

Instructional Schedule. Ninety-six percent of the teachers reported that their schools are on a 6-day teaching cycle with 42 teaching periods in a cycle. This means that during each school day, there are seven teaching periods, which are on average 40 minutes long, giving a total of 280 minutes of instructional time per day. To complete the day there are usually homeroom periods. These are non-instructional units of time used primarily for managerial tasks. Sixty-four percent of the teachers reported that their schools did in fact have homeroom periods that were completely separate from teaching periods. The remaining 36 percent of the teachers reported that they do have homeroom periods but that these sessions are part of the instructional day. The average time across the province allocated for homeroom periods is six minutes. With the time allocation for homeroom periods added to the instructional time, there is, on the average, a total of 286 minutes in the school day. This is slightly below the statutory requirement of 300 minutes per day.

Class Changes. Another normal routine in the daily school schedule is changing classes. Sixty-eight percent of the teachers reported that there was no time allocated in their schools for class changes, but that the time required for changing classes was part of the instructional day. Across the province, the average time allocated for changing classes is only one minute. Nevertheless 64 percent of the teachers indicated that they feel that this is adequate. If schools allow just one minute for changing classes, this results in five minutes a day of lost instructional time or 16 hours of instructional time per year. In practice, it is clear that in most schools it is impossible to accomplish the physical change, let alone the usual stop and start routine in one minute. Preliminary data from an observational study suggest, in fact, that the time is much greater than indicated (Crocker, 1988).

Time Lost as a Proportion of Total Time Available

With the revised high school program 120 hours of instructional time are allocated for each mathematics and science course offered in the schools. If all the factors that intrude on instructional time are considered, then it appears that there is a wide gap between allocated time and the time actually available for teaching.

In the previous sections, teachers reported the amount of time spent on examinations, unit tests, review and other activities. Table 14 presents a summary of these activities and the average amount of time spent on these activities across the province.

Table 14

Summary of Time Spent on Non-instructional Activities

Activity	Average number of days	Average number[1] of hours	Percentage of total 120h
Examinations	15.19	10.13	8.4
Unit tests	7.98	5.32	4.4
Review	11.97	7.98	6.7
Extracurricular	2.80	1.87	1.6
Workshops	1.70	1.13	0.9
Closures	3.72	2.48	2.1
Absenteeism	3.37	2.25	1.9
Total	46.73	31.16	25.9

[1] Based on one 40 minute period per day

Teachers reported the number of days or class periods spent on each of these various activities. To relate this time to the 120 hours of instructional time available, it was necessary to convert the average number of days to the average number of hours. For this purpose, a day means a class period and a class period is 40 minutes.

As shown in Table 14, throughout the school year, approximately 31 hours of instructional time are spent on non-instructional activities. This means that of the 120 hours allocated for each course, only 89 hours or 74 percent are actually spent teaching. This estimate is minimal. It only includes those variables that teachers could easily and accurately report on in the questionnaire. It does not take into account time lost for preparation for graduation, guest speakers or class changes; taking these other factors into consideration it could be safely said that the 74 percent calculated above is a conservative estimate.

Teachers' Perceptions of Adequacy of Time

In addition to reporting on the amount of instructional time available, the teachers were asked to report on whether or not they feel the time adequate. Table 15 summarizes the responses of teachers on this matter.

Table 15

Teachers' Perception

of the Adequacy of Instructional Time Available

	Too Little	About Right	Too Much
Mathematics 3201	49.0	49.0	2.0
Mathematics 3202	2.3	82.2	15.5
Mathematics 3203	49.8	47.8	2.4
Biology 3201	50.0	47.8	2.2
Chemistry 3202	52.6	45.3	2.1
Geology 3203	15.8	78.9	5.3
Physics 3204	25.7	73.5	0.7

For many mathematics and science courses, teachers have indicated that there is too little time available to cover the courses. For Mathematics 3201, Mathematics 3203, Biology 3201 and Chemistry 3202, about half of the teachers indicated that there is not enough time available for these courses. On the other hand, most teachers have indicated that there is enough time available for the Mathematics 3202, Geology 3203 and Physics 3204 courses.

In the section of the questionnaire on problems in mathematics and science teaching and learning, approximately 50 percent of the teachers reported that they feel too much time is spent on non-instructional activities. In their comments, many teachers again identified the time available as a problem (Fushell, 1989).

Teachers reported many consequences of having too little time to complete the courses to their satisfaction. They argued that because of time constraints, it was difficult to help the brighter students or the weaker students. When classes are in session, it is necessary to teach core material; there is little, if any, time remaining to give extra help to those who need it regarding either the current topic or any earlier topics that students may not have understood. On the other end of the continuum, there is not enough time to develop any enrichment activities or even to assign many of the more challenging problems that are in the textbook. Finally teachers reported that as a consequence of time restraints, they tend to teach less material than they would like.

Students' Perceptions

Students were also asked their opinion on the amount of instructional time available for mathematics and science courses in high school. The responses are reported in Table 16.

Table 16

Students' Opinion on Time

Institution	Percentage Agree Time Inadequate	
	Mathematics	Science
Memorial	60.0	58.3
Grenfell	65.6	67.1
Cabot	69.8	63.4
Marine	60.4	57.2

As these data indicate, most students feel that the instructional time in mathematics and science in high school is inadequate. From the follow-up survey and from focus group discussions done with first-year post-secondary students in November, it was apparent that they feel that there is not enough time to cover all of the topics required for the public examinations. For the science courses, they indicated that there was not enough time available for laboratory work (Banfield, 1989b). This is contrary to what the teachers reported in that they indicated that they carried out an adequate amount of laboratory work throughout the year. However, most students and teachers do agree that there is not enough instructional time available in high school to cover all the topics in mathematics and science adequately.

CHAPTER 5

INSTRUCTIONAL TIME AND ACHIEVEMENT

This chapter examines the third research question. This question concerns the relationship of instructional time to achievement in mathematics and science. This analysis is done for both the school level and the student level, as appropriate for the variables being considered. For the school level, the means for each element of instructional time lost were calculated based on the responses from the teacher surveys. Correlations were used to determine if any associations do exist between instructional time lost and achievement in mathematics and science. At the student level, correlations were calculated for time lost and achievement. This analysis was then refined using multiple linear regression. Before considering the correlation between the variables, scattergrams were made to determine if there were any extreme data points that might influence the results.

Public Examination Data

Although the teacher survey was conducted in the 1988-89 school year, the public examination data for that year was not available at the time of the analysis. This made it impossible to have an exact parallel match between the data for instructional time lost and achievement. It was, therefore, decided to use the public examination data available from the Department of Education for the 1987 - 88 school year. It was felt that this match was appropriate because the elements of time that were investigated in this study were not likely to vary much from one school year to another and, based on the Department of Education statistics, it was apparent that the teacher population was relatively stable. In addition to this, the survey was administered in the early part of the school year so that the teacher responses to the questions that were asked on the questionnaire related to time would have been estimates of time allocations based on their experience in previous years.

Correlations for Mathematics Courses

The scattergrams of the time spent on examinations, tests and review for the unit tests with the school averages on the public examination scores in Advanced Mathematics, Academic Mathematics and Business

Mathematics revealed no systematic pattern. They did show the presence of several outliers on both variables. These outlying points did not seem to be extreme enough to be omitted from the population. Thus all of the teacher responses were included in the analyses. The first analysis considered the relationship between the various time elements and the school averages on the public examinations for the mathematics courses. The correlation coefficients for the mathematics courses are summarized in Table 17.

Table 17

Correlations between Instructional Time Lost and Public Examination Scores in Mathematics

	Math 3201	Math 3202	Math 3203
Time spent on examinations	-.0512	-.0135	-.0093
	n = 57	n = 139	n = 149
Time spent on tests	.0021	.1231*	-.0417
	n = 39	n = 109	n = 108
Time spent on review	.1038	-.0608	-.0598
	n = 55	n = 135	n = 147
Extracurricular activities	.0504	-.1302*	.0021
	n = 54	n = 135	n = 143
School closures	.0477	-.1204*	-.1390**
	n = 56	n = 140	n = 149
Workshops	-.0223	-.2355**	.0020
	n = 57	n = 133	n = 144
Absenteeism	-.0662	-.1287*	-.0092
	n = 52	n = 128	n = 140

* $p \leq .10$ ** $p \leq .05$

In general, the correlation coefficients between time spent on examinations and mathematics public examination scores are quite low indicating weak relationships between the two variables. At the same time, a clear pattern of negative correlations exist, suggesting that there is indeed some systematic relationship between time and achievement. For the three mathematics courses, the negative coefficients indicate that the more time spent on examinations the more likely that these schools will obtain lower average scores on the public examinations.

The other variable that has a negative coefficient for all three mathematics courses is absenteeism; this indicates that the more days that a school has large numbers of students absent the more likely it is that school will have lowered achievement in mathematics on the public examination. The coefficients for the other variables included in this analysis do not show any regular pattern.

Correlations for Science Courses

In addition to obtaining the correlation coefficients between the public examination scores in mathematics and time lost, the study also investigated the degree of relationship between the public examinations scores in the various science courses and the amount of instructional time lost. The correlation coefficients are summarized in Table 18.

Table 18

Correlations Between Instructional Time Lost and Public Examination Scores in Science

Variable	Biol 3201	Chem 3202	Geol 3203	Phys 3204
Time spent on examinations	.2272***	.1600	.0932	.2889**
	n = 105	n = 59	n = 37	n = 52
Time spent on tests	-.1064	-.0205	-.4818***	.2191*
	n = 82	n = 47	n = 24	n = 40
Time spent on review	.0815	.0985	-.0920	.0149
	n = 109	n = 61	n = 38	n = 53
Extracurricular activities	.0709	-.1206	-.0562	.0983
	n = 108	n = 57	n = 36	n = 51
School Closures	-.0680	-.1163	-.2062	-.1285
	n = 107	n = 59	n = 35	n = 54
Workshops	.1592**	-.1130	-.1889	-.1239
	n = 107	n = 59	n = 37	n = 52
Absenteeism	.0065	-.3102*	-.1605	-.0216
	n = 99	n = 55	n = 34	n = 51

* $p \leq .10$ ** $p \leq .05$ *** $p \leq .01$

As is shown in Table 18, the pattern of correlation coefficients for the relationships between science achievement and time spent on examinations is different from that reported in Table 17 on mathematics. The coefficients for these courses indicate that there is a weak, positive relationship between the public examination scores in these subjects and the time spent on examinations. This means, that for these courses, the more time a school spends on examinations the more likely that school is to obtain higher marks on the public examination in these courses.

As is shown in the table the school closures variable is negatively correlated with achievement in all of the science courses. The small, negative coefficients indicate weak, inverse relationships between the number of days a school is closed and the school's performance on the public examination in each of the science courses. This means that the more closures a school experiences the lower the school's performance on the public examinations is likely to be.

Correlations for Student Level Data

At the student level, data analysis was conducted to determine if there were any relationships between the number of classes that students miss at university, the number of hours that the students spend studying and the score that they obtain in their university mathematics or science courses; and to determine if the students' marks in mathematics and science could be estimated based on these variables.

In the first part of the analysis, correlation coefficients are used to determine the relationship among the high school mark, the number of classes missed, the number of hours spent studying and university marks. The first set of variables considered is the time lost in high school and the students' public examination scores. The results are summarized in Table 19.

Table 19

Correlation Between the Number of Days Missed in Grade 12 and Public Examination Scores in Mathematics and Science

	Mathematics 3201	Mathematics 3203	Biology 3201	Chemistry 3202	Physics 3204
Days Absent	-.1180*	-.1229**	-.1173*	-.0637	-.1484**
	n=433	n=1125	n=435	n=622	n=695

* $p \leq .01$ ** $p \leq .001$

The correlation coefficients in Table 19 reveal the number of days that a student was absent in high school was significantly, and negatively correlated with the students' high school marks in mathematics and science. This pattern of negative coefficients indicates that the more days a student is absent the more likely that student will obtain a lower mark in mathematics and science.

The second set of variables examined at the student level to determine if a relationship existed between them was the number of classes missed, the number of hours spent studying and university marks in mathematics and science. Again, the correlation coefficients are calculated and the results are recorded in tabular form. Table 20 displays the results for mathematics and Table 21 for the science courses.

Table 20

Correlations between University Marks and Student Time in Mathematics

	Mathematics 1000	Mathematics 1080	Mathematics 1050
Classes Missed	-.2133**	-.3072***	-.3283***
	n=157	n=502	n=91
No. Hours Spent Studying	-.0117	.0100	-.1576*
	n=158	n=504	n=92

* $p \leq .10$ ** $p \leq .01$ *** $p \leq .001$

The correlation coefficients in Table 20 reveal that there are statistically significant, weak, negative relationships between the number of classes missed and the mark that the student obtains in mathematics.

Therefore, it is likely that the more classes that a student misses will result in a lower mark in the mathematics course that is being studied.

The correlation coefficients between the number of hours that students spend studying and the mark they obtain in mathematics reveal that there is no relationship between these variables. Thus, knowing the number of hours that a student spends studying reveals very little about the mark that the student will obtain in a particular course.

Table 21

Correlations Between University Marks and Student Time in Science

Variable	Biology	Chemistry	Physics
No. Classes Missed	-.1608*	-.3757**	-.2954**
	n = 78	n = 161	n = 198
No. Hours Studying	-.1863*	-.0100	.0406
	n = 78	n = 161	n = 200

* $p \leq .10$ ** $p \leq .001$

The correlation coefficients in Table 21 reveal that there is a statistically significant, negative relationship between the number of classes missed and achievement in Biology, Chemistry and Physics. It is likely that the more classes that a student misses in any particular science course the lower the mark that student will obtain in the course. The correlation coefficients between the number of hours that students spent studying and the mark they obtain in university science course reveal no distinct pattern for these variables.

The next component of the model that was examined is the relationship between the high school marks that a student receives in mathematics and science and the use that student makes of time while attending university. As with the other variables, correlation coefficients were calculated. The results are summarized in Table 22.

Table 22

Correlations Between High School Marks and Student Time

	Classes Missed	Hours Studying
Advanced Mathematics	-.1599*	.0329
Academic Mathematics	-.2086**	.0213
Biology	-.0696	-.0373
Chemistry	-.2338**	.0163
Physics	-.0563	.0344

* $p \leq .01$ ** $p \leq .001$

The correlation coefficients in Table 22 reveal that there are weak relationships between the marks that students receive in high school and the number of classes that they miss at the university. This means that it is probable that the lower the mark that the student obtained in these courses in high school, the more likely that the student will miss classes at university.

The results for the high school marks and the number of hours spent on school work outside of class time indicate that there is very little relationship between high school marks and the number of hours spent studying. Thus, knowing a students' high school mark tells us very little about how much time that student spends studying while at university .

Multiple Regression Analysis

In order to refine the analysis completed for the student level data, multiple linear regression was used. This technique allows us to determine the relationship between the criterion variable, unviersity score and a combination of the time variables as predictors. The model used in the analysis is summarized in the schematic shown in Fig 1.

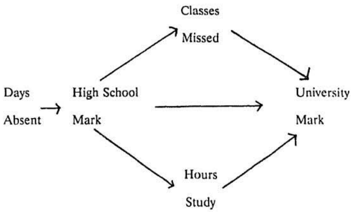

Fig. 1

Multiple Regression Analysis Model

For this analysis, stepwise variable entry was chosen because this method determines if adding time variables to the equation will improve the predictive power compared to the high school mark alone. The first step in multiple regression is to compute the correlation between the best predictor and the criterion variable. This procedure produces the multiple correlation coefficient (R). R is defined as the correlation between the criterion variable and the best linear combination of the predictors

(Howell, 1987).

The statistic R^2 is known as the coefficient of determination (Borg & Gall, 1983). It is calculated to determine the percentage of variation accounted for by the predictor variables. The fifth column of Table 23 presents the R^2 increments for the multiple regression analysis. The increment expresses the additional variance in the criterion variable that can be explained by adding a new predictor variable to the multiple regression analysis.

The second predictor is chosen on the basis of how well it improves upon the prediction achieved by the first predictor. This predictor should have low correlation with the first predictor variable. If the two variables correlate highly with each other, then the second variable can be expected to add little to the prediction. The third predictor entered in the multiple regression analysis is determined by whether it improves the prediction made by the first two predictors.

Research has often shown that past performance is a good predicator of achievement for a course currently being studied. In this study the relationship between the high school mark and the university mark in mathematics, biology, chemistry and physics was examined to see if time exerts any effects on performance independent of past achievement. The correlation coefficients included in Table 23 which reports the results of the regression analysis for mathematics.

Table 23

Regression Analysis for

Mathematics Achievement at Student Level

Variable	Correlation Coefficient r	Multiple Correlation R	R^2	R^2 Increment
Mathematics 1000 Score				
Advanced Math Mark	.63	.63	.40	
Mathematics 1080 Score				
Advanced Math Mark	.57	.57	.32	
Classes Missed	-.31	.62	.38	.06
Mathematics 1080 Score				
Academic Math Mark	.66	.66	.43	
Classes Missed	-.31	.67	.45	.02
Mathematics 1050 Score				
Academic Math Mark	.40	.40	.16	
Classes Missed	-.33	.52	.28	.12

As indicated in Table 23, four multiple regression analyses were done. In the first analysis the students high school mark is the first predictor entered into the multiple regression since it is the best predictor for Mathematics 1000. The Advanced Mathematics mark received in high school is the only variable that is used to predict achievement in Mathematics 1000.

From the table, we can see that 40 percent of the variance in Mathematics 1000 scores can be accounted for by the mark the student received in Advanced Mathematics. The variance in the Mathematics 1000 mark that can be accounted for the number of classes missed or the number of hours spent studying is too small to be able to use it to confidently predict any improvement over and above the prediction made by using the high school mark alone. Since the addition of the number of classes missed and the number of hours spent studying as predictors did not increase the percentage of explained variation in Mathematics 1000 scores, then these are not significant predictors of achievement for Mathematics 1000. This was the only regression analysis completed for Mathematics 1000 because using the mark obtained in other high school mathematics courses resulted in a small sample size.

The next multiple regression analysis is for Mathematics 1080. As shown in Table 23, the two predictor variables together yield a multiple correlation coefficient of .62 which is a small improvement upon the prediction achieved by just using the Advanced Mathematics mark as a predictor.

The third predictor chosen by the multiple regression analysis was the number of hours students spent studying. This new predictor did not contribute sufficiently to the prediction of the university mathematics score to make any difference in R, therefore, it was omitted from the analysis and in the presentation of the results.

From the table, we can see that 38 percent of the variance in Mathematics 1080 scores is accounted for by the combination of the two predictors whereas 32 percent is accounted for by the Advanced Mathematics mark alone. Hence, the addition of the number of classes missed explains six percent more of the variance in the students' Mathematics 1080 score than can be explained by the Advanced Mathematics mark alone.

The second multiple regression analysis that is completed for Mathematics 1080 enters the Academic Mathematics as the first predictor and the number of classes missed as the second predictor. These two predictor variables together yield a multiple correlation coefficient of .67 which is a small improvement upon the prediction achieved by just using the Academic Mathematics mark as a predictor.

From the table, we can see that 45 percent of the variance in Mathematics 1080 scores can be explained by the combination of the two predictors whereas 43 percent is accounted for by the Academic Mathematics mark alone. Hence, the addition of the number of classes missed explains two percent more of the variance in the students' Mathematics 1080 score than can be explained by the Academic Mathematics mark alone.

In the final regression analysis completed, the score obtained in Mathematics 1050 was the criterion variable. This analysis also entered the high school achievement as the best predictor and the number of classes missed the second predictor. These two predictor variables together yield a multiple correlation coefficient of .52 with only 28 percent of the variance in Mathematics 1050 scores being explained by the combination of the two predictors. It appears that neither one of the variables is a very good predictor of achievement in Mathematics 1050 either alone or in combination.

Multiple Regression Analysis for Science

Multiple regression analysis was also done to determine if variation in achievement in Biology, Chemistry, or Physics could be explained by any of the three predictor variables, high school achievement, the number of classes missed and the number of hours spent studying, or any combination of those variables. A summary of this analysis is shown in Table 24.

Table 24

Regression Analysis for Science

Achievement at Student Level

Variable	Correlation Coefficient r	Multiple Correlation R	R^2	R^2 Increment
University Biology Score				
Biology High School Mark	.85	.85	.73	
University Chemistry Score				
Chemistry H.S. Mark	.59	.59	.35	
Classes Missed	-.38	.65	.42	.07
University Physics Score				
Physics H.S. Mark	.54	.54	.29	
Classes Missed		.57	.32	.03

From the table, we can see that 73 percent of the variance in the Biology scores can be predicted on the basis of the high school Biology mark alone. The variance that can be accounted for by the number of classes missed or the number of hours spent studying is too small to be able to use either of the variables to confidently predict any improvement over and above the prediction made by using the high school mark alone.

The second analysis in Table 24 is for the Chemistry. Together the high school chemistry mark and the number of classes missed produced a multiple correlation coefficient of .65 which is a small improvement upon the prediction made by just using the high school mark as a predictor.

Again the number of hours spent studying did not contribute sufficiently to the prediction of university Chemistry achievement to make any difference in R.

From the table, we can see that 42 percent of the variance in the university Chemistry scores is accounted for by the combination of the two predictors whereas 35 percent is accounted for by the high school Chemistry mark alone. Hence, the addition of the number of classes missed to the analysis explains seven percent more of the variance in university Chemistry than can be explained by the high school mark alone.

The final analysis is for Physics. A combination of high school physics mark and the number of classes missed produced a multiple correlation coefficient of .57 which is a small improvement upon the prediction made by just using the high school mark as a predictor. As with the Biology and the Chemistry, the number of hours of studying did not contribute sufficiently to the prediction of the student's achievement in university level Physics to make any difference in R.

As is indicated in Table 24, 32 percent of the variance in the university Physics marks can be accounted for by the combination of the high school mark in Physics and the number of Physics classes missed whereas 29 percent can be accounted for by the high school mark alone.

Hence, the addition of the number of classes missed to the analysis explains three percent more of the variance in Physics scores than can be explained by the high school Physics mark alone.

In summary, high school marks were, as expected, good predictors of performance in the university courses. Generally, the time variable added only small increments to the predicted variance. One of the reasons time is not as good a predictor as one might expect is that time variables are correlated with high school marks.

CHAPTER 6

SUMMARY AND CONCLUSIONS

This chapter presents a summary of the purposes, methods, analyses and findings obtained in this study as well as conclusions based on those findings. It also includes some recommendations for future study in this area of education.

Summary of Purpose, Methods, and Analyses

The purpose of this study was to investigate time allocation and use for mathematics and science in the high schools of Newfoundland and Labrador. The study aimed to examine how much instructional time in mathematics and science classes was lost. It further aimed to determine if the instructional time lost was related to achievement in these subjects.

To fulfill these objectives, a questionnaire was administered to mathematics and science teachers in the province of Newfoundland and Labrador during the 1988-89 school year. On this questionnaire teachers were asked to respond to a number of questions relating to time allocation and use in their schools. They were also asked to give their opinion on the adequacy of the time available for their particular mathematics and science courses.

A questionnaire was also administered to first year post-secondary students attending Memorial University of Newfoundland in the Fall, 1988. On this survey, the students were asked their opinion on time allocation and use as experienced in their particular high school.

To determine if there was a relationship between instructional time and achievement, the public examination scores for the 1987 - 88 school year were examined. The marks that the students received in the various mathematics and science courses for the fall semester were also reviewed. The data analysis included descriptive and inferential statistics. To analyze the extent of the instructional time lost, frequencies, means and standard deviations were calculated for each of the time elements contained in the teacher and student surveys.

To determine if any relationships between instructional time lost and achievement existed, the data was analyzed at the school level as well as the student level. The teacher responses were aggregated to the school level and correlations were done to determine the degree of relationship. At the student level, the correlations between student time and achievement were completed. This was followed up by multiple linear regression to obtain further information on any existing relationships.

Summary of Findings

The major findings of this study are outlined below:

1. Approximately fifteen days of instructional time are spent on writing examinations in the high schools in Newfoundland and Labrador.
2. An additional twenty days are spent on reviewing for and administering unit tests in mathematics and science.
3. Besides the time spent on evaluation, there are approximately twelve days of instructional time spent on non-academic activities.
4. Both teachers and students feel that the instructional time in mathematics and science is inadequate.
5. The amount of instructional time lost is negatively related to a school's performance on public examinations in mathematics and science.
6. The amount of instructional time lost is negatively related to a student's achievement on public examinations in mathematics and science.

7. The amount of time lost is negatively related to a student's achievement in first year university mathematics and science courses.

8. The time variable can be used to help predict a student's score in first year university mathematics and science courses.

Conclusions

In preliminary discussions with school and district personnel, there appeared to be some concern over the amount of time spent evaluating the students. Based on the research findings, these concerns are well-founded. According to teacher responses and discussions with district personnel, it seems that there is no set policy at any level of the system on the amount of time that schools should allot for evaluating students. Teachers generally decide the number of unit tests and the number of review periods for their particular courses. Either the schools or the districts set the midterm examination period and the Ministry of Education sets the final examination schedule.

Research supports the idea that student evaluation is a necessary part of the learning process. Based on the findings of this study, one can conclude that the schools in Newfoundland and Labrador overemphasize the evaluation process in its present form. All of the evaluation reported on in this study is summative. The instructional models proposed by Carroll (1963) and Bloom (1973) indicate that the purpose of evaluation is to determine if a student can successfully complete a specific learning task. If one accepts this concept of evaluation, then the methods chosen to determine if a student has mastered an objective are many and varied. The teachers and students of Newfoundland and Labrador need to shift their perspective slightly. They need to move away from the notion that evaluation is synonymous with unit tests and examinations and think of evaluation as an ongoing process. The Ministry of Education is presently moving in this direction. It is developing policy that reflects the philosophy of mastery learning as devised by Bloom (1973). If this could be achieved, then the time required for examinations and unit testing would be greatly reduced.

The amount of instruction the student receives is partially reflected in public examination scores. Teachers in the schools which spend a great deal of time evaluating their students indicated on the questionnaires that emphasis is given to core material that teachers expect to be tested on the public examinations. Thus the teaching strategies employed leave little room for any enrichment activities. This practice of concentrating on specific areas of a given course makes it difficult for students to perform well in post-secondary programs where they are responsible for a major portion of the course material on any given test.

It is not just the number of days that are designated for examinations that present difficulties but also the way in which the examination period is structured. Once the examinations begin, no instruction or study time is available for the students except on a one-to-one basis. The students that are not scheduled to write an examination in any particular session are free to remain at home and are generally not encouraged to be in school during this time. Ostensibly, this time is designated as study time. However, there is no way of knowing how much out of class time is actually spent studying.

The research findings revealed that there is a lot of instructional time lost on non-academic activities. Through discussions with school and district administrators it appears that many think that students are a captive audience for many interest groups. Some feel that there should be a distinction between time spent on these activities and time wasted. On the teacher survey, there was also disagreement on whether or not too much time was spent on these activities at the expense of mathematics and science classes.

The difficulty over instructional time lost on non-academic activities appears to be an universal one. One of the consistent findings of the research on time use in schools is that much time is spent on non-instructional activities and transitions (Borg, 1980; Hornberger, 1987; Lindsay, 1988; Lowe & Gervais, 1988; Rosenshine, 1980). The BTES project (1978) concluded that 20 percent of the time is spent on non-instructional activities. This included waiting after finishing an assignment, going to and from lunch and recess, transition between activities. The present study found that twelve days or eight percent of the instructional time is spent on non-academic activities such as extracurricular activites, teacher workshops and absenteeism. This study was limited by data gathered from teacher and student reports and did not include any classroom observations. Therefore, this percentage does not include any time required for transition or time lost during actual classes.

One interesting point about the amount of time spent on non-academic activities is that there is disagreement among the teachers on whether or not this time should come from mathematics or science classes. The fact that most teachers indicated that instructional time available for mathematics and science courses was inadequate suggests that they feel the time for non-academic activities should be taken from somewhere other than mathematics and science classtime.

Teachers and students both indicated that the amount of instructional time in mathematics and science is inadequate. It is important to note that these perceptions are based on the current situation in which there is substantially less than the allocated 120 hours available for actual instruction. Based on the research findings, it seems that it is unnecessary to lengthen either the school day or the school year to acquire more time but rather to better utilize the time that is allocated. If one-half of the thirty-one hours lost could be regained, then both teachers and students might have different perceptions. The fact that so much time is lost yet public examination scores are consistent over time makes one question the method of evaluation currently being used. It suggests that there are flaws in the evaluation system or that the mathematics and science courses only need 75 to 80 hours of instruction. If the former is true, then such a system can only appear to produce graduates capable of studying at post-secondary level. Once they attend post-secondary institutions, students often realize they know far less than the high school system lead them to believe. If the latter is true, then one should consider increasing the curriculum either in breadth or in depth or both.

The correlation coefficients reveal that generally the more time that a school spends on evaluation, and non-acadamic activities, then it is more likely that that school will obtain lower marks on the public examinations in mathematics. For the science courses, the reverse is evident from the coefficients. It seems that the more time spent on examinations, the more likely that school will obtain higher marks on public examinations in these courses. The relationships between instructional time and achievement found in this study are weak because the time elements used were those reported by the teachers. As such they were estimates of the actual times. Also, the instructional time available variable is one component of the quantity of schooling as described in the models that include time as a variable to learning (Bloom, 1973; Carroll, 1963; Wiley, 1974). Thus, one would expect weak relationships between instructional time and achievement. What is important here is the pattern of these relationships. These weak, negative relationships do indicate that time is associated with achievement. These results are consistent with the existing research base. Like this study, there have been many studies that have found the amount of time allocated to a particular task is associated with higher achievement levels (Borg, 1980; Karweit, 1976; Rosenshine, 1980; Schmidt, 1978; Stallings, 1980; Wiley, 1974). If students were to receive more instructional time then they would be engaged in their school work for more hours and therefore, be more likely to perform better. Literature supports the notion that increasing time does not lead to diminishing returns when one increases the time that the students are engaged in teacher directed activities (Walberg, 1983).

The regression analysis indicated that when the number of classes that students miss is combined with the students' previous performance, then there is improvement in the explained variance over using the achievement alone. Students who presently miss classes indiscriminately could possibly obtain gains in their performance if they attended more classes in their mathematics and science courses.

Recommendations for Future Study

Throughout this research project, questions concerning time would arise that could not be addressed in the present study. These concerns are outlined below:

1. In dealing with the extent of the problem, the study did not collect any data regarding the time spent on activities that occur randomly throughout the school year. These activities should be dealt with and included in the estimate of instructional time lost. To collect such

information, the researcher would need to record the activities in a school on a daily basis. One way to do this is to use the assistance of a teacher on staff to record any ongoing activities.

2. A measure of time that was not addressed in this research study is the engaged time - how students use their instructional time and also how the teachers use their instructional time. To acquire any data on such proximate measures of time as this would involve classroom observation in which the classroom activities are recorded as they occur.

In conclusion, effective time use is necessary if a school wishes to improve its performance. This study has found that the schools in Newfoundland and Labrador could make more effective use of the time available. This study and similar studies have also found that time use is associated with achievement. If the goal of the schools is improved achievement then it seems that one way that schools could work towards that goal is to use the time allocated to the various subject areas more effectively.

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APPENDIX A

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 instructionai 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.

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 mathematics 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 mathematics 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 math 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

13. Which pattern describes your high school math program?

A. 1201 2201 3201

B. 1203 2203 3203

C. 1201 2203 3203

D. 1201 2201 3203

E. Other (please specify)

16. 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 (e.g. accounting, secretarial science)
- D. Other

For students at the Marine Institute

- A. Food Technology
- B. Mechanical or Electrical
- C. Nautical Science
- D. Naval Architecture
- E. Other

SECTION B

PROBLEMS IN MATHEMATICS TEACHING AND LEARNING

The statements given below are about problems that people sometimes identify in mathematics teaching and learning. Please complete each item by filling in the circle on the answer sheet which corresponds to the degree to which you agree or disagree with the statement. In responding to the items, please think of your own experiences or those of other students you know.

		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
17.	Many students are not capable of understanding mathematics concepts at the high school level.	1	2	3	4	5
18.	Most of the math teachers I had in high school did not seem to know their subject well.	1	2	3	4	5
19.	Students just do not work hard enough at mathematics to do well.	1	2	3	4	5
20.	Facilities for teaching high school mathematics are not adequate.	1	2	3	4	5
21.	There is not enough time in high school to cover the mathematics course adequately.	1	2	3	4	5
22.	High school teachers do not pay enough attention to the problems of individual students.	1	2	3	4	5
23.	High school mathematics classes are dull and boring places.	1	2	3	4	5

24.	Most students are satisfied with barely passing mathematics.	1	2	3	4	5
25.	Concepts covered in the high school curriculum are too advanced.	1	2	3	4	5
26.	Public examinations in mathematics are too difficult.	1	2	3	4	5
27.	Too many students are allowed to pass mathematics with very little understanding of the subject.	1	2	3	4	5
28.	Mathematics in high school should be taken only by the best students.	1	2	3	4	5
29.	It is easy to pass high school mathematics without doing much work.	1	2	3	4	5
30.	Many 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 mathematics. Please answer each item as before, but this time thinking only of your own feelings.

		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
31.	Studying mathematics is just as important for females as for males.	1	2	3	4	5
32.	When I am faced with a hard mathematics problem I give up easily.	1	2	3	4	5
33.	I expect that university mathematics will be much more difficult than high school mathematics.	1	2	3	4	5
34.	Mathematics is really difficult for me even though I study hard.	1	2	3	4	5
35.	Mathematics is not very important for my career plans.	1	2	3	4	5
36.	I don't expect to get as much attention from my post-secondary mathematics instructors as I did from my high school mathematics teachers.	1	2	3	4	5

37.	Mathematics is a necessary subject for all students in universities and colleges.	1	2	3	4	5
38.	My parents have always encouraged me to work hard in school.	1	2	3	4	5
39.	I really did not have to work very hard at mathematics in high school.	1	2	3	4	5
40.	I would never take another mathematics course if it were not required.	1	2	3	4	5
41.	It is important to be good at mathematics in order to be competitive in the job market.	1	2	3	4	5
42.	I always try for the highest mark possible, not just a pass.	1	2	3	4	5

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 OMIT 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

    B. overall workload too great

    C. conflicts or diffic- with instructor

    D. illness/family problems

    E. other

80. How often have you attempted this chemistry course?

    A. first time

    B. second time

    C. third time

    D. other

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

    A. fewer than 3

    B. 3 - 6

    C. 7 - 10

    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.