THE PROVISION OF SCIENCE CURRICULUM IN SMALL RURAL HIGH SCHOOLS IN NEWFOUNDLAND AND LABRADOR

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BY

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Abstract

This thesis investigates the provision of science education in small rural high schools throughout the province of Newfoundland and Labrador.

In recent years there has been a call for greater participation and achievement in science provincially, nationally and internationally. Provincially, several documents have recently addressed either science education, small schools or both. However, none actually focuses directly on the problems associated with providing science education which are faced by small schools within the province. This thesis attempts to examine these problems.

Schools within the province which offer any of grades 7-12 and which were defined as small according to the provincial guidelines were identified. Two questionnaires were then developed to be sent to each of the schools identified.

The principal questionnaire examined general school information, science courses offered, distance education, school budget, teacher hiring and personal data.

The teacher questionnaire examined educational background, pre-service training for small schools, present teaching duties, science lab facilities, distance education, professional development, teaching resources, teaching strategies and personal data.

Principal survey results showed a large variation in science programs offered throughout the province's small schools. Most schools were lacking in funding, facilities and resources. Program offerings were often limited due to these factors as well as the unavailability of qualified teachers.

Teacher survey results showed a significant lack of appropriate pre-service training as well as insufficient in-service training and professional development. Teachers also complained of a lack of adequate facilities, equipment and resources. Teacher workloads were tremendous and most teachers reported teaching in a multi-grade situation.

For both the principals and teachers, most respondents were male, relatively young with little teaching experience.

This study provided insight into the current provision of science curriculum in small rural schools throughout the province of Newfoundland. The surveys provided both teachers and principals with an opportunity to voice their opinions concerning the provision of science curriculum in their schools. The study has resulted in recommendations with respect to pre-service training, curriculum development, teacher workload, small school funding, distance education offerings, professional development, and science lab facilities. It is hoped that the information gathered in the study can be used to improve the provision of science curriculum in Newfoundland's small schools.

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CHAPTER 1

THE RESEARCH PROBLEM

Overview of the Chapter

The purpose of this chapter is to introduce the research problem and establish the need for this particular study. The chapter discloses the research questions and identifies the limitations and significance of the study.

Concern for Science Education

The general context of this study is the universally expressed concern about the quality and quantity of science education in today's schools. The particular focus of the study is the provision of science curriculum in the small rural secondary schools in the province of Newfoundland and Labrador.

In academic journals, government reports and the popular press, science education is receiving a failing grade. The consequences of this situation are linked directly to the economic well being of particular nations, states and provinces. The information age's technology driven revolution depends, we are told, on science education. The rhetoric rivals that generated by the USSR's success with Sputnik and the fear and panic of that event.

Recent reports in the U.S. (*A Nation at Risk*, 1983;

Action for Excellence, 1983; *Our Children at Risk*, 1985) show that many students are graduating without a basic understanding of math, science or technology. As a result, the country's demands for scientists, mathematicians and engineers is not being met (Aldridge, 1992; Fisher, 1992).

According to Joyce (1986) there has been an overall decline in American achievement test scores, yet children should be more literate due to media and computer exposure. As well, the number of students selecting advanced science and math courses has not risen despite the recent focus on scientific literacy.

Internationally, U.S. students rank among the lowest in both science and math achievement. These results are part of the *International Assessment of Educational Progress*, based on standardized math and science tests given to students in twenty industrialized countries in 1991. Canadian students ranked somewhere in the middle.

The American solution has been the development of a "national project designed to reform science education" (Aldridge, 1992, p. 13). This project is referred to as the *Project on Scope, Sequence, and Coordination of Secondary School Science (SS&C)*. The project focuses on a greater depth of understanding, less coverage, more hands on experience, student preconceptions and sequencing of student developmental levels. Student assessment is performance based using computer-disk interactive (CD-I) technology.

The need for a "strong engineering, science and technology skills base in Canada" was called for by the Federal Prosperity Initiative in their Action Plan for Canada's Prosperity (Department of Education, 1993, *Profile '92: Educational indicators*, p. 18). Thus, Canada must increase the number and quality of students graduating in these subject areas.

The International Association for Evaluation of Educational Achievement (IEA) conducts international educational research. In 1984 they conducted the *Second International Science Study (SISS)*. Canada was one of 25 countries which participated. Students' science ability was assessed for 10 year olds, 14 year olds and 17-18 year olds. In comparison to 15 countries, Canadian students ranked sixth for 10 year olds and fourth for 14 year olds. For 17-18 year olds Canada ranked eleventh for biology and twelfth for chemistry (Connelly, Crocker & Kass, 1989).

A similar study carried out by the International Assessment of Educational Progress (IAEP) in 1990-91 surveyed the math and science abilities of 9 and 13 year olds in twenty countries. Canada's 13 year olds ranked ninth out of fifteen. The nine year olds ranked fourth out of ten (Lapointe, A., Askew, J., & Mead, N., 1992).

In the same study, Newfoundland ranked eleventh out of fourteen "provinces" in the science assessment of 13 year olds (although there are only ten provinces and two territories, several provinces tested English and French speaking students separately, while others did not participate) (Lapointe et al.,1992).

Provincial concerns about participation and achievement in academic science courses led to the creation of the Task Force on Mathematics and Science Education in 1989. The Task Force was appointed as a result of "public concern over levels of achievement and participation in mathematics and science programs throughout the educational system" (Government of Newfoundland and Labrador, May 1989b, *Towards an achieving society: Summary report*, p. ix)

The Task Force reached a general conclusion that "the educational system is in the midst of a **crisis of low expectations**" (Government of Newfoundland and Labrador, May 1989b, *Towards an achieving society: Summary report*, p. 2). This decrease in expectations coincides with the increased need for education for the economic well-being of our province. Our society is becoming one in which "information and the ability to use information are the most prized commodities" (Government of Newfoundland and Labrador, May 1989b, *Towards an achieving society: Summary report*, p. 2). As such, our students need to experience success in those academic areas (math and science) which will allow them to pursue a higher education.

Thus, the Task Force identified three reasons as to why math and science should be given the highest priority in the educational system: 1) math and science programs will convey to students the transformation from a resource-based, industrial society to a knowledge-based, information society; 2) math and science education will allow students to further their education and increase their ability to function in society; 3) students are not likely to become competent in math and science outside of the school setting.

The five main goals of science education identified by the Task Force are as follows: scientific literacy, science for informed citizenship, science for work, science for further education and science for critical thinking. Similar goals for mathematics education were identified.

The Task Force made recommendations dealing with such topics as improving participation, science curriculum, time allocation, testing and evaluation, teaching facilities and teacher education.

Specific recommendations of the Task Force include such things as the development of advanced courses in math and science, an increase in the minimum number of science credits required for graduation from two to six, the allocation of additional time to science courses for laboratory work, the identification of science as a specialist subject in terms of teacher hiring and allocation, a suggested minimum standard for laboratory facilities and equipment for all schools and the upgrading of teacher pre-service training to include more science and science education (Government of Newfoundland and Labrador, May 1989a, *Towards an achieving society: Final report*).

In 1990 the Newfoundland Government appointed the Williams' Royal Commission on Education. The resulting report, issued in 1992, entitled *Our Children Our Future*, raised many issues concerning our current educational system. One such issue was science achievement levels. At a time when our world is rapidly changing, we need to produce graduates who are able to cope with rapid technological changes and innovations in science. The Commission reports that "too many graduates lack the basic and relevant skills required to function in our present society" (Government of Newfoundland and Labrador, March 1992a, *Our children our future: Final report*, p. xv).

The Commission repeatedly refers to the links between economy and education and points out the increased skill levels required for most jobs. Technological advances have resulted in businesses seeking workers who are "active learners". The graduates produced by our educational system must be "manipulators of knowledge".

In their call for a better quality of education the

Commission states "coping with technological change and scientific innovation will require a sound set of basic skills which will go beyond the necessary fundamentals of literacy and numeracy" (Government of Newfoundland and Labrador, March 1992a, *Our children our future: Final report*, p. 44). To respond to these demands the Royal Commission recommends that the provincial curriculum have a more academic focus, enabling students to receive a "high quality academic education", thus enabling them to further their education following high school graduation.

Provincial achievement in the Canadian Test of Basic Skills (CTBS) for the past several years places Newfoundland well below the national median level in all grades tested (Government of Newfoundland and Labrador, March 1992a, *Our children our future: Final report*; Department of Education, 1993, *Profile '92: Educational indicators*). Also, as stated earlier, in the 1990 IAEP survey of math and science skills Newfoundland students ranked near the bottom of Canada's science assessment of 13 year olds. The Task Force reports that the science achievement of our students "is among the lowest found in any of the countries for which data are available" (Government of Newfoundland and Labrador, May 1989b, *Towards an achieving society: Summary report*, p. 10).

Thus, the Royal Commission suggests that subjects such as science are more important than some others in the curriculum and as such should be allocated more time in the program. The suggestion is also made that core science courses should be made available to all students in the province.

In their summary report, the Royal Commission recommends that "a core curriculum be established comprising a minimum of 50% of instructional time in the disciplines of Language, Mathematics and Science and in which standards of achievement in these subjects become a primary aim of education at all levels" (Government of Newfoundland and Labrador, March 1992b, *Our children our future: Summary report*, p. 15).

Despite the types of recommendations made by both the Task Force and the Royal Commission participation and achievement in science remains low. Even though the Task Force recommended the requirement of six science credits (three courses) for graduation, it is still possible for a student to graduate from our school system with only two science courses completed at the senior high level. As well, there are no restrictions as to which science courses must be completed. For example, a student could complete General Science 1200 and Physical Science 2205, and graduate with no academic science courses and no Level III science credits.

In recent years there have been some modifications made to several science courses. A new Physics course has been introduced, as well as a new Environmental Science course (meant for the academic student, but still being offered to the non-academic student). A new Science, Technology and Society course has been devised, to be implemented in the 94-95 school year (however, it will not be required by all students in Level I as recommended by the Task Force). A new Biology course is being piloted and the junior high science program is also being changed (both are to be introduced in the 94-95 school year). The recent introduction of distance education has provided for the delivery of Physics 2204 to rural areas of the province. Despite these changes, participation in the more academic science courses (chemistry and physics) remains low, at around 30% (Department of Education, 1993, *Profile '92: Educational indicators*). Thus we have a long way to go to increase academic science participation and to ensure that our students graduate academically prepared to meet the future.

Concern for Small Rural Schools

These recent educational studies have also focused their attentions on small schools in our province. Several educational publications and studies allude to the large number of small rural schools in our province. With declining enrolments the number of small schools is expected to increase (Government of Newfoundland and Labrador, March 1992a, *Our children our future: Final report*; Mulcahy, 1992a; Riggs, 1987). Further consolidation of small schools may be possible, but the general view is that schools have amalgamated as much as possible.

The *Small Schools Project*, which was completed in 1987, focused on the problems facing small schools and attempted to develop "proposals to enhance educational opportunities" for small schools (Riggs, 1987, p. 3). The project produced 33 recommendations which dealt with such things as defining small schools, funding of small schools, pre-service training for teachers, course offerings, teacher allocation and resources.

The 1992 Royal Commission also made several recommendations dealing specifically with small schools. These recommendations included school consolidation, the development of a Professional Development Centre, the availability of special services and training for teachers in small rural schools and multi-grade classrooms, the development of a Centre for Small Schools, the addressing of curriculum needs for students in multi-grade classes, subject-area integration and the provision of a forum for multi-grade teachers to share teaching strategies and practices.

Science Education in Small Rural Schools

The current emphasis on science education will present a particular challenge to small rural high schools in the province. In rural areas the course offerings in a high school often depend upon student enrolment and teacher qualifications. These two factors and others will impact on the capacity of small schools to offer a quality science education program.

Following the *Small Schools Study Project* in 1987 the Department of Education proposed the following definitions for small schools. For a primary and elementary school, the school is considered small if the total student enrolment divided by the number of grades offered is less than twelve. For an all-grade, central or regional high school, the school is considered small if the total student enrolment divided by 25 is less than the number of grades offered.

According to statistics received from the Department of Education for the 1992-93 school year there were 130 schools in the province offering grade 7 and above which were identified as small (five of these are joint services and were reported twice). The total number of schools in the province which offer grade 7 and above is 320. Thus over 40% of schools which offer intermediate and senior high science are small schools.

These small schools range in structure from schools which offer K-12, K-10, K-9, K-8, K-7, 6-12, 7-12, 10-12 and include several which offer any grades from K-12 for which they have students. Enrolment in these schools ranges from six students (Frampton Elementary in Monkstown and St. George's School in Paradise River) to 324 students (Deer Lake School in Deer

Lake). Over half of these schools have enrolments of less than 100 students.

The provincial small schools differ not only in structure and size but also in geographical location. With respect to the school's capacity to offer a quality science program, location plays an important role. In Newfoundland, a rural school is one located in a rural area, ie. a community of less than 5000 inhabitants. However, not all small schools are located in rural areas. On the other hand, many of our small schools are located in isolated areas of the province which may be accessible only by ferry or small plane. Consider, for example, the resources (both human and physical) which are at the disposal of students attending St. John's Academy in St. John's versus those available to students attending Jens Haven Memorial in Nain or St. Peter's All Grade in McCallum.

All of the provincial educational reports have alluded to the problems associated with offering a comprehensive educational program to small rural schools. The 1992 Royal Commission summary report entitled *Our Children Our Future* acknowledges these problems stating "it is logistically and financially impossible to offer every high school course, as well as every elective to every student in the province" (p. 16).

The 1987 *Small Schools Study Project* points out the inequities in senior high school course offerings among schools, specifically pinpointing the lack of emphasis on science courses. The Project reports findings that small schools offer fewer pure science courses than larger schools, students in small schools take fewer science courses than students in larger schools and that small schools lack proper science facilities and equipment. Their results showed that as recent as 1986 fifteen percent of the small schools in the province had no science laboratory. They state that science achievement was not related to school size, but that there was a significant relationship between science achievement and the number of science courses completed by students.

The 1989 *Task Force on Mathematics and Science Education* also points to the problems of offering a comprehensive program in small schools, reporting that most school boards were concerned with "increasing the scope of programs in small schools" (Government of Newfoundland and Labrador, May 1989b, *Towards an achieving society: Summary report*, p. 14). The report states that student access to programs in small schools has been a problem and that programs in small schools are not broad enough. However, rather than suggesting that small schools attempt to increase their offerings the Task Force suggests that small schools offer a core program which would include advanced math along with physics or chemistry to be offered to the graduating class.

The Task Force also acknowledged the lack of science facilities and equipment which existed in small schools, recommending that all schools have minimum standards for lab facilities and receive extra funding to purchase equipment. These minimum standards would include the provision of space exclusively for science laboratory work, including laboratory benches with running water, electrical outlets, storage and preparation space (Recommendation 12.10).

The Task Force also compared math and science achievement of students in small and large schools, concluding that students in larger, urban schools achieved at higher levels than those in smaller, rural schools. However, they point out that these differences in achievement are smaller than the differences which exist between and within boards.

The 1992 *Royal Commission on Education* also acknowledges the inequalities that exist between schools, stating that "inequalities in access to quality education have become more unacceptable as the level of education required for meaningful participation in society increases" (Government of Newfoundland and Labrador, March 1992a, *Our children our future: Final report*, p. 37). The Commission acknowledges that the problem of providing educational services in rural areas is compounded by isolation, declining enrolments and the increasing cost of services.

With respect to achievement of rural versus urban students, an analysis of CTBS scores revealed that students in smaller schools tended to score below those of larger schools. However, the Commission states that it would be difficult to prove a causal relationship due to the variety of factors associated with school size.

Science education is given a high priority by the Royal Commission, which states that Language Arts, Mathematics and Science are fundamental to student success in other subjects and should be assigned the largest time allocation.

Thus, it has been recognized by many that increasing the quality and quantity of science education in small rural schools will be a particular challenge.

Distance Education

In all of the recent provincial educational reports reference has been made to the suggestion that distance education be introduced as a means of reducing program inequity in small rural schools. The Royal Commission refers to distance education as being able to "provide improved educational opportunities to small isolated schools, so that the needs of learners can be met regardless of location" (Government of Newfoundland and Labrador, March 1992a, *Our children our future: Final report*, p. 318).

Distance education was first introduced to the province's schools in 1988-89 with the offering of Advanced Math courses. Instruction is through teleconference, telephone and facsimile. Since its introduction provincial enrolment in Advanced Math has increased dramatically. For rural students participation in Math 1201 has increased from 16% in 1988 to 34% in 1992 (Department of Education, 1993, *Profile '92: Educational indicators*).

Recently, Physics 2204 was made available to rural students through distance education, with plans to implement Physics 3204 in the 1993-94 school year. In 1992, 87 students in 20 schools were enroled in Physics 2204 via distance education (Department of Education, 1993, *Profile '92: Educational indicators*).

Thus, as of 1993 Physics 2204 and Physics 3204 are offered through distance education. However, these are only two of more than twenty science courses offered in the provincial senior high science program. At the recent Small Schools Conference held in Gander in October 1992, Doug Young, Distance Education Consultant for the province, indicated that Chemistry was one course for which distance education would not be an easy solution.

The report by the Royal Commission acknowledges that distance education has the **potential** to reduce educational inequality, but that the service must be "well-articulated, well-developed, and well-managed". To obtain such a service the Commission calls for the development of "formal policies about on-going services, types of technologies and needs and priorities" (Government of Newfoundland and Labrador, March 1992a, *Our children our future: Final report*, p. 318).

STEM~Net

STEM~Net has been proposed as a provincial network for educators in the province, particularly in the field of science, math and technology. The network was proposed in response to ACOA's recognition that higher education in science, math and technology would lead to improvements in employment and ultimately our province's economy (Weir, 1993). As teacher qualification is one factor which is often cited as being responsible for the relatively low number of course offerings in rural schools, such a network may very well reduce professional isolation and provide teachers with the training and expertise they need.

The proposed STEM~Net network is in accordance with recommendations made by the 1992 Royal Commission on Education. Such recommendations include emphasis on professional development and the focus on distance education would place the technology required for the delivery of such programs in all small rural schools. Thus the mission of STEM~Net, to support the "teaching, curriculum and professional development activities" and to contribute to efforts to "bring about a substantial improvement in student achievement in mathematics, technology education and science" would help to satisfy the Commission's recommendations (Weir, 1993, p. 1.3).

Purpose of the Study

There is a definite concern for the quality of science education in our province, as indicated by the numerous studies, inquiries and commissions which have investigated science education as part of their mandate. These studies have resulted in at least an acknowledgement of the existence of small schools in the province, and the awareness that there are problems in delivering a complete education program to students in these schools.

What is lacking at this point is a focused, comprehensive study which attempts to document the current curriculum provision for science education in small schools in Newfoundland and Labrador. The purpose of this study is to conduct an inquiry which will document the current situation vis a vis science education in small rural schools. If one considers the current interest in science education as well as the current interest in small schools, then it seems only natural that the delivery of science in small schools needs to be examined.

This study will incorporate the point of view of rural educators who must meet the challenges of rural schools daily. Small schools have specific concerns regarding curriculum provision. An examination of science curriculum in small schools should highlight these concerns and contribute to the development of solutions to deal with them. Such a data base would be very useful to guide and inform any future planning and development efforts to improve the quality and quantity of science education in small rural schools.

THESIS QUESTION

WHAT IS THE CURRENT PROVISION FOR SCIENCE CURRICULUM IN SMALL RURAL HIGH SCHOOLS IN NEWFOUNDLAND AND LABRADOR?

The focus of the proposed study is the current provision for science curriculum (Grades 7-Level III) in the rural areas of the province. To determine the existing provision the following factors were investigated.

Science Program

School principals were asked to identify which science courses were being offered in their school. This included those offered through distance education, as well as those which would be offered in alternating years.

As well, reasons as to why a science course was or was not offered was examined so as to determine those barriers which exist for particular science courses. This was done in part by examining school budgets and resources. Course time allocations were examined to determine if all schools allocate an equal amount of instructional time for various courses (particularly at the junior high level).

Principals were asked questions concerning their school's budget to determine whether or not there is a discrepancy in funding received by different small schools and to determine if small schools differ in the amount of money spent on science instructional supplies based on school size and course offerings. Ways in which small schools compensate for insufficient funding (if it exists) was also examined.

School principals were also questioned as to the school's access to guidance counsellors and teachers for special needs students as their presence or absence in the school would likely impact on the science teacher. As well, teacher allocation was looked at to see if there are discrepancies between schools designated as small (particularly in joint service schools).

Resources

Both principals and teachers were asked to identify their school's science resources and laboratory facilities. Teachers were questioned regarding science lab facilities to determine the extent to which small schools are equipped to offer the various science courses which are a part of the provincial science curriculum. An attempt was also made to determine why facilities are lacking. The lack of proper science lab facilities and equipment is one concern which has been raised in numerous studies (*Small Schools Study Project*, 1987; Royal Commission, *Our Children Our Future*, 1992). Student access to science laboratories was examined to determine whether or not access is adequate.

The resources which teachers in small schools have access to was looked at, in order to determine those resources which science teachers find most valuable and those to which they would like to have access.

The Science Teacher

A general profile of the science teacher in small rural schools was composed by looking at their educational background, pre-service training, course assignment and workload, and their teaching strategies. As well, teachers were asked their age, sex and total years teaching experience so as to develop a profile of the science teacher in small rural schools.

The educational background of teachers was examined. Questions asked included university degrees held, number and type of university science courses completed, science education courses completed and post university training.

Teachers were questioned as to the amount and type of pre-service training which they received which specifically prepared them for their present science teaching assignment in small schools. Questions asked dealt with student teaching and internship assignments, pre-service training for small schools and multi-grade training.

Teachers were questioned as to their overall satisfaction with such things as class size, preparation time, resources and number of preparations. As well, they were asked about their present teaching assignments (courses taught, grades taught) to determine the extent of teacher misassignment and multi-grading.

The various teaching strategies which science teachers in small schools employ, both in single grade and multi-grade classrooms was investigated. This may in turn assist in the development of a curriculum appropriate for use in small schools.

Principals were questioned concerning the factors that influence the hiring of science teachers for their school. This will help determine what schools are looking for in a science teacher, perhaps helping to determine the pre-service training requirements of science teachers in small rural schools.

Professional Development

Professional development is a concern that was raised by the 1992 Royal Commission *Our Children Our Future*. The amount and type of professional development which science teachers receive or have access to was examined, as well as reasons why teachers are not attending professional development provided.

Distance Education and STEM-Net

As distance education, particularly in science, is fairly new to our educational system, there may be some problems which exist about which few educators are aware. Teachers were questioned as to whether or not they are aware of any problems which distance education students are experiencing in their school. Principals were questioned regarding the implementation of distance education in their schools so as to determine the advantages and disadvantages of distance education programs. As well, course offerings and enrolments were examined so as to produce a profile of science distance education.

STEM-Net is one resource proposal which is intended to reduce professional isolation of teachers. This, too, was examined. This was achieved, in part, by determining the extent to which science teachers in small schools make use of computers in their teaching.

This information, along with a thorough review of the relevant literature and an investigation of strategies and approaches recommended in other areas of Canada and other countries (such as *Scope, Sequence and Coordination* in the U.S.) resulted in various recommendations for improvement in the provision of science curriculum in small schools throughout the province.

Limitations

As with any type of research, this inquiry has its limitations. The study focuses on the provision of science curricula (Grades 7-Level III) in small rural schools in Newfoundland and Labrador. Thus, the study is limited to: a) the province of Newfoundland and Labrador and b) small rural schools. Statistics received from the provincial Department of Education indicate that there were 130 small schools in the province which offered Grade 7 to Level III. Five of these schools were joint service, thereby listed twice. Thus sample size was limited to 125 schools.

The extent to which the responses could be generalized was limited by the response rate. It has been recognized by the researcher that teachers in small schools are extremely busy, thus it may be that those teachers who failed to respond may have been too busy to do so. The response rate, in turn, limits the number and type of correlations which may be made from the data collected.

Another limitation within the study is school size. There is a great variation in the student population of those schools surveyed (from 6-324 students). However, all of the schools surveyed fit the province's definition of small.

Because many of the responses on the survey were written, interpretations of statements made by teachers and principals may also be a limitation. Where statements were ambiguous or it was felt by the researcher that further explanation was required, these statements were omitted.

Significance

This study is one which was needed, given the current interest in the problems facing our small schools and the demand, provincially and nationally, for higher participation and achievement in science. This study focused exclusively on the small rural high school, which has not previously been done. The study has resulted in a clear picture of problems facing science teachers in small schools and ways in which some of these problems can be alleviated. Information collected has resulted in a comprehensive data base which can contribute or inform the development of solutions to problems facing science teachers in small rural schools. Data collected could be made available to schools, school boards, the NLTA, the Faculty of Education at Memorial University as well as the Department of Education and thus be used to guide future planning and development decisions.

Summary

This chapter has introduced the research problem, described the research questions and identified the limitations and significance of the study. The next chapter will review the current literature regarding science in small schools.

CHAPTER 2

LITERATURE REVIEW

Overview of the Chapter

The purpose of this chapter is to review the literature regarding science provision in small schools and to discuss the points which have been made by researchers in this field. Although there has been much written regarding science education there has been little research in the field of rural education. DeYoung (1987) states that "research on the particular problems, issues, and trends in rural education is relatively scarce" (p. 123) and that "the current status of rural education studies is underdeveloped" (p. 124). Even less research has been carried out in the combined field of science in small rural schools.

Topics discussed in this chapter will include: small school characteristics and effectiveness; school size vs. achievement; recruiting and retaining teachers; staff development in terms of in-servicing and upgrading (including telementoring and telenetworking); multi-grade teaching; and distance education.

Small School Characteristics

Current literature concerning small school characteristics reveals many advantages of small schools for students, teachers, administrators and parents. For decades the philosophy that "bigger is better" guided educational philosophy and reform. However, recent concerns re achievement, discipline, effective schooling and economics have forced policy makers to take a second look at small schools. What they have found is that small schools are unique, offering many advantages often not found in large schools and may, in fact, serve as models for effective schools (Horn, 1991; Hutto, 1990).

Advantages of Small Schools

Cutler (1989) looks at the advantages of small schools from six view points. In terms of administration small schools have less need for hierarchy, fewer rules and regulations, and better communications between administration and staff members as compared to large schools. Teachers in small schools enjoy a lower pupil/teacher ratio, are able to provide their students with more individual attention and tend to be more receptive to change than are their counterparts in large schools. Students in small schools are more likely to participate in extra-curricular activities and tend to develop a better sense of purpose, pride and independence than do students in large schools. In terms of community, the small school is often the community focus . . . a source of identity for the community. As a result, parents and residents are often more willing to support the school financially. With respect to guidance and atmosphere, herein lies perhaps the greatest advantage of the small school. Small student numbers result in each student having easy access to the principal and teachers within the school. Students are more willing to approach teachers and the result is closer relationships between teachers, principals and students.

Fennell (1990) states that the advantages of small schools include closer relationships between teachers, students, administrators and parents, more individualized student attention from teachers, good discipline and high student participation in extra-curricular activities. As well, Fennell cites studies which found "smaller schools are more conducive to students' well being and social development" (p. 12). Other studies cited by Fennell state that small schools allow for teachers and principals to be more innovative and to develop leadership skills.

Horn (1991) in a study of rural, small school effectiveness found that "rural people have the same general perceptions of what characterizes an effective/quality school as do educational researchers" (p. 25). Horn found that the small schools studied had low drop out rates, high achievement, good teacher-student relationships, higher participation in extra-curricular activities and a higher percentage of students planning to attend post-secondary institutions. Horn concludes that "small schools have distinct advantages for effective schooling" and that it is "time to consider small schools as the best ground for curricular innovations, alternative organizations, and use of technology to build on the advantages" (p. 26).

Hutto (1990) states that many effective school practices exist in small rural schools and that these schools need to "accentuate the positive and create . . . an awareness that rural education provides effective and quality learning for the students it serves" (p. 7). Hutto refers to the fact that implementing change is easily achieved in small schools, that involvement of administration and staff in change boosts staff morale and provides teachers with a sense of "ownership". In contrast to Fennell (1990), Hutto states that teachers and administrators in small schools are free to add courses and implement special programs due to a lack of bureaucracy. Teachers in small schools have close relationships with students and parents, are involved in innovative teaching methods, individualized instruction and extra-curricular activities and choose to teach in these schools.

With respect to community, Hutto echoes the idea that small schools bring a sense of identity to communities, which in turn fosters a sense of identity and belonging in students.

Parents are often involved in school activities and interested in student progress. As a result the school often receives extra support for extra-curricular activities and school-community relationships are enhanced.

In a study of urban versus rural schools Lomotey and Swanson (1989) also support the idea that rural schools are characterized by a sense of community. Extra-curricular activities in rural schools are seen as being an integral part of school life as the school is often the social and cultural center of the community. They report Skelly's finding that within these schools "there is a climate of acceptance, cooperation and mutual support" (p. 442).

Barker and Gump (1964) also found "clear evidence of greater participation in school activities by small school students than by large school students" (p. 74). As well, they found that more students held positions of importance and responsibility in small schools and that junior students in small schools reported better non-class experiences than students in large schools.

Provincially, advantages of small schools, similar to those reported above, were reported in the Royal Commission's report *Our Children Our Future: Final Report*. These advantages included, but were not limited to, the following: smaller pupil-teacher ratio; learner-centered atmosphere and program; high student morale; good discipline; high parental involvement and student loyalty to home, school and community.

Similar advantages of small rural schools are discussed in Haller, Monk, Spotted Bear, Griffith and Moss, 1990; Parkay, 1983; Barker, 1985 and DeYoung, 1987.

Disadvantages of Small Schools

Although there are many advantages of small schools, there are also disadvantages. In order for small schools to remain viable and effective these disadvantages must be recognized and minimized.

Cutler (1989) states that perhaps the biggest disadvantage in small schools is the lack of course offerings. Distance education courses are seen by Cutler as being the answer to restricted course offerings. He proposes, as well, a curriculum developed for small schools with multi-graded classes and better teacher preparation for such situations.

Fennell (1990) refers to studies which show that there is limited training available for both rural administrators and teachers. Rural administrators are likely to have teaching assignments on top of their administrative duties and little time for curriculum development and other administrative duties. Rural teachers are often assigned teaching responsibilities in multiple grades and curriculum areas. As well, rural teachers face high expectations from the community and are often heavily involved with extra-curricular activities.

Fennell also refers to the limited curricular offerings found in small schools, stressing the lack of vocational programs, gifted programs and programs for the physically and/or mentally handicapped students.

Sutherland (1989) discusses some of the disadvantages in Newfoundland's small rural schools as discovered by the 1987 *Small Schools Study Project*. Sutherland makes reference to the concerns of teachers, who believed "instructional effectiveness was sharply reduced by being required to teach too many grades, with too many courses, with insufficient library, laboratory, remedial and enrichment services" (p. 2). Sutherland concludes that the financial, curricular and personnel needs of small schools may only be addressed when small schools become a majority in the province.

Lomotey and Swanson (1989) also report that one of the major disadvantages of rural schools is their limited curricula. Reporting studies by Monk (1984, 1986), they state that there are fewer science courses offered in small school districts and that there are virtually no advanced courses offered in smaller schools.

Also reported was the fact that small school districts had a high percentage of first-year teachers, as well as teachers teaching outside of their area of specialization. Higher qualified teachers were more likely to be teaching in larger school districts. They also reported informal decision making and inexperienced professional leadership in rural schools.

School Size Versus Achievement

Much has been written regarding student achievement, particularly in math and science, and many studies have attempted to distinguish between student achievement in small versus larger or rural versus urban schools. However, findings have been inconclusive and open to debate as to whether differences were actually related to school size, school location or a variety of other factors.

Fennell (1990) reports findings by Marshall that student achievement in low-enrolment, multi-grade classes was not adversely affected. In describing another study by Randhawa and Hunt, Fennell states that although urban students scored slightly higher, results were attributed to the educational and motivational levels of urban parents.

Horn (1991) reports findings by Green and Stevens that school size is not directly linked to student achievement; many factors must be taken into consideration. In Horn's study of small rural schools, he found that students in these schools performed above the state average in all test areas.

In a study of achievement in rural schools, Sunal (1991) found that rural students had lower science achievement scores than urban students. Sunal, however, attributes the difference to factors other than location, stating that such factors as instructional materials, facilities, teacher certification and teacher in-service were correlated to achievement.

Alspaugh (1992) compared urban versus rural achievement using socioeconomic measures. He found that there were no significant differences in achievement levels between urban and rural schools. However, he did find major socioeconomic differences, such as percentage of minorities and number of two-parent families. Alspaugh found rural schools to be more homogeneous than urban schools. He concludes that instructional improvement strategies in urban and rural schools should be different, as the factors which affect achievement (SES) are also different.

Lomotey and Swanson (1989) reported that student achievement in rural schools approximated both national and state averages, and had for many years, according to a recent *National Assessment of Educational Progress*.

Findings, by Connelly et al. (1989), on tests of senior high sciences across Canada showed that large urban schools performed better than small rural schools. Number of labs and lab usage were also factors which positively affected achievement.

Provincially, there have been major concerns with respect to achievement in small rural schools. CTBS results reported in *Profile '92: Educational Indicators* show that urban schools scored higher than rural schools at all grade levels and in all test areas. Similar results are reported in *Towards an Achieving Society: Final Report* (1989). Students in urban schools were found to perform better in public exams, as well as CTBS. However, the study reported that differences in achievement **within** school districts were greater than the differences between urban and rural schools. This prompted the suggestion that "the emphasis on school size as a factor in achievement may be exaggerated, and that the district would be a more strategic focal point for efforts at improving achievement" (p. 89).

Recruiting and Retaining Teachers

A frequently cited problem in small rural schools is that of recruiting and retaining qualified teaching staff. There may be several reasons for this problem, including lack of appropriate pre-service training for rural schools, school location, as well as social and cultural factors. Since quality teachers are believed to be an important factor in student success it is important that rural schools overcome this problem.

Wollman (1990-91) states that teacher qualification plays a major role in student success. In rural areas, attracting qualified teachers is a problem and as small schools often only hire one teacher per subject area, quality is critical. Wollman feels that part of the problem lies in the teacher selection and recruitment methods used by small schools.

In a study of recruitment practices in rural schools Wollman found that rural schools often hired teachers in a hurry, on a needs basis, and usually in the spring. Most school districts did not have a written hiring policy to follow, or if one existed it was not followed. Wollman recommends better recruitment policies in rural areas "in light of the generally accepted belief that quality teachers are not easily attracted to rural areas" (p. 26). Wollman concludes that meeting student learning outcomes can best be achieved by hiring the best teachers which would be "a result of effective recruitment and selection practices" (p. 26).

In a study of the academic preparation of science teachers, Heikkinen (1987) refers to the shortage of qualified science teachers, which he states has been particularly serious for small rural school districts. Heikkinen found that: in the subject areas of physiology, chemistry and earth science, teachers who taught in small schools had significantly fewer credits; fewer teachers had a major or minor in their subject area; and fewer were endorsed to teach the subjects they were teaching. However, there was little difference in the total number of science credits and percentage of Master's degrees held by teachers in small and large schools. With respect to course preparations, number of preparations increased as school size decreased. Heikkinen concludes that his findings should be encouraging to rural administrators as it seems large schools have the same problems in attracting qualified science teachers as small schools.

Luft (1992-93) states that because of a lack of appropriate training teachers are often ill-prepared for the realities of teaching in small rural schools. He cites several reasons why teachers leave rural schools, including lack of social and cultural opportunity, geographic isolation and inadequate staff development programs. Luft states that teachers in small rural schools are often heavily burdened as they are often expected to assist with extra-curricular activities and at the same time teach a wide range of subjects.

In his study of recruitment/retainment practices of rural school districts, Luft found that factors which make it difficult to recruit teachers to rural areas include isolation, lack of community services, salary, lack of social life and distance from a university. Successful recruitment practices included salary packages and benefits, recruiting from colleges which fed from rural areas, personal interviews, on-site visitations, hiring people from rural areas and promoting the positive aspects of small schools and rural living.

Administrators felt universities could help rural districts recruit/retain teachers by offering internships in rural areas, teaching multi-grade techniques, offering rural visitations, posting job openings, selling the positive aspects of rural teaching, having rural educators as guest speakers and sponsoring recruiting fairs.

Luft concluded that once hired, rural teachers may be retained by offering release time for in-servicing and professional development, frequent in-servicing and administrative support.

Garman and Alkire (1992-93) discuss the high rate of staff turnover in small rural schools. Many of the teachers leaving rural settings were young and left for social and cultural reasons. Garman and Alkire refer to the idea that the quality of teachers is crucial to the quality of the school district and, thus, the selection of qualified teachers should be a reliable process.

In a study of the selection process of new teachers in small rural schools Garman and Alkire found that characteristics most preferred by hiring officials included proficient student teaching experience, classroom management, vitality and enthusiasm. They also found that principals were actively involved in the hiring process, usually in the form of structured interviews.

In a similar study, Pesek (1993) states that "the source of recruitment . . . had a definite relationship with satisfactory employee placement" (p. 25). Pesek studied such factors as recruitment sources, effectiveness of recruitment methods and retainment of quality teachers. He found that substitute teacher lists were most often used as a recruitment source and were found to be the most effective source. Pesek feels that this is because a substitute teacher will have "gained a realistic job preview through other teachers and their own experience at that school" (p. 28). As well, the administration will have had the opportunity to evaluate the individual. Also, substitute teachers are likely to be members of the community and, therefore, unlikely to leave. Universities were also widely used and ranked as the second most effective recruitment source.

With respect to hard to fill positions such as chemistry and physics, Pesek states that recruiting for such positions will remain a challenge and that schools must emphasize the positive aspects of rural life and teaching in small schools.

Pesek concludes that most schools do not evaluate their recruitment program and that since the recruitment of teachers is a time consuming, costly process it is one which needs to be evaluated. By choosing the best recruitment source, schools will be able to hire and retain highly qualified teachers. He concludes that low salaries, lack of professional development opportunities, geographical, cultural, personal and professional isolation and inadequate housing are some of the factors which need to be addressed by rural school districts.

In a study of teacher incentives in rural schools, Reed and Busby (1985) discuss the use of rewards and incentives to improve rural education. Problems in attracting and retaining qualified teachers include lack of status, low salary and poor school environments. Results of the study showed that most school systems used fringe benefits, such as health insurance, leave plans and competitive salaries, to recruit new teachers. Many also offered professional development programs or paid tuition for courses. Most schools did not offer rewards to their superior teachers.

Reed and Busby found that the recruitment and retainment rates were directly related to the incentives and rewards offered by the school districts. As such, they recommend the following as guidelines for small rural schools: assist new teachers in finding suitable housing; reimburse high demand teachers (math and science) for moving expenses; offer time and resources for professional development; sponsor and endorse social activities; offer rewards to superior teachers; offer salary bonuses to superior teachers.

In a study of why teachers choose rural schools Matthes and Carlson (1986) found that teachers accepting rural positions considered pace of living, cost of living and school size to be important. These teachers were concerned about settling into the community. Factors which were named as reasons why teachers left rural schools included salary, parental support, fringe benefits, school climate and resources. Matthes and Carlson conclude that schools are "faced with the challenge of creating professional conditions in which teachers can find rewards and a professional identity" (p. 27).

Provincially, concern has also been raised regarding the recruitment and retainment of quality teachers throughout the rural areas of the province. The 1987 *Small Schools Study Project* refers to the difficulty school boards experience in hiring and retaining teachers who can cope in multi-grade classrooms. A result of this difficulty is extensive misassignment of teachers in small rural schools. Such findings resulted in recommendations that teacher education programs reflect the characteristics of small rural schools and multi-grade classrooms and that some prospective teachers be required to complete their internship in a small school (Recommendations 5.2, 5.3 and 5.4).

Directly related to the shortage of math and science teachers in the province are several recommendations made by the 1989 Task Force on Math and Science *Towards an Achieving Society: Final Report*. These recommendations include offering grants of $2000/yr to students concentrating in math or science in their fourth year of training, who maintain a second class standing, provided the recipients agree to teach for two years in designated schools. The Task Force also recommended that new math and science teachers receive a salary bonus of $2000/yr for their first three years of teaching (Recommendations 13.5, 13.6 and 13.7).

The 1992 Royal Commission *Our Children Our Future: Final Report* discusses the problem of "finding and retaining qualified teachers for rural schools and for mathematics, science, French and specialist positions" (p. 291). Given the fact that more than half of the province's schools are small and most future positions will be in rural areas, the Commission believes that teachers entering the profession will "face special challenges and restricted career choices" (p. 291). Thus, the Commission recommended an assessment of present and future employment needs of the school system to promote an awareness of these needs among prospective teachers (Recommendation 87).

Professional Development

Pre-service Training

The literature on small schools repeatedly refers to the unique role of the rural, small school teacher. Related to this unique teacher role is the problem rural school districts have in recruiting and retaining highly qualified teachers for small schools. Part of the blame has been laid on the universities, which have been charged with failing to adequately prepare prospective teachers for their unique role in small rural schools.

In a study of the teacher preparation for small rural schools Horn, Davis and Hilt (1985) describe some of the abilities needed by teachers in small schools. These include being able to do the following: teach more than one subject and grade level, as well as a wide student ability range; obtain resource materials; coordinate extra-curricular activities; and assist students with correspondence courses. Problems faced by these teachers include: large numbers of daily preparations, frequent misassignment and inadequate budgets. Ways in which universities could help prepare teachers for small school assignments include increasing the number of content areas and age ranges teachers train in and helping prospective teachers develop the ability to integrate curricula.

In their study, Horn et al. found little difference between perceived areas of importance in pre-service training between teachers in small and large schools. All teachers felt that oral communication, discipline, classroom management, student motivation and teaching major were important pre-service areas. The researchers recommended emphasis by pre-service programs on selection of curricular materials, self-assessment of teaching ability, preparation of teaching aids, developing personal professional development plans and a teaching minor. They conclude by recommending further research in the area of effective small rural schools and the development of teacher education programs which "capitalize on the characteristics of students, schools and communities in rural areas" (p. 29).

In a literature review of teacher preparation for small schools, Meier and Edington (1983) discuss problems facing rural educators, the role of universities in preparing rural educators to meet these problems and in providing ongoing assistance and in-service. Problems facing rural teachers, cited in the study, include those previously discussed, as well as low salary, lack of opportunity for in-servicing and upgrading and problems associated with small town living such as gossip. To deal with these problems universities are urged to focus on the problems of rural education in an effort to produce quality teachers for rural schools; teachers who are flexible and responsive . . . generalists.

Meier and Edington suggest several ways in which universities can solve the problems facing rural education. Firstly, universities need to assess rural concerns by researching rural education. Secondly, they must provide special training for rural schools, both in pre-service and in-service areas. Thirdly, universities must collaborate with rural schools and become visible in rural communities by forming cooperative relationships. Fourthly, universities need to respond to rural needs by providing resource people. Fifthly, teacher-training needs in rural areas could be met by creating off-campus centres. Finally, universities need to help organize curricula for rural schools.

Meier and Edington conclude by discussing how these solutions will change the role of universities. They claim that the role of universities will expand to include off-site training. As well, the role of professors will shift to that of resource persons. Finally, universities will pursue "field-based models" in an attempt to "intervene . . . from the outside and to work *with* rural educators" (p. 7).

Nationally there have been some such moves to improve pre-service training for rural teachers. Borys et al. (1991) describe such an attempt by the University of Alberta (U of A). The Fort Vermilion School Division in Alberta established a working relationship with the university with respect to practicum placements, in an attempt to solve the district's hiring crisis. U of A screened candidates, the school board helped to fund student teacher expenses and the university supplied resource persons for workshops and support. Participants in the program found the experience to be beneficial for all involved. Benefits of such a partnership include; easing the university's placement problems, sharing teacher preparation with the schools, experimenting with technology such as teleconferencing and computers as a delivery approach, recognition and support for cooperating teachers, including an opportunity to network, potential for renewal and change between school staff and university personnel, potential for research within rural schools, a means by which rural schools may recruit teachers and a sharing of resources between the universities and rural school districts. Overall, Borys et al. conclude that such collaborative projects benefit all involved; school boards, universities and student teachers.

Provincially, reference has been made to lack of adequate preparation of rural teachers in several studies and reports. The 1987 *Small School Study Project* refers to the frequent misassignment of teachers, specifically a lack of teachers holding primary degrees. Reference is also made to the difficulty school boards had in recruiting teachers who could cope in multi-grade situations or teach a wide variety of subjects.

Recommendations to overcome these problems include that more students be accepted into the primary degree program, that education programs at all levels "reflect the characteristics of small schools and multi-graded classrooms" (p. 59), that the secondary program require teachers to complete a range of courses and that a number of student teachers complete their internship in small rural schools (Recommendations 5.1, 5.2, 5.3 and 5.4).

The 1989 Task Force on Math and Science *Towards an Achieving Society: Final Report* also acknowledges that teachers in small schools often teach a broad range of courses, which they are often not qualified to teach. In an attempt to improve the math and science qualifications of teachers, the Task Force recommends an increase in the number of math, science and corresponding education courses prospective teachers are required to complete (Recommendations 13.1, 13.2, 13.3 and 13.4). Reference was also made to the development of a "program which would be especially suited for teachers in small schools" in an attempt to "optimize the match between qualifications and job requirements" (p. 288).

The 1992 Royal Commission *Our Children Our Future: Final Report* also discusses the inadequacies of current teacher preparation for small rural schools. Suggestions are that teacher education should be more relevant to the current needs of schools and, thus, better prepare teachers for multi-grade situations and teaching in rural areas. One important recommendation made by the Commission calls for the establishment of a Centre for Small Schools which would address issues related to small schools and multi-grade approaches (Recommendation 80).

In-service Training

For those teachers already employed in small rural schools, help in coping with their teaching assignments must come from in-service training. Complaints regarding such training include its lack of relevance, suitability, inconvenience, or simply the lack of such training. Clearly, as in pre-service training, there is a need to redefine the type of in-service training being presented to rural teachers, particularly science teachers.

Hoover and Boethel (1990-91) surveyed the staff development in the southwestern U.S.. In reviewing the literature regarding staff development in rural schools, they suggest that "effective staff development must be *comprehensive, needs-based, participant-owned, and supported over time*" (p. 9).

In their study they found most small schools followed an episodic approach to staff development; "one shot lectures presented by non-local personnel with little follow-up" (p. 13). There seemed to be no long range planning and little consideration given to local needs. Most educators surveyed viewed their in-servicing as self-improvement rather than school-wide improvement.

To improve staff development, respondents suggested a "collective, locally directed approach", emphasizing hands-on activities, peer-coaching and long-term follow-up. Hoover and

Boethel conclude by recommending a comprehensive, systematic approach to staff development in small rural schools. Even though it is more costly, time-consuming and requires a great deal of commitment, the rewards would include teacher renewal, improved school climate and increased student achievement.

Shroyer and Enochs (1987) discuss the idea that the needs of rural educators have been ignored, particularly those of rural science educators. They promote Nachtigal's view that "rural science education should reflect the unique and diverse strengths and weaknesses of rural life" and that "rural teachers should learn to become developers and adapters of alternative models of curriculum and instruction" (p. 39). To accomplish this, rural science teachers must be aware of their needs and be able to match those needs with school and community strengths in order to improve their school's science program.

Shroyer and Enochs describe a program set up by the National Science Foundation which attempts to do so. The program involves the identification of outstanding rural science teachers. These teachers are then trained in science content, science education and staff development so that they may become "leaders of rural science education improvement" (p. 39) in their local areas.

The project begins with an analysis of needs. The needs of rural science teachers often reflect many of the problems of rural science teachers; professional isolation, misassignment, heavy workloads and lack of resources. Once the local needs have been determined, participants analyze the strengths of the school and community. Such strengths include enhanced individualized instruction, more personal contact and easy access to natural resources. The third step of the program matches the strengths and needs to create a mission statement and plan for the future. The plan involves an assessment of teachers' backgrounds and teaching assignments, a description of the organizational context within which the plan will take place, an analysis of the proposed change and finally a plan for implementation.

Such an improvement program is based on local needs and strengths and, thus, constitutes a form of staff development which is participant-owned and needs-based . . . a step in the right direction.

Prather and Hartshorn (1989) describe a similar approach aimed at improving elementary science instruction in small rural schools. The recent call for improvement in science education has resulted in a reform that calls for a hands-on approach. To effect such an approach, training would be required, given that most elementary teachers feel unqualified to teach science. In rural schools the problem of such training is compounded by the fact that there are few science specialists to provide leadership. Thus, improving science teaching in rural areas would require the development of both instructional and administrative skills.

Teachers involved in the program worked in local teams (including teachers and administrators) to plan a one-year project to improve science teaching in their school. Evaluation of the program showed an increase in science content, a more positive attitude towards science and science teaching, increased computer literacy and increased student achievement. Such a program is deemed effective due to active participation by teachers and administrators. Such a successful program has shown that "rural school systems can bring about reform within their own ranks through local leadership development" (p. 12).

Bitner (1990) evaluated a similar year-long in-service aimed at improving the attitudes of elementary science teachers. Although the workshop was not exclusively aimed at rural science teachers, most of the teachers involved were rural educators. The workshop was designed by university professors and school administrators and involved the identification of priority objectives by participants, in an attempt to tailor the workshop to participants' needs. Evaluation of the workshop showed an increase in positive attitudes towards science and science teaching and helped reduce teacher anxiety in working with science equipment. Again, the in-service is long term, needs-based and participants were actively involved.

Baker and Ambrose (1985) discuss a slightly different approach to rural school science in-servicing. They acknowledge the professional isolation often experienced by rural teachers and the lack of science training of many primary and elementary teachers. They advocate school-based in-servicing for the rural science teacher, arguing that the effects of such in-service will be longer lasting because of the greater teacher involvement and immediate influence.

Training is brought into the classroom in the form of a tutor, using available resources and allowing for meaningful discussion between teacher and tutor, developing teacher confidence and skills and reducing insecurity.

The INSET program helps reduce professional isolation, at the same time developing curriculum innovation in small schools. The program gives priority to "the provision of school-based support in materials, equipment, curriculum projects, consultancy and, most significantly, in a sustained teaching commitment" (p. 33).

Hadfield, Lillibridge and Hutto (1991-92) state that the problems facing rural science teachers, such as professional isolation and lack of resources, often lead to a negative attitude towards science, resulting in less class time. The solution to these problems is seen to be in-servicing, which trains teachers in the construction of resources for use in hands-on science and proper use of such resources. Their evaluation of a five day summer workshop showed significant gain in both science content and teaching confidence, resulting in improved science teaching (determined by follow-up visits). They recommend such workshops as a "viable part of the solution to enhancing current elementary science education programs, particularly in small rural schools" (p. 15).

The 1987 *Small Schools Study Project* makes little mention of the need for in-servicing of teachers in small rural schools other than to say that there were calls for increased in-service training in submissions they received.

The 1989 Task Force on Math and Science *Towards an Achieving Society: Final Report* feels that the need for continuing teacher education is likely to increase in the future. According to complaints, teachers and school boards regarded one day workshops as inadequate, a waste of time and costly, which led to the recommendation that one day workshops be eliminated as a means of in-service (Recommendation 13.8). The Task Force recommends a change in in-service practices that would see in-servicing occur in the summer, be tied to teaching assignments and pay teachers for their participation (Recommendations 13.9, 13.10, 13.11, 13.12, 13.13 and 13.14). These recommendations have not yet been implemented.

The 1992 Royal Commission *Our Children Our Future: Final*

Report calls for a "new, comprehensive and co-ordinated approach to the professional development of teachers and administrators" (p. 281), stating that the current *ad-hoc* approach is both inefficient and ineffective. The Commission calls for schools to voice their needs and to build on their capabilities. They recommend organized professional development within school districts (through Staff Development Committees) as well as provincially (through the creation of a Professional Development Centre). Issues of professional development in small rural schools are specifically addressed in the recommendation that "special in-service training and professional development services be developed and made available for teachers working in small rural schools and multi-graded classrooms" (p. 285) (Recommendation 75). In all, twelve recommendations were made to improve professional development of the province's teachers (Recommendations 65-76).

Telementoring/Telenetworking

Advances in telecommunications are becoming a major information tool and resource in education. One new-found use of these telecommunication advances has been in the training and delivery of resources to rural educators.

Several concepts are involved. *Telementoring* refers to a telecommunications network linking a post-secondary institution with public schools. Such a network allows for faculty to assist in problem-solving and to provide information. *Teletraining* refers to the use of telecommunications technology in the delivery of instruction and research. Teletraining is used to deliver in-service and university programs in an individualized manner. *Networking* is the use of telecommunications to allow the sharing of information and multiple communications between computers.

Kendall (1992) states that innovations in telecommunications networks are having a major impact on teacher training programs. Networking has had a positive impact on the delivery of teacher training to rural areas, curriculum development, the sharing of information and resources and the delivery of university credit courses to rural students. Benefits of networking include reducing the cost of providing information and data to rural schools, increased communication between educators and improved teacher training programs.

Kendall evaluated a network established to provide in-service teacher training to early childhood-special education teachers in rural areas. He found that the network had a positive impact on the learning of new information, utilization of scarce resources, professional development and in student self-learning. Kendall recommends the following: integration of telementoring with pre and in-service education; proper staffing to solve technical and cultural problems; credit be given to teachers as an incentive; district and administrative support in the form of time and computers. Kendall concludes that through the use of telementoring and telenetworking "the problem of being located in a rural area will no longer present a barrier for immediate access and exchange of educational information" (p. 46).

Ruopp, Pfister, Drayton and Gal (1993) describe a telecommunications network called LabNet, funded by the National Science Foundation (NSF). The goals of LabNet (aimed primarily at Physics teachers) include encouraging student projects, building a professional community of high school science teachers and using telecommunications to connect teachers.

The project provides teachers with support and resources, peer support and technical advice. Teachers within the network community provide support and leadership and play an active role in the planning, implementation and dissemination of the LabNet project.

Implementation of the project has taken three years and a second three year phase was initiated in 1992. Teacher training involved a workshop which introduced teachers to curriculum units designed to help them integrate microcomputer based labs (MBL's) and telecommunications activities into their science curricula. Teachers were also trained in telecommunications software. Post workshop follow-up programs were designed, whereby teacher liaison consultants (TLC's) provide needed support to participants.

Rupp et al. found that LabNet made a difference for teachers by providing them with opportunities to explore new teaching methods and integrate technology. They also found that teachers needed to take leadership roles for the network to be successful. They concluded that "LabNet has proven useful in connecting teachers to one another as a community of practitioners" (p. 18). They found that LabNet strengthened connections between teachers, was used by teachers to support their teaching and created opportunities for teachers to become leaders. They suggest that telecommunications will play a major role in future reform efforts.

Gal (1993) discusses network research for rural education. Gal feels that the conditions and features of educational practice in rural areas need to be determined. Once this has been done it must be determined whether or not networks support rural education or if new educational issues will arise. The contributions which network use can make to teaching need to be determined by examining how networks are utilized for teaching. Gal states that the "criteria for successful use of networks must be the *purposeful use* of a telecommunications network by a teacher that contributes to his or her teaching practice and/or professional development" (p. 38).

Gal discusses four problems faced by rural teachers; isolation, resistance to change, limited resources and professional development. LabNet is described by Gal as being able to reduce isolation and produce resources, provide contact with other teachers interested in introducing change and provide a means for professional development.

Networks are often seen as being used to expand teaching. Gal reciprocates by stating "That teachers *choose* to use networks for this purpose suggests their *need* to expand their teaching" (p. 40). Networks allow for such expansion by providing a supportive community of practice. Such a community allows for professional dialogue to discuss experiences and exchange ideas.

Network limitations exist which must be overcome. These include the idea that network users feel the need to know each other in order to build up trust. As well, there are equipment and time limitations and the need for teachers to be able to communicate openly with other teachers rather than with supervisors. Thus, Gal states the need to create "an appropriate work environment that takes into account the time and resources for teachers to communicate with peers" (p. 41). To do so requires the creation of a "community of practice that holds a common view about the effective and purposeful use of the network" (p. 41). Such a community will not only utilize the network, but examine its effectiveness in serving the needs of the community.

Gal calls for further research in the use of networks for rural teachers. He suggests that rural teachers are more capable of introducing change, more interdisciplinary, have more flexibility in planning their teaching experiences and teach in unique settings. Topics for further research include both (a) determining the features that are unique to rural teaching and how networks might be applied to these features, and (b) determining the needs of a rural teachers network and the aspects of a rural community of practice which might benefit urban teachers.

The 1992 Royal Commission report *Our Children Our Future: Final Report* discusses the use of telecommunications technology in the professional development of rural teachers. Such technology is seen as being able to "involve many more teachers and principals, eliminate costly travel and save time" (p. 320). Interactive media and electronic bulletin boards are also promoted for professional development. In addition to recommending the development of a Professional Development Centre, the Commission recommends the use of computer technology to ensure that teachers in isolated schools have access to professional development. As such, teachers and administrators are encouraged to become competent in the new technologies (Recommendations 75 and 76).

In 1992 a computer network known as STEM-Net was established for K-12 teachers and college educators in Newfoundland, with emphasis on math, technology and science. The mission of STEM-Net is "to be a high quality computer network for educators in Newfoundland and Labrador, and to support their teaching, curriculum and professional development activities" (Weir, p. 1.3). The focus of STEM-Net is to improve communications, facilitate access to resources and foster an understanding of information technology among educators.

Users include K-12 teachers, school administrators, school board personnel, Department of Education personnel, NLTA staff, college and university personnel and a variety of resource personnel. Services available to users include e-mail, bulletin boards, library and database resources and access to the Internet (a worldwide network). Specific programs will be developed for teachers including on-line newsletters, course materials, mini-courses in network use, conferences and teacher mentors. As well, databases of test items and lesson plans will be made available. The program development and training spans a five year period from 1992-1997.

Weir suggests that provincial educational advancement has been impeded by professional isolation experienced by teachers, especially those in small rural schools, and by a lack of knowledge of technology, specifically computer and communication technologies. STEM-Net has the "potential to foster excellence in teaching through the elimination of professional isolation and the improvement of teacher skills in computer-mediated communications" (Weir, p. 2.1).

Multi-grade Classrooms

Multi-grade classrooms are a reality in schools throughout the U.S. and Canada, although their existence is overlooked and/or denied by many. Not only do they exist, but they are common in many rural areas. The concept of multi-grading is viewed negatively by many, seen as a step backward in the educational process. However, research is exposing the positive aspects of multi-grading which have been long overlooked.

The 1992 Royal Commission *Our Children Our Future: Final Report* refers to the concepts of multi-grade classrooms and non-graded classrooms. The report defines multi-grade classrooms as "a classroom containing one or more grade levels. The number of grades may vary" (p. 507). A non-graded classroom is defined as "a classroom characterized by the removal of traditional age-grade grouping and replaced by multi-age grouping" (p. 508).

Provincially, multi-grade classrooms vary in structure from two grades in a classroom (eg. grades 1 and 2) to several grades per class. Most multi-grade classes are at the primary/elementary levels, but multi-grade classes exist at the junior/senior high levels as well. Schools which have multi-grade classes tend to exist in rural areas of the province, although some suburban areas also have multi-grade classes (eg. Pouch Cove Elementary).

The 1992 Royal Commission report *Our Children Our Future: Final Report* states that 10% of the province's schools have multi-grade classes. However, Riggs (1987) in the *Small Schools Study Project* reported that more than 30% of the province's schools contained multi-grade classrooms, with 70% of teachers in small schools teaching more than one grade per classroom. The project found that 30% of small schools offer one grade per class, 48% offer two grades per class, 14% offer three grades per class and 9% offer more than three grades per class. Mulcahy (1993), in a study of multi-grade classes in K-6 found that 38% of K-6 schools have one or more multi-grade classrooms, containing 10% of the province's K-6 students. He also found that 17% of rural students and 60% of students in small schools are being educated in multi-grade classrooms. With enrolments declining, how could the incidence have dropped from 30% to 10% in just five years?

Perhaps one of the biggest criticisms of multi-grading has been its perceived negative effect on student achievement. Miller (1990) reports that very few quantitative studies have been carried out which examine student achievement in multi-grade classrooms. Even fewer such studies have been done in rural areas. Thus the focus has not been on urban vs. rural differences but rather on how multi-grade students compare to single grade.

Miller's review of quantitative studies examining student achievement shows "little or no difference in achievement in students in single or multigrade classrooms" (p. 2). Miller reports a comprehensive study by Rule in 1983 which reported mixed results. Rule concluded that in multi-grade classes reading achievement may be enhanced, math achievement may be negatively affected and suggested combining average/high achieving students for multi-grade classes. Another study reported by Miller was conducted in Australia in 1986 by Pratt and Treacy. The study examined differences between single and multi-grade primary classrooms in both rural and urban schools. They found "no indication that academic progress or social development were affected by how students were grouped" (p. 4).

Fennell (1990) reports similar findings regarding achievement in multi-grade classrooms. Studies reported by Fennell (Marshall, 1985; Randhawa and Hunt, 1987) reported "no adverse affects of the achievement of students in low enrolment, multi-grade classrooms" (p. 13) and that differences in achievement levels may be due to other factors.

Students in small rural schools and multi-grade classrooms tend to outperform students in larger, urban single grade classrooms with respect to the affective domain. Miller (1990) reports that "results generally favor the multigrade classroom when measures of student attitude towards self, school or peers are compared" (p. 4). His analysis of quantitative studies of student attitudes showed that students in multi-grade classrooms had a more positive attitude towards themselves and school, as well as more positive social relationships.

Similar results are reported by Fennell (1990) who reports Marshall's findings that students in multi-grade classrooms have "better attitudes towards schooling, better self-concepts. . . . experience less anxiety, and tend to develop sense of purpose, problem-solving, perseverance, people-orientation and sense of pride in their schools" (p. 12).

Miller (1990) concludes that multi-grade classes do not negatively affect academic performance, student attitudes or social relationships. Thus, he claims, the multi-grade classroom is a "viable and equally effective organizational alternative to single grade instruction" (p. 6). Miller calls for further research into how teachers plan, prepare and teach in multi-grade classrooms, how students are grouped, how classes are managed and organized and the teaching strategies used in various subject areas.

Multi-grade classrooms present particular problems to teachers. The 1987 *Small Schools Study Project* surveyed teachers in multi-grade classrooms to determine their areas of concern. Teachers rated number of grades and courses they are required to teach as being their biggest concern. Other concerns included lack of services for students working below grade level and for special education students. To overcome the curriculum problems the report suggested that the primary/elementary curriculum be reorganized such that common texts across grades or a thematic approach could be used in small schools (Recommendation 3.3). Other recommendations (discussed earlier) were made which suggested teachers should be better prepared to meet the challenges of multi-grade classrooms through teacher education which emphasized multi-grade classrooms.

The 1989 Task Force on Math and Science *Towards an Achieving Society: Final Report* makes no reference to multi-grade classrooms, but does refer to small schools. In an attempt to alleviate the problems of insufficient course offerings in math and science in small schools, the Task Force recommends a core program be offered to students which would include math and physics or chemistry (Recommendations 8.1 and 8.2). The report also acknowledges the increased course load of teachers in small schools, requiring many to teach math and science. As such, it recommends that primary/elementary teachers be required to take science and math courses as well as corresponding education courses to provide them with a background in these subject areas (Recommendation 13.1, 13.2 and 13.3).

The 1992 Royal Commission *Our Children Our Future: Final Report* discusses the lack of recognition of multi-grade classrooms by curriculum documents and personnel, accusing them of assuming "a structure with discrete subject-area grade boundaries" (p. 296). The report discusses the lack of direction available to multi-grade teachers in "adapting resources, providing individualized instruction, devising group strategies, or general planning and organizing" (p. 304). To address the concerns of multi-grade teachers the Commission recommended: that policies be established to address curriculum needs in multi-grade classes; that subject area integration be developed, as well as a handbook of techniques and skills for multi-grade teachers; that alternative texts and resources be produced; and that the professional development of multi-grade teachers be addressed through forums and special programs (Recommendations 94-99). As well, the Commission recommends the development of an Administrator's Institute on multi-grade teaching, developed by the Professional Development Centre, to address topics such as the integration of curricula and effective teaching strategies (Recommendation 62). Other recommendations (discussed earlier) regarding teacher pre-service and in-service training which deal with multi-grading were also made by the Commission.

Mulcahy (1991, 1992a, 1992b, 1993) voices many of the same concerns, curricular problems in multi-grade classes, that were expressed by Miller, Riggs and the Royal Commission. Teachers are faced with trying to teach a curriculum prescribed by the Department of Education which has been developed for single grade classes.

A teacher in a multi-grade class of two grades may be responsible for 20 course preparations. This number is significantly increased as the number of grades per class increases. Often these teachers, as a result of inappropriate pre-service training, attempt to teach as if they were in a single grade situation. As a result, students often receive an education which is inferior, often with some subjects omitted (eg. music, art and science). Mulcahy reports that in some schools "various forms of horizontal and vertical integration, thematic and 'whole language' approaches, cross grading, various forms of grouping/collaborative, peer teaching and so on have been attempted" (1991, p. 4) with some success. These approaches are further described by Mulcahy (1992a) in a second article discussing approaches used by multi-grade teachers. The various approaches were only partly successful due to the fact that the curriculum being followed by the teachers was designed for use in single grade classes.

Mulcahy concludes that our current curricular approach which is "single, tightly prescribed, centrally controlled, content-oriented, subject-centred, lock-step graded" (1991, p. 5) does not work in small schools and multi-grade classrooms. Thus, he calls for "the development of a curricular approach designed specifically to be responsive and sensitive to the needs of multi-age contexts" (1991, p. 5).

To begin such an approach requires first of all that educational agencies such as Memorial University, the Department of Education and the NLTA acknowledge the existence and realities of multi-grade classrooms. Mulcahy (1992a) documents the lack of recognition small schools and multi-grade classrooms have received provincially and nationally. This acknowledgement is beginning, with the completion of the 1987 *Small Schools Study Project*, recognition from the 1992 Royal Commission and the holding of the National Conference of Small Schools in Newfoundland in 1991.

Once multi-grade classrooms have been acknowledged, they must be recognized as being different from single grade classrooms. Mulcahy (1992b) reports that ranges in student ability and achievement are much greater in multi-grade classrooms. In addition, the amount of curriculum for which a multi-grade teacher is responsible is greatly increased, placing unrealistic demands on a teacher's time and energy.

Due to the wide range of abilities, maturation levels and the combination of subjects and grades, students often lack individualized attention, which may be particularly problematic for low achievers, and is often blamed for the higher dropout rate in small rural schools. All of these differences and problems require extra time and effort on the part of the multi-grade teacher in terms of planning and preparation; extra time in schools where teachers often have fewer preparation periods (if any) than teachers in larger schools.

Considering the positive aspects of multi-grade classrooms in terms of student achievement, learning and attitudes, and the call for curricular reform for multi-grade classrooms, then it is clear that such reform must "build on and incorporate in its overall design such positive attributes" (Mulcahy, 1992b, p. 16).

School Size Versus Curricular Offerings

One of the major criticisms of small rural schools has been the lack of curricular offerings, as has been previously discussed. Although small schools may indeed offer fewer courses than large schools, the impact may not be as negative as is implied by some.

Barker (1985), in a study of curricular offerings in small and large American high schools, found that "most students who attend small high schools face curriculum disadvantages uncommon to students who attend large high schools" (p. 37). Of the 105 courses surveyed, 35% were offered significantly more frequently in larger high schools as compared to only 2 courses being offered more frequently in small schools. With respect to science courses, an analysis of the data showed that with the exception of Biology and General Science, all others were offered more frequently in the larger schools. Geology was the only science course offered significantly more frequently in larger schools.

Barker concludes that the problems facing schools, in general, are magnified in small schools, particularly in terms of meeting educational needs, as per pupil costs of staff, programs and facilities are increased due to low enrolment. However, the virtues of small schools are being realized and thus increasing program diversity and curricular offerings need to be analyzed.

Sederberg (1983) also discusses the lack of curricular offerings found in small rural schools. He states that often small schools justify fewer course offerings due to low community expectations, low student demand and lack of resources. However, Sederberg feels program disadvantages in small schools should be defined partly in terms of the delivery organization. He proposes a learning center approach in terms of a multi-grade, multi-course organization.

Lack of curricular offerings in small schools is also documented in a study of school and program comprehensiveness by Haller et al. (1990). Their study showed three findings. First, that small schools offered a less comprehensive program than larger schools. With respect to science offerings most small schools offered a basic science course, less than half offered advanced science courses and even fewer offered alternative science courses. Secondly, they found that program comprehensiveness varied by subject at all school sizes, science programs being less comprehensive than math. Their third finding was that a general parity in program comprehensiveness was reached in basic courses when graduating classes reached a population of 100 students, and in advanced and alternative courses as the graduating class reached a size of 200.

Lomotey and Swanson (1989) also discuss the limited curricular offerings in small rural schools, stating that there are fewer opportunities for non-college bound students to study science.

Barker and Gump (1964) in *Big School, Small School* found that although larger schools did, in fact, offer a greater variety of classes, students in large schools participated in fewer classes and a smaller variety of classes than students in small schools. They concluded that "if versatility of experience is preferred over opportunity for specialization, a smaller school is better than a larger one; if specialization is sought, the larger school is the better" (p. 201).

Provincially, limited curricular offerings in small rural schools has also been recognized. The 1987 *Small Schools Study Project* recognized the "numerous inequities in the offerings of senior high school courses across schools of various sizes" (p. 25-26), including a lack of emphasis on high school science courses. The study recommended that high schools offer all courses which were prerequisite to post-secondary institutions (including second level chemistry and physics) either through direct classroom teaching or by means of distance education (Recommendations 3.4 and 3.5).

The 1989 Task Force on Math and Science *Towards an Achieving Society: Final Report* also addresses the problem of limited curricular offerings in small rural schools. The report advocates the use of distance education to bring various courses into small schools. As well, a core program is advised for schools with less than 20 graduates, consisting of advanced mathematics and chemistry or physics (Recommendations 8.1 and 8.2).

The 1992 Royal Commission *Our Children Our Future: Final Report* offers many recommendations to expose students in small rural schools to a wider variety of course offerings and thus reduce the disparity between urban and rural schools. Such recommendations include development of curriculum suitable for multi-grade situations and the promotion of distance education programs.

Distance Education

To compensate for the lack of curricular offerings in small schools, educators and educational agencies have promoted the concept of distance education. Distance education is defined by the 1992 Royal Commission *Our Children Our Future: Final Report* as being "the use of technology and media to deliver instruction to schools to meet the specific educational needs of students" (p. 506).

Courses offered through distance education are seen by many as being the means by which equity of educational programming can be achieved. However, distance education should not be viewed as a panacea for solving curricular problems in small schools. Although there are distinct and obvious advantages to offering courses to small schools through distance education, there are also problems and concerns which need to be examined.

Barker (1990) discusses the use of distance education as a means of increasing curricular offerings in small schools where isolation, low enrolment and teacher availability limit course offerings. Barker describes distance education as a telecommunications link between student and teacher which "permits live, interactive audio and/or video exchanges between teacher and students" (p. 4). Barker describes interactive satellite broadcasts, interactive TV delivered via microwave, fiber optics and cable, as well as microcomputer based and audiographic teleteaching linking computers and telephone lines. Barker states that there is no one best technology for the delivery of distance education but that the technology chosen should meet the "goals, needs and financial resources of the local school" (p. 4). He feels that the advantages of the various technologies outweigh the disadvantages, which may in time be overcome with further research and advances in technology. Barker concludes that the "success of any telecommunications delivery system will ultimately depend more on the quality and usefulness of the content delivered and received than upon the choice of the equipment used" (p. 7).

Rideout (1986) discusses the role distance education could play in Newfoundland's small schools. He claims that distance education has the "potential for large scale education in its mass production of programming while also supporting individual learning related to the student's personal interests" (p. 12). He acknowledges that not all subject areas lend themselves to distance learning, especially those which involve psychomotor skills (eg. physical education, chemistry). This in itself is a problem as many of the courses which are not offered in small schools are courses such as these.

Rideout also discusses the cost of distance education, stating that the initial development of courses and materials would be high, but that operating costs are minimal. He suggests that costs of tutoring and program development could be offset by salaries of redundant and retired teachers. As well, Rideout promotes the expansion of distance education to include community education through adult education and retraining. Rideout concludes that distance education should be considered as "one alternative for our schools in setting up student programs" (p. 13).

De Luna (1988) describes the distance education program in Alberta called Distance Learning in Small Schools (DLSS). The program allows senior high students to enrol in courses not offered in their schools, and replaces a former correspondence program. The distance education program has increased student participation, course completion and passing rates. Schools involved in the program had to provide a tutor/marker for a subject area and assign a distance learning coordinator. Schools could have an intern to offer assistance and each school received a FAX machine. Course materials were supplied by the Alberta Correspondence School. Costs of the program were funded by Alberta Education, with the exception of the cost of phone lines and secretarial help.

De Luna reports that certain aspects of the distance education program need to be monitored, such as the teachers employment conditions (workload, isolation and status). The isolation factor may be improved through the development of a computer network which will link teachers and coordinators. A bulletin board on the network may improve teacher-student interaction and encourage peer teaching. De Luna concludes that overall, the distance education program has been successful in Alberta, particularly "in schools where the project has been well administered - where a teacher has been identified as a coordinator - and where the concept has been well supported" (p. 3).

Harte (1990) describes an Ontario study which analyzes the strategies of schools identified as being successful users of Independent Learning Courses (ILC's). Schools involved had a student enrolment of less that 300 students in grades 9-12 and a higher than average participation and completion rate of ILC's.

A study of those schools deemed to be most effective resulted in the following recommendations to schools considering offering distance education, or wishing to improve their existing program. 1) Structure courses around regular day-school courses, within the school timetable and school year. 2) Increase counselling and screening of distance education students such that students enroling have demonstrated the ability to learn independently and are aware of course difficulty and expectations of them. 3) Monitor student progress by checking work, lesson completion and parental contact. 4) Award more time to day-school coordinators so that their responsibilities may be carried out properly.

Harte concludes that distance education can benefit small secondary schools, but that "the onus, however, is on the school to take advantage of these services and to fit them to the existing parameters of the day school" (p. 12). Although the ILC's studied are correspondence courses, the recommendations made by Harte could certainly be applied to distance education courses involving the use of telecommunications.

Provincially, there have been many calls for the development of a distance education program. The 1987 *Small Schools Study Project* recommended that all courses prerequisite for post-secondary institutions be offered in small schools either through direct teaching or by means of distance education. As well, in acknowledgement of the problems of offering science in small schools the project recommended that specially designed courses in physics and chemistry be developed and offered to small schools via some means of distance education (Recommendations 3.4 and 3.5).

Other recommendations by the project included further research into the use of technology in program delivery to small schools and the development of a Distance Education School (Recommendations 3.6 and 3.7). An alternative to distance education, for courses involving psychomotor skills (home economics and industrial arts) was the employment of itinerant teachers and mobile laboratory units (Recommendation 3.8).

However, even the *Small Schools Study Project* describes the ability of distance education to increase course offerings in small schools as a "reasonable compromise in the absence of an adequate number of teachers to teach the necessary course offerings in all schools" (p. 35).

The 1989 Task Force on Math and Science *Towards an Achieving Society: Final Report* does not endorse distance education as a means of improving provincial math and science education. The report recognizes the advantages of distance education as being able to bring courses into the smallest of schools, employ the best instructors to prepare and deliver courses, and utilize technology to enhance the quality of instruction.

The Task Force alludes to the possibility that distance education will be made to appear successful by "modifying the course to accommodate the limitations of the technology" (p. 157). A further criticism of distance education is its cost. The Task Force argues that start up and operating costs are so high that a large number of participants will be needed for the program to be cost-effective. Since the programs would only be offered to small schools when other alternatives were not available, the participation may never offset the costs. Distance education programs are seen to be of a "last resort nature" and are abandoned in preference of the development of a core program for small schools.

The 1992 Royal Commission *Our Children Our Future: Final Report* supports distance education as a means of expanding the curriculum in small schools. The Commission argues that "a well-articulated, well-developed, and well-managed distance education service can thus play a significant role in improving the educational opportunities of all students" (p. 318). A communications system which allows "concurrent interaction between teacher and student and among students" (p. 319) is recommended. Such a system is seen as being able to improve curriculum, programs, professional development and be utilized within communities as well.

To ensure the development of a high quality distance education program the Commission recommended the development of a Provincial Advisory Committee on Distance Education and Technology to advise the Department of Education on appropriate policies and strategies (Recommendation 130). As well, they recommended the establishment of a School of Distance Education and Technology to assume responsibility of delivery of distance education courses and integration of the technology (Recommendations 131 and 132).

Other recommendations include guidelines for curriculum development, to ensure the integration within the existing curriculum development process and the integration of the distance education system with other agencies, such as government departments and post-secondary institutions to prevent duplication of r`sources (Recommendations 133, 134, 135 and 136).

However, the Commission also recommends that courses offered through distance education not be limited to small rural schools. Herein lies the risk that distance education will not attempt to meet the needs of small schools, needs which differ from those of large schools.

In 1988 the Department of Education offered its first distance education course to high school students in small rural schools, Advanced Mathematics 1201. Since then other courses have been added, including French, Physics 2204 and other math courses. In the 1992/93 school year 500 students were enroled in distance education courses in 53 schools (Department of Education, 1993). Provincial participation for some courses has been increased in small schools. At present, instruction involves teleconference, telephone and facsimile.

Young (1992) states that slightly more than 50% of the province's small schools now have access to distance education. Young claims that, due to declining enrolments, without distance education course offerings will decrease. Distance education is one way to increase course offerings as well as increase the technological experience of students. As well, Young argues that distance education programs "can offer a model for lifelong learning on the part of the student since they typically promote and require a level of independence from the learner. . . . students direct their own learning" (p. 10).

Courses that could be offered through distance education include math, physics, chemistry, statistics, French, and others. Other uses/advantages of distance education as seen by Young include special programs for gifted students, specialist services, teleconference meetings, in-service for teachers, post-service instruction and professional development activities. Young concludes that the "potential impact of distance education . . . can be significant" (p. 9).

Distance education programs may, in fact, be **part of** the solution to problems facing the province's small rural schools. However, they should not be seen as the **only** solution. If used, these programs need to be developed by taking into consideration the unique strengths, weaknesses and needs of small rural schools.

Summary

This chapter has examined the literature surrounding science provision in small rural schools. A wide range of topics have been discussed including characteristics of small schools, student achievement, teacher recruitment and retainment, professional development of teachers, multi-grading, curriculum and distance education. The following chapter will outline the methodology utilized in this study.

CHAPTER 3

METHODOLOGY

Overview of the Chapter

The purpose of this chapter is to describe the methodology used in this study. The chapter includes a discussion of how the study population was defined, the development and distribution of the survey instrument and subsequent analysis of results.

Selection of Survey Methodology

The purpose of this study was to determine the current provision of science curriculum (Grade 7 to Level III) in small rural schools in the province of Newfoundland. Thus, this research would be classified as descriptive, as its aim is to determine the nature of a situation, that of the provision of science curricula in small schools, as it existed at the time of the study. The study was not directed at testing a hypothesis, but at describing "what existed" with respect to several variables.

The type of study which has been chosen to carry out this research was the survey, in the form of a questionnaire. The survey has been described as "an important and frequently used method of research . . . for education" (Ary, Jacobs & Razavieh, 1990, p. 407). Gay (1987) describes descriptive research in survey form as being able to provide valuable data. Such research is also supported by Borg and Gall (1989). A questionnaire allowed a large number of schools to be studied, including those in isolated areas of the province. Data gathered from the survey was analyzed to show the incidence of, distribution of and interrelationships between the variables studied. Variables studied included both tangibles (eg. age distribution of teachers in small rural schools) and intangibles (eg. teachers' opinions regarding STEM~Net).

In addition, some documentary analyses were carried out to determine past practices and recommendations with respect to science curriculum provision in small schools. Records obtained from the Department of Education were analyzed to determine current trends in achievement and participation in small schools. Thus information gathered from the study included both quantitative and qualitative data.

This study was primarily a school survey, described by Gay (1987) as "generally conducted for the purpose of internal or external evaluation or for assessment and projection of needs" (p. 192). The data collected will be valuable not only to the schools involved but to other school related agencies such as the NLTA, Memorial University's Faculty of Education and the provincial Department of Education. This information should result in the development of recommendations for the improvement of science education in small schools.

Defining the Population

A major problem encountered by the researcher was that of defining small rural schools. A review of the literature resulted in many different definitions of both small and rural. Fennell (1990), defines a small school as one with less than 20 students per grade. A rural school is defined as one which is part of a rural school district or located in a town or village. Harte (1990), defines a small school as one with less than 300 students in grades 9-12. Sunal (1991) defines a small school as one with fewer than 500 students in grades 7-12.

Many of the definitions for small rural schools found in the literature would include virtually all schools and communities in the province of Newfoundland and Labrador. For the purpose of this study the definitions which were used are those proposed by the Department of Education following the 1987 *Small Schools Study Project*. According to the Department of Education small schools are defined based on the enrolment and grades offered. For schools offering primary/elementary grades, if the total enrolment divided by the number of grades offered is less than 12, the school is defined as small. For an all grade, central or regional high school, the school is considered small if the total student enrolment, divided by

25, is less than the number of grades offered.

The Department of Education defines rural schools as those located in a rural area. Rural areas are defined as those communities with less than 5000 inhabitants.

Using these definitions for small schools the Department of Education was contacted and a list of all small schools in the province offering any of Grades 7 to Level III was requested, based on enrolment for the 1992-93 school year. This list included 131 schools, seven of which were native. The list identified each school by district and included a breakdown of enrolment by grade for each school. One school (Salvation Army Youth Center, Topsail) was omitted from the study as it is actually a rehabilitation center, and is not listed in the Provincial School Directory.

Of the remaining 130 small schools identified, the enrolments and grade combinations varied considerably. Enrolments varied from 6 students (Frampton Elementary, Monkstown; St. George's School, Paradise River) to 324 students (Deer Lake School, Deer Lake). Grade combinations offered in these schools included: K-12 (77 schools); K-11 (2 schools); K-10 (3 schools); K-9 (18 schools); K-8 (10 schools); K-7 (5 schools); 6-12 (1 school); 7-12 (13 schools); 10-12 (1 school). In some schools, not all grades were offered, depending upon enrolment. Thus actual grades offered vary from year to year.

For the purpose of this study it was decided that schools would be categorized based on their enrolment in grades 7 to Level III. Five enrolment categories were produced as follows: 1) 0-49; 2) 50-99; 3) 100-149; 4) 150-199; 5) 200 +. This resulted in student enrolments varying from 1 student (St. George's School, Paradise River) to 238 students (R. W. Parsons All Grade, Roberts Arm). Schools were then placed in each category according to enrolment in these grades.

Table 1

Schools Categorized by Enrolment in Grades 7 to Level III

Enrolment	Number of Schools
0-49	66
50-99	27
100-149	24
150-199	12
200 +	1

Other factors however, must be considered other than enrolment when one considers curriculum provision. One such factor is location. Not all small schools are located in rural communities (St. John's Academy, St. John's). Many of the schools identified are only accessible by ferry (Douglas Academy, LaPoile) or by small plane (Jens Haven Memorial, Nain) for example. Thus, not only do schools vary in their size, but also in the degree to which they are rural. All Saints All-Grade, a school of 53 students (23 in grades 7-12), located in Grey River, accessible only by the South Coast ferry is much more rural than say Highview Academy, a school of 43 students (17 in grades 7-12), located in Corner Brook. One would anticipate curriculum provision to be much more problematic in the more isolated areas of the province.

Once schools had been categorized based on their enrolment in Grades 7 to Level III they were identified and pinpointed on a map of Newfoundland and Labrador. As one would expect, schools with larger enrolments were generally located in larger communities and vice versa. However, this was not always the case. Due to the denominational system, several large communities contained several small schools in addition to larger schools already located in the community. For example, Marystown, in addition to other schools, contained two small schools. Crestview Academy offered grades K-9, had a total enrolment of 20 students and was operated by the Seventh Day Adventist School Board. Creston Academy offered grades K-8, had a total enrolment of 36 students and was operated by the Pentecostal Assemblies School Board. St. John's, Corner Brook and Deer Lake had similar situations.

As well, there were smaller communities throughout the province which contained several small schools which, if their enrolments were combined, would no longer be considered small.

Many of these offered the same grades and, therefore, most likely, a duplication of services. For example, in Harbour Breton there were two small schools: King Academy offered grades K-12, had a total enrolment of 282 students and was operated by the Bay D'Espoir-Hermitage-Fortune Bay Integrated School Board; St. Joseph's All Grade also offered grades K-12, had a total enrolment of 277 students and was operated by the Gander-Bonavista-Connaigre Roman Catholic School Board. In addition, there were at least twelve situations where two schools were within 10 km of each other, offering the same grades. For example St. Peter's Academy in Westport offers K-12, had a total enrolment of 133 students and was operated by the Green Bay Integrated School Board. Five kilometers down the road is St. George's Elementary in Purbeck's Cove which offered K-9, had a total enrolment of 9 students and was operated by the same school board.

Another problem found by the researcher was that in several cases, schools listed as small schools were actually joint service schools operated by both the Integrated and Roman Catholic school boards. In some cases both boards reported the school as being small, in other cases only one board listed the school as small. For example, in Deer Lake, Elwood Regional High was listed as small under the Humber-St. Barbe Roman Catholic School Board, with an enrolment of 63 students in Levels I-III. In actual fact, Elwood Regional

High is a joint service school with a total enrolment of 380 students in Levels I-III . . . certainly not a small school. J. R. Smallwood Collegiate in Wabush was listed with the Labrador West Integrated School Board as having an enrolment of 284 students in grades K-12. It was also listed with the Labrador Roman Catholic School Board as having 193 students in grades K-12. Combined enrolment was 477 students in grades K-12, which does not fit the provincial definition of a small, all grade school.

When contacted, the Department of Education admitted that there are several such cases and that they were aware of such discrepancies. However, each school board submits their own enrolment per school. As such, some joint service schools which, based on total enrolment, are not small schools, may be reported once, or twice, as being a small school, based on enrolments reported by each school board. This may not seem to be a problem until one considers the fact that school boards in the province receive extra teacher allocations based on the total number of students enroled in small schools. The irony is that the extra teachers allocated by the province may be placed at the school boards' discretion, thus they may not even be placed within a small school. The researcher was advised that the Department of Education was, in fact, revising its allocation policy because of these discrepancies.

In the list of small schools received from the Department of Education, five schools were listed twice. These included: Avoca Collegiate, Badger; Buchans High, Buchans; Cottrell's Cove Academy, Cottrell's Cove; Lakewood Academy, Glenwood; and J. R. Smallwood Collegiate, Wabush. To prevent duplication of data these schools were only sent one survey each.

It was decided by the researcher that all schools offering Grades 7 to Level III, identified by the Department of Education as being small would be included in the study. Thus a total of 125 schools were included. These 125 schools belong to 23 of the 27 provincial school boards. A list of these school boards is included in Appendix A. The schools listed by school board are listed in Appendix B. Appendix C contains a detailed breakdown of the schools, including community, grades offered, total enrolment and enrolment in Grades 7 to Level III.

Development of Survey Instrument

A literature review, discussion with colleagues and the researcher's own knowledge provided a variety of issues to be investigated concerning the provision of science curriculum in small rural schools. It was decided that two questionnaires would be developed, one for the principal and one for the science teacher in each of the 125 schools included in the study. Information such as hiring practices and planned course offerings was most likely known by the principal more so than the school science teacher. On the other hand, information such as teaching strategies and teaching resources would be more accurate if it were to come directly from the teachers involved. It was assumed that most small schools would only have one science teacher per se, however, it was feasible that some of the larger small schools may have had more than one teacher assigned to teach science courses.

Literature regarding survey questionnaires was examined to guide the statement and organization of questions, and the distribution of the questionnaires (Ary et al., 1990; Gay, 1987; Borg & Gall, 1989).

An attempt was made to ask as many questions as possible in a closed format. However, the researcher felt that some issues were best dealt with in open-ended questions which would allow the respondents to state their opinions or further explain an answer.

Question formats included open and closed questions. Styles of closed questions included rank order, rating, Likert style and checklists. Every attempt was made to ensure that all possible answers were included in the choices and where appropriate the choice "other-please specify" was included.

Questions were grouped together according to topic/issue and placed in a logical order from general to specific. Questions of a biographical nature were placed at the end of both questionnaires.

Field Testing

Once completed, the questionnaires were passed on to several groups of people for examination and pre-testing. Initially, an expert in questionnaire techniques examined the questionnaires and gave feedback on layout and question format. He suggested an initial coding scheme and that several questions be changed from an open to a closed format. At the same time a science teacher, a faculty of science education professor and a faculty of science education lab instructor were given the questionnaires and asked to evaluate them with respect to content. Suggestions were made as to other questions to include and alternate choices for answers.

The questionnaires were revised and then given to a group of principals and teachers from small schools who were registered at the university. A copy of each was also given to the Nova Consolidated School Board Science Coordinator. The teachers and principals gave advice concerning wording and ambiguity of questions and also suggested some possible choices for answers. The coordinator also gave advice regarding questions which were ambiguous. He also stated that there were several questions regarding the teaching of distance education courses which were not relevant, as the courses were not being transmitted out of small schools. This information was confirmed by the Department of Education and, as a result, those questions were omitted from the questionnaires.

The questionnaires were then passed on to a statistical analyst who examined them for ease of coding, phrasing and layout. He made several suggestions as to coding of answers and layout.

All persons commented on the length of the teacher questionnaire and the number of open ended questions. However, as stated earlier, it was felt that these open ended questions would provide valuable insights regarding the provision of science curriculum in small rural schools. With respect to length, a number of questions concerning science fairs were subsequently omitted, as science fairs are not directly related to curriculum provision.

Final Form

The end result was a principal questionnaire consisting of 41 items and a teacher questionnaire consisting of 69 items. Although the length was still a concern for the researcher, all items were deemed relevant and necessary to elicit the information needed to provide a complete picture of science curriculum as it existed in small rural schools in Newfoundland and Labrador.

Distribution

The questionnaires were then printed by the NLTA and mailed to each of the 125 schools. To improve the return rate, a cover letter was included which stated the purpose of the research, requested their cooperation and thanked the respondents for their anticipated cooperation (Appendix I). A consent form was also sent to each participant to inform them that: their participation was voluntary; their identity would be protected; the research was sponsored by Memorial's Faculty of Education; and that the results would be made available at their request (Appendix J). To facilitate follow up each return envelope was coded with a number so as to identify the school from which it was sent. Each school was sent a package containing a cover letter, four copies of the consent form, a principal questionnaire, a teacher questionnaire and two self-addressed, pre-stamped return envelopes. The questionnaires were mailed out by the NLTA on Monday, November 14, 1993. The first reply was received on Friday, November 19, 1993.

Prompts

Two weeks following the mailing of the questionnaires, schools which had not yet replied were contacted by phone. A message was left with either the school secretary, principal or teacher urging them to respond. Several schools contacted in Northern Labrador had not yet received the questionnaire.

Numbers and Perceptions

By early January the last of the questionnaires had been returned. It was learned through the responses that St. Peter's All-Grade in River of Ponds had amalgamated with Ingornachoix Bay Elementary in Hawke's Bay, St. Boniface All-Grade in Ramea had burnt down and the following schools no longer offered the grades being studied: St. Francis Elementary, Parson's Pond; St. J. Fisher and T. More School, Petite Forte; Cassidy Memorial, St. Fintan's.

There may have been other schools which were no longer operating or which no longer offered the grades which were being studied. Taking the above information into account the population size had been reduced to 120 schools.

A total of 56 teacher questionnaires (47%) and 78 principal questionnaires (65%) were returned. In all, a total of 84 schools (70%) responded. Of the schools which responded 50 of the 84 schools returned both teacher and principal questionnaires, 28 schools returned principal questionnaires only and 6 schools returned teacher questionnaires only.

There were several instances in which the school principal was also the school science teacher. As all respondents did not sign their name, it was difficult for the researcher to know exactly how many such cases exist.

Three of the respondents requested a copy of the research results. Many respondents indicated that such research was long overdue and that they felt total frustration with the lack of resources with which they had to work.

Analysis and Interpretation

Data from the questionnaires was coded and initially organized using Lotus 1-2-3. Once initial compilation was completed and basic frequency, means and ranges of variables were computed, the data was transferred to an SPSSX file for further statistical analysis.

Document Analysis for Supplementary Information

Three main provincial documents were examined to determine past recommendations with respect to the provision of science curriculum in small rural schools in the province. These documents included the 1987 *Small Schools Study Project*, the 1989 Math Science Task Force Report *Towards an Achieving Society* and the 1992 Royal Commission on Education *Our Children Our Future*.

Summary

This chapter has described the methodology used in the study. The selection of the study population has been described as well as how the survey instrument was developed and distributed. The method by which results were analyzed was also discussed. The following chapter includes a detailed discussion of the survey results.

CHAPTER 4

DATA ANALYSIS

Overview of the Chapter

The purpose of this chapter is to present the findings of the surveys distributed to principals and teachers in small rural schools. The focus is on the provision of science in grades 7-12 within the province of Newfoundland and Labrador. The chapter begins with an analysis of the principal surveys, followed by an analysis of the teacher surveys. General comments concerning the provision of science, made by both principals and teachers, are also included.

Principal Survey Results

General Information

Of the 125 schools surveyed, five schools had ceased to offer grades 7-12, as they had amalgamated with others, or no longer existed. Thus, of a possible 120 principal responses, 78 (65%) were returned.

Of the 78 schools which responded the majority offered grades K-12 (47 (60.3%)) or grades K-9 (13 (16.7%)). Other frequent grade combinations included K-8 and 7-12. Table 2 shows the grade combinations of schools which responded.

Student populations ranged from 3 students to 480, with 50% of responding schools having a population of less than 101 students. Slightly more than 20% of the responding schools had a student population of more than 200, and 6.4% of these had a population of greater than 300. Thirty-two percent of schools had fewer than 25 students in grade 7-12, 48% had fewer than 50 students and 71% fewer than 100 students.

Table 2

Grade Combinations of Schools

Grade Combinations	# of Schools	% of Schools
K-12	47	60.3
K-11	2	2.6
K-10	1	1.3
K-9	13	16.7
K-8	5	6.4
K-7	1	1.3
7-12	7	9.0
8-12	1	1.3
10-12	1	1.3

No school had more than 29 teachers on staff. Twenty-three percent of schools had 1-5 teachers, 35% had 6-10 teachers and 30% had 11-20 teachers. More than 50% of the schools had less than 10 teachers.

Of the responding schools, 43 (55%) had a guidance counsellor on staff or shared one with another school. Sixty-one schools (78%) had one or more teachers for special needs students.

Courses Offered

Junior High

The junior high science program consists of a general science course offered in each of the three grades. The old program *Searching for Structure* is presently being replaced by a new program, which offers schools a choice of one of two textbooks, *Science Plus* or *Science Directions*. The new program is being implemented in grade 7 in the 1994-95 school year and will be implemented in grade 8 in September, 1995 and in grade 9 in September, 1996.

Not all junior high grades were offered in all schools. Of the 78 schools which responded, 76 offered grade 7, 76 offered grade 8 and 71 offered grade 9. The corresponding science courses for each of these grades was not necessarily offered in each of these schools, due to the fact that several schools are operating on a multi-grade basis. That is, they may offer grade 7 science to a class of grade 7 and 8 students this year, with the intent to offer grade 8 science the following year. Thus, although grade 7 is offered in 76 of the schools which responded, only 65 of these schools are offering grade 7 science to their students.

With respect to junior high sciences there was a great variation in the number of minutes of instruction per five day week. Instructional time for grade 7 science, offered in 65 of 76 schools (85.5%), varied from 100 min/5 day week to 240 min/5 day week. Nineteen of the schools delivered 200 minutes of instruction which would indicate 40 minutes of instruction per day.

Much the same can be said for grade 8 science offered in 72 of 76 schools (94.7%). Again, instructional time varied from 100 to 240 min/5 day week, with 22 schools delivering 200 min/5 day week.

Grade 9 science was offered in 68 of 71 schools (95.8%). Instructional time per five day week varied from 45 to 225 minutes, with 21 schools delivering 200 min/5 day week.

An examination of those schools offering the junior high sciences in 93/94 and 94/95 would indicate that many schools alternate their offerings. That is, they offer grade 7 science one year and grade 8 the next. Due to the fact that many principals did not indicate which science courses would be offered in 94/95, one cannot determine the percentage of small schools which operate in this manner.

Senior High

The senior high science program consists of over 20 science courses in the following subject areas: chemistry, biology, physics, geology, environmental science, general science, physical science, science and technology, and computer science.

Of the 78 schools which responded, 59 schools offer senior high grades. Two of these only offer up to grade 11 and one offers up to grade 10 only. The number and types of science courses offered at the senior high level vary considerably (see Table 3), as did the amount of instructional time devoted to each course.

Instructional time for senior high science courses, which are designated as two credit courses, varied from 100 to 270 min/5 day week . . . a significant variation. The recommended instructional time is an average of 40 min/day. For most courses the average number of minutes of instructional time per five day week was 200 minutes.

For those courses designated as one credit courses (eg. computer applications), instructional time per five day week varied from 90 to 264 minutes, with most schools delivering the recommended 100 minutes of instruction.

Table 3

Senior High Science Course Offerings

Science Course	93/94	94/95	% Schools 93/94
General Science 1200	16	11	27.1
Physical Science 2205	24	16	40.7
Environmental Science 3205	29	24	49.2
Biology 2201/2211	34	32	57.6
Biology 3201/3211	35	27	59.3
Earth Science 2203	10	11	16.9
Geology 3202	5	3	8.5
Chemistry 2202	24	15	40.6
Chemistry 3202	14	15	23.7
Physics 2204	36	28	61.0
Physics 3204/3214	37	27	62.3

Table 3 (cont)

Senior High Science Course Offerings

Science Course	93/94	94/95	% Schools 93/94
Microcomputer Systems 1100	49	36	83.1
Computer App. 2100	24	19	40.6
Keyboard./Word Proc. 1101	51	33	86.4
Adv. Word Proc. 2101	21	27	35.6
Computer Technology 3200	6	10	10.2

With respect to the amount of instructional time schools spend delivering the various courses which they offer, one principal stated the following:

> "If time requirements in JHS were designed to fit with the SHS requirements (or vice versa) this would greatly simplify scheduling, assignment of teachers, fair distribution of teaching loads, etc."

As with the junior high science courses, it would appear that a number of schools alternate their course offerings from year-to-year. For example, a school may offer Biology 2201 in one year and Biology 3201 the following year.

Many principals (28 or 47.5%) indicated that there were science courses which their school would like to offer, but could not, due to a lack of facilities. Courses included chemistry (26 or 44.1%); physics (7 or 11.9%); biology (3 or 5.1%) and computer courses (2 or 3.4%). Other courses included geology, environmental science and advanced placement courses (1 or 1.7% each).

The lack of necessary facilities which would permit schools to offer a science course such as chemistry, prompted many comments by principals. Surprisingly, many principals referred to the fact that their school did not have a proper science lab.

> "No lab. Science is taught in the classroom 3 grades at one time. I cannot do justice to any science program without necessary materials."

> "I feel my students get short changed in Science particularly. I just cannot provide the materials necessary for hands-on instruction. I don't have a lab - not even a portable lab. I have only 2 microscopes, one balance, etc. It is impossible to deliver a 'good' program without the necessary resources."

> "Due to the small enrolment at our school (8

students) we do not have a lab and our science supplies and activities are somewhat limited."

"I feel the grade 7 and 8 *Searching for Structure* science program is a very poor program. It is too activity oriented. This puts small schools with no labs at a big disadvantage."

The junior high science program is currently being changed, with the new grade 7 program being implemented in the 94-95 school year. However, any school without a lab will still be at a disadvantage as science should be primarily a hands-on, activity-oriented subject, regardless of the program being offered.

Two principals offered the following advice with respect to school planning:

"Personnel responsible in planning the blueprints for schools, regardless of their size, should provide for ample laboratory space and special rooms for storing science materials."

"Schools should be assessed on a province wide scale identifying needs for the delivery of science programs. That is lab facilities, science materials, science teachers are in place."

Other principals commented on the general lack of materials and the poor quality of their science facilities:

> "Our school has been open for 15 years, but our propane in our lab is not yet connected."
>
> "Even though we are offering several of the lab sciences our facilities are desperately lacking."
>
> "A much better lab facility desperately needed."
>
> "Although we offer a wide range of science courses over a three year period we would like to have lab facilities, equipment improved."
>
> "It is unfortunate that the smaller schools in our province are not as well equipped as they should be. Thus restricting the courses offered."
>
> "All too often teachers are hesitant to teach science courses but the situation is compounded by the fact that there is little materials and equipment to do the necessary experiments. The argument is made that much of it can be collected locally -- however, try it if you teach full time and are responsible for all subjects in 2 or more grades."

"I feel that teachers should be commended for taking responsibility to teach new courses - but we desperately need support for these teachers."

The principal of one of the provinces native schools offered this interesting comment regarding science provision in their school:

"Students in our school learn English as a second language. Our greatest problem in science is that the textbooks are designed for English-speaking children. Our students are introduced to English in Grade 4. We have a great challenge in trying to find suitable material for them."

Many principals (26 or 44.1%) indicated that they could not offer some courses due to a lack of qualified staff. These courses included chemistry (22 or 37.3%); physics (8 or 13.6%); computer courses (4 or 6.8%) and biology (3 or 5.1%). Other courses included general science, environmental science and advanced placement courses.

Several principals commented on the fact that the quality of course offerings often depended on the availability of qualified staff:

"Our teachers involved in the lab sciences are not really qualified in those areas ie. physics, chemistry."

"During my experience I feel that there is a problem with general teachers teaching science. This is demonstrated mostly in primary, elementary, and junior high. Students miss out on a lot when taught science by a generalist teacher. Students must be turned on to science, not turned off."

One principal suggested how the quality of science teachers might be improved:

"Memorial University should provide more science methods courses in education (no less than 5 courses) to qualify for an education degree. The programme should also involve more time in observation in primary and elementary science classes."

One principal commented on the frustration experienced when trying to implement new science courses, due to a lack of available in-servicing:

"At the junior and senior levels we have increased the number of science courses offered, but teachers are frustrated by the lack of in-service for these courses. This is especially true for the computer courses."

As well, many principals (34 or 57.6%) indicated that there were science courses their school could not offer due to an insufficient number of staff. Such courses include chemistry (21 or 35.6%); physics (12 or 20.3%); geology (7 or 11.9%); biology (6 or 10.2%); computer courses (5 or 8.5%), general science (4 or 6.8%) and advanced placement courses (1 or 1.7%). Two principals indicated that a larger number of staff would allow them to discontinue the practice of rotating courses from year to year.

Problems associated with teacher allocation resulted in comments from principals regarding their inability to increase the number/range of science course offerings:

> "At present we teach General Science 7-9, and Biology to Levels I, II and III. That's the extent of our sciences. Physics, Earth Science, Chemistry, etc. are out of our reach."

> "We can do more Science BUT we would have to do LESS of other things."

> "At present we can only offer one high school science course per year, and students have no choice as to what they take. I would like to offer an STS course, as well as Biology, Chemistry or Physics."

> "Our teachers are sacrificing preparation time in order to offer the number of science courses we

do."

"Lack of funding and qualified personnel (teacher allocation) are the two factors which most limit adequate provision of Science programs in the school."

"Not enough teachers allocated to staff to offer desired science courses."

"The basic problem we have is teacher allocation. Without more staff members (and this is unlikely) science will continue to be a difficult course to teach at this school."

Thus, it appears that many schools would like to offer more of the academic science courses, such as chemistry, physics, biology and computer courses, but are unable to do so due to a lack of proper lab facilities, qualified staff or an insufficient number of staff.

A rank order question on factors determining the offering of science courses could not be interpreted as intended, as many principals failed to rank the factors, but rated them instead. A total of 54 principals answered the question by ranking the factors as was intended. Responses from principals who did not answer the question as was intended were omitted. As such, each factor will be described by indicating how it was ranked (1 being most important; 7 being least important).

The following numbers and percentages of principals (out of 54) ranked the stated factors between 1 and 3: qualified teachers: 43 (79.6%); lab facilities: 31 (57.4%); prerequisite for post-secondary institutions: 29 (53.7%); teacher allocation: 24 (44.4%); student ability: 19 (35.2%); student choice: 15 (27.8%).

Thus, it appears that the availability of qualified teachers and lab facilities are important factors in determining whether or not certain science courses are offered in small rural schools.

A small number of principals referred to the sharing of facilities and staff between schools, as one way of improving their school's science program:

> "Because of the high cost of technology and the rapid advances in technology high schools have to be combined where it is possible (7-Level III) - class size, equipment, academic challenges, staffing."

> "Note that our school also serves 170 Roman Catholic students and staff. Through shared facilities and staff we are able to offer a greater

variety 'together' than either of us could separately."

Not all of the comments made by principals regarding the extent of their school's science program were negative. Several principals commented on the increases in science programming which had occurred within their school, through school and often school board initiatives:

"Our school has had a fairly significant increase in the number of students taking Biology, Physics and Chemistry. I feel I have been a major factor in that increase since taking on the principalship of this school, ie. emphasizing the importance of Science courses and the changing workplace and society."

"Our board has a Modern Technology Budget through Native Funding. (Our school is one of four schools on the Labrador Coast designated as a native school.) We have used this fund to equip our school with computers, primary, elementary and senior science materials. We participate in Science Fairs and have devoted this year to emphasize science/math in the school. The board has been very supportive of this school."

"Over the past few years we are making a more conscious effort to offer as much science as we can. Science Fairs are heavily promoted. A high percentage of school funds are directed to this area of the curriculum."

Distance Education

Thirty-seven of the 59 schools offering senior high courses (62.3%) offer distance education courses. Of these, 25 schools (44%) are offering science courses through distance education. Physics 2204 is being offered in 16 schools (27.1%) and Physics 3204 in 15 schools (25.4%). A total of 76 students are enroled in Physics 2204, while over 48 students are enroled in Physics 3204 (one school did not enter the number of students).

Principals were asked if students were required to meet any prerequisites before being permitted to do distance education courses. High academic ability was indicated by 32 principals, while 31 principals indicated that students should be independent learners. Other prerequisites indicated by principals included students being self-motivated, mature, able to work in a group, committed to the time required and disciplined (with respect to self-control, behaviour and listening skills). One principal indicated that the only prerequisite was that the student had chosen to do the course, while another indicated that whether or not the course would fit into the student's schedule/timetable was a prerequisite.

Students were counselled about distance education learning prior to instruction in 36 of the schools, with student progress being monitored throughout the year in 37 schools. In 35 schools teachers were assigned to monitor student progress, yet only five of these teachers were assigned time daily in which to carry out these duties.

Several principals commented on how the task of monitoring student progress was handled in their individual school:

> "As principal, I have accepted the role of distance education advisor - or contact person between teachers, parents and students."

> "It's made part of our extra-curricular workload."

> "Another problem is supervising the students. We don't have extra teaching units freed up to handle this. Also the extra work placed on a teacher handling distance education is unfair (photocopying, giving tests, corresponding with distance education center, faxing material, etc.)."

With respect to problems schools were experiencing with distance education, timetable problems appear to be the biggest problem, as indicated by 20 principals. Other problems experienced by schools include bussing, monitoring of students, space for allocation of distance education students and the extra time and work required by teachers in ensuring the program runs smoothly.

Quite a number of comments were expressed by principals with respect to the types of problems they experienced with distance education. Many comments were regarding problems with timetabling, especially from schools in Labrador, due to the time difference:

> "Some timetabling - scheduling [problems] because of the one half hour time difference [between the] Island and Labrador."

> "In Northern Labrador, we run by Atlantic time, therefore classes begin at 8:30 and end 9:10. Our students work out of the computer room and therefore use up the first 10 minutes of any class regularly scheduled for this room (classes begin at 9:00). This also makes the day for those involved 1/2 hour longer. It also forces us to put our math classes for other students in the same slots."

> "Distance education does restrict us with regard to timetabling. Distance education courses must be

offered in certain periods. This year we had to shorten our recess break from 20 minutes to 15 minutes to accommodate distance education."

"There are a lot of problems. Timetabling is a major problem. Kids have to miss other classes in order to be on line for distance education."

"It is very difficult to fit distance education courses into our timetable. This year French 3200 classes are during our lunch hour and Physics 3204 classes overlap two of our periods."

"Testing has sometimes run late (bussing). Some testing must be supervised and there may not be a teacher free in the timetable. We would like to go on a 14 day schedule with 5 classes a day as opposed to a 6 day schedule with 7 classes a day but distance education operates on 7 classes a day."

"Bus scheduling. Our students have to travel with the elementary students and have 40 minutes added to their day to do the Physics 3204."
Students were also reported to be encountering problems

with the distance education program. The problem reported most often by principals (11) was that students were having difficulty with the concept of independent study. Linked to this problem were reports that students had difficulty handling the workload required of them and had problems grasping more difficult concepts. Difficulty with completing laboratory work was reported by five principals while four principals reported technical problems. Other problems included lack of study space, students missing parts of other classes due to timetable clashes and discipline problems within distance education classes.

Comments made by principals regarding student difficulties with distance education include the following:

> "Working independently has been the greatest problem. With a teacher assigned to students at all classes, much more would be accomplished, and more students would take advantage of this learning tool."

> "They [students] sometimes get frustrated when they are working on something (ie. lab) and don't know how to proceed and the instructor is not readily available to offer assistance."

> "The reduction in instructional minutes is a

problem for most students. Also, students must be able to discipline themselves to work when they are not on line."

"Biggest problem is the technology. This could be much better. Videotape labs, interactive T.V., better audio."

"Lack of space is a problem - presently students are using staff room and the staff have moved into the kitchen where STEM~Net will soon be set up. Schools were not designed for these, and there aren't any funds to make the necessary renovations."

Principals indicated that besides obtaining a valuable course, distance education increased the independent learning skills of students (31 schools), provided students with broader course offerings (26 schools), and increased students' knowledge of technology (24 schools). Other principals indicated that distance education increased students' self-esteem and self-confidence, better prepared students for post-secondary institutions and gave students a break from the two or three teachers who taught them all of their other courses.

Schools also benefitted from offering distance education by receiving various pieces of equipment and services previously not available to them. Such benefits included provision of teleconferencing sites (34 schools), FAX machine services (32 schools), and availability of continuing education courses (27 schools). Other principals indicated that offering distance education courses provided them with STEM~Net access, equipment which could be used in other courses, technology (computers) for lab work, and provided their school with a subject area for which they no longer had to provide a teacher.

Several principals commented on how distance education had enabled them to enhance their school's science program, thus benefitting both the students and the school:

> "This technology has allowed us to more than double the number of math/science course offerings in our school with such a limited staff."

> "I feel that distance education is very important to our school and without it, this school and the students would suffer greatly. Many of the students would have to move away to larger centers to do their sciences, or come back to school for an extra year. I feel that distance education is the future for small schools."

> "I might add distance education is a valuable part

of your curriculum and gives our students [a chance] to complete courses they would not otherwise."

As stated previously, 37 schools offering senior high grades were receiving distance education courses. In addition, 22 principals of schools not presently receiving distance education courses indicated that they would like to be able to offer distance education in the future. However, for some schools distance education may be too late arriving as evidenced in the following comment from one principal:

"Yes - If our school survives. It likely will not."

Two schools indicated that they would not be interested in offering distance education courses in the future. Both schools were relatively large with 96 and 140 students in grades 7-12. One principal, whose school no longer offered distance education, made the following comment:

"Students do not take it serious enough to follow along on their own and do the assignments. One class a week is not enough for most students."

Thus, the last comment not withstanding, it would appear that most schools offering senior high grades either receive distance education courses or would like to in the future.

Principals were also asked about STEM~Net. Of the 78 principals that responded, 70 (89.7%) indicated that they had heard of STEM~Net. Of these 70, 65 (83.3%) indicated that they felt STEM~Net would serve as an important link/resource for teachers in small schools.

School Budget

All principals were questioned regarding their school's budget. A small number of principals (13 or 16.7%) indicated that their school qualified for extra funding due to low student enrolment, and two schools qualified for extra funding because they were native. Most schools (55 or 70.5%) said they did not qualify for extra funding and eight principals did not respond to the question.

One principal made the following comment in response to being asked if his school qualified for extra funding because of low student enrolment:

"If we do it has not been clearly defined to me."

Schools receiving extra funding were asked how much money they received per student. Amounts ranged from $5 per student (one school) to $300 per student (one school) with only 8 of the 15 schools responding. Most principals were not aware of how much extra funding they were receiving.

Several principals commented on the extra funding for which their school qualified:

"We qualify, - but receiving is something else."

"Yes. But it is not sufficient."

In addition to the general school budget, principals were asked how much money their school spent last year to purchase science equipment. Twelve principals did not respond. Amounts indicated by the other principals varied from $50 to $10,000. Ten schools indicated that they had spent $500 on science supplies, while six schools spent $2,000. Of the 66 schools which responded the average amount of money spent on science supplies was $1,040. Many principals indicated that the amount spent in 92/93 had been greater than in other years due to the fact that computer equipment had been purchased as well.

When asked if their school's budget was large enough to allow them to offer a complete science program, principals' responses were generally negative. Comments included the following:

"Absolutely not."

"Far from it - we can't even order the necessities."

"Definitely not."

Most principals (59 or 75.6%) indicated that their school budget was inadequate. As a result, they could not afford to offer a complete science program.

Many principals commented on their inability to offer a complete science program or purchase needed science equipment as a result of their low school budgets:

> "I would love to emphasize the science aspect of the curriculum, but until funds are made available, this is impossible."
>
> "Government should provide more financial allocations for science grants."
>
> "Much more funding required to purchase science equipment."
>
> "More money needed for lab and supplies."
>
> "There has been quite a push from our board to improve our math/science [program]; however it seems that they expect us to do this on a very tight budget."

One principal of a K-9 school with 15 students indicated that the total budget for the school was only $1100, which had to cover the purchase of all supplies. Obviously, few science materials and very little equipment could be purchased from such a small budget.

Principals indicated a variety of means by which they obtained equipment which their school could not afford to purchase out of their regular school budget. Many principals (45 schools) indicated that sometimes the equipment was purchased by the school board or that students fund-raised (39 schools). Less frequent means of purchasing equipment was through parents/PTA's fund-raising (27 schools), and through Local Education Committees (LEC's) (3 schools). Other means of purchasing needed equipment included money being taken from the general supply fund (which meant going without something else), use of school canteen funds, requesting student fees (with no obligation for students to pay), use of school rental monies, teachers fund-raising, church funding and native funding. Often, needed equipment is simply not purchased, as was indicated by 32 schools.

A comment made by one principal sums up the means by which many schools obtain their equipment:

> "Quite often we simply make do with what we have. Most items (if expensive) we have to do without. Some items are purchased through fund-raising - a minimal amount comes from central office."

Teacher Hiring

A rank order question of factors considered when hiring a new science teacher could not be interpreted as intended, as many principals failed to rank the factors, but rated them instead. A total of 48 principals answered the question by ranking the factors as was intended. Responses from principals who did not respond as intended were omitted. As such, each factor will be described by indicating how it was ranked (1 being most important, 9 being least important).

The following numbers and percentages of principals (out of 48) ranked the stated factors between 1 and 4: possess B. Sc./B. Ed.: 42 (87.5%); teaching experience: 39 (81.3%); small school experience: 29 (60.4%); multi-grade teaching experience: 28 (58.3%); ability to teach a wide variety of courses: 21 (43.8%); possess a M. Sc./B. Ed.: 17 (35.4%); willing to participate in extra-curricular activities: 9 (18.8%); known through substituting: 5 (10.4%). Other factors which principals consider include whether or not the individual is computer literate and a willingness of the individual to work hard with students in a caring and motivating manner.

Thus, it would seem that principals are looking for individuals who have some experience in small schools, in multi-grade situations, and are generalists rather than specialists.

Personal Data

Of the principals who responded 71 (91.0%) were male while only 7 (9.0%) were female. Ages ranged from 23 years to

53 years old with more than half of the principals (40 or 51.3%) being younger than 40 years old. Number of years teaching experience ranged from 2 years to 37 years, with 12 principals (15.4%) having less than 10 years of teaching experience.

General Comments

A number of principals made general comments regarding the overall survey which the researcher felt should be stated here as they reflect the general frustration and sense of isolation and neglect felt by small schools in general.

> "Most of this survey was geared to the high school. I wish the lower grades could be more adequately addressed."

> "I've taught science in this school for the last 10 years. I do not have any science background. I wonder how many other schools are like ours. Teachers are over-worked and are required to teach too many courses in small schools.
>
> For example: I teach 42 classes in a six day cycle, preparation classes are non-existent and to top it all I am principal with no administration time. Tell that to Clyde and many of his

colleagues and they claim that teachers are crazy to say such things. Cut down on one fishing/ hunting trip or a couple of drinks for a buddy and enough money would be saved to allow a principal 40 minutes per week for administration. Give me 2 or 3 a day and I can run Confederation Building."

"You have covered most of my concerns. Put it this way; if they were adhered to I would be quite satisfied. It's a good questionnaire, although probably one that government will again neglect to act on. Make your feedback known!!"

Teacher Survey Results

General Information

As discussed earlier, the population sample of 125 schools had been reduced to 120 due to the closure/ amalgamation of schools. Of a possible 120 teacher responses, 56 responses (46.7%) were received.

Educational Background

Teachers were asked about their educational background in terms of degrees held, science education and post-graduate studies. Two teachers (3.6%) held no university degrees. None of the respondents held a B. Ed. (Primary). Eight teachers (14.3%) held a B. Ed. (Elementary). Forty-two teachers (75.0%) held a B. Ed. (High School). Nineteen respondents (33.9%) held a B. A., with majors in English (5 or 8.9%) and history (4 or 7.1%) being most common. Other majors included geography, psychology, archaeology, religion and economics. Thirty-four teachers (60.7%) held a B. Sc., with majors in math (8 or 14.3%), biology (8 or 14.3%) and geology (5 or 8.9%) being most common. Other majors included chemistry, geophysics, geography, biochemistry, psychology and physical education. None of the respondents held a major in physics. One teacher held a M. Ed. in Administration, while several were currently working towards a M. Ed.. One teacher held a M. A., while none of the respondents held a M. Sc.. Four teachers (7.1%) held a B. PE. and one teacher held a degree in Industrial Arts.

The number of science education courses completed by science teachers was also examined. Seventeen teachers (30.4%) indicated that they had not completed any science education courses. Other science education courses completed by science teachers are as follows: Ed 2182 An Introduction to the Teaching of Science in the Primary and Elementary Grades: 7 (12.5%); Ed 3170 Foundations of Science Education: 22 (39.3%); Ed 3171 An Introduction to the Teaching of Science: 22 (39.3%); Ed 3275 Science in the Elementary Grades: 4 (7.1%); Ed 3276 The Teaching of Science in the Junior High: 4

(7.1%); Ed 3277 The Teaching of Environmental Science: 3 (5.4%); Ed 4168 The Teaching of Computer Science in the Secondary School: 1 (1.8%); Ed 4170 The Teaching of Physics in the Secondary School: 8 (14.3%); Ed 4171 The Teaching of Chemistry in the Secondary School: 11 (19.6%); Ed 4172 Advanced Science Education Methodology: 1 (1.8%); Ed 4270 The Teaching of Biology in the Secondary School: 14 (25.0%); Ed 4271 The Teaching of Earth Science in the Secondary School: 9 (16.1%). Other methods courses completed included Science 115A and 115B indicated by two teachers, Teaching Science in High School (completed in the early 70's by one teacher) and graduate courses Ed 6700/6701 (completed by one teacher).

Thus, with respect to high school methods courses the areas in which most science teachers have training are biology, chemistry, earth science and physics.

Table 4 indicates the specific subject areas and numbers of university science courses which science teachers have completed.

Examination of Table 4 shows that of the three major subject areas of science (biology, chemistry and physics) more teachers seem to have completed at least some courses in physics and biology, with fewer teachers having completed chemistry courses. A large number of teachers (35 or 62.5%) have not completed any computer science courses, which is discouraging considering the recent advances in computer technology and the role computers are playing in science education. Almost all teachers (50 or 89.3%) have completed some university math courses.

Table 4

Science Courses Completed by Teachers

Subject Area	Number of Courses Completed				
	0	<5	6-10	11-15	>15
Biology	21	14	8	8	5
Chemistry	26	21	5	2	2
Physics	17	31	6	2	0
Geology	35	15	1	0	5
Computer Science	31	24	1	0	0
Psychology	12	26	13	3	2
Biochemistry	40	13	1	2	0
Math	6	34	7	2	7

Twenty-six teachers indicated that they had completed university courses/institutes in the past five years or since graduation. Of these, 8 teachers had graduated within the past five years, thus only 18 teachers (30.5%) have actually upgraded in the past several years. Of these 18 teachers, 5 were working towards completing a M. Ed., and two had completed a physics institute. Other areas of upgrading included course work in biology, chemistry, math, psychology and education, institutes in computer science, and course work in subject areas not related to science such as history, industrial arts, and geography. Six teachers had done some of their upgrading through distance education via teleconferencing.

Pre-Service Training for Small Schools

Teachers were questioned about their pre-service training in terms of how it prepared them for their role as a science teacher in a small rural school.

Only seven teachers (12.5%) indicated that they had completed courses which prepared them directly or indirectly for teaching in a small rural school. These teachers indicated that courses at MUN which had helped to prepare them included the following: Ed 3171 An Introduction to the Teaching of Science; Ed 3275 Science in the Elementary Grades; Ed 4171 The Teaching of Chemistry in the Secondary School; Ed 4270 The Teaching of Biology in the Secondary School; Ed 4271 The Teaching of Earth Science in the Secondary School and Science 115A/B.

Ways in which teachers had been prepared included: emphasis on laboratory and practical work in the classroom;

examples of activities which could be adapted to small groups; teaching methodologies which could be used in small schools; and how to deal with the lack of resources often encountered in small schools (eg. alternate equipment and activities).

The ways in which they were prepared are reflected in the following comments:

> "Education 4171 - We were made aware of simpler lab preparations using cheaper equipment, that were part of the chemistry program."

> "In Education 3171, some topics dealt with the specific problems of applying methodology in small schools. eg. problems with lack of materials, remote areas, etc. (such as computers)."

Teachers offered a variety of suggestions as to how MUN could better prepare future teachers for their role as science teachers in small rural schools. One teacher made the following comment, suggesting that MUN prepares the majority of teachers, ie. those that teach in large schools:

> "Courses are designed for larger schools that have more equipment. Most people will go on to work in larger schools. As a result an institution like MUN would not be able to prepare somebody for something that they believe they will not need."

Suggestions to improve pre-service training included the following: instruction on how to teach in multi-grade classrooms/small schools (18 teachers or 32.1%); strategies for dealing with the lack of resources including substitute materials/equipment (11 teachers or 19.6%); completion of an internship in a small rural school (7 teachers or 12.5%); an increase in the number of practical experiences (6 teachers or 10.7%); more generalization/integration of science courses (6 teachers or 10.7%). Comments made by teachers concerning these recommendations include the following:

> "How to handle a multi-graded classroom (teaching science to 2 or 3 grades at one time)."

> "Since most small schools have 2-3 grades and sometimes 4 or 5 grades per classroom, courses should be designed to prepare students for this shock. Also the professors, some have never taught in multi-grade schools. How do they know what to expect?"

> "Have a course specifically directed toward small school teaching. It would be worthwhile for most beginning teachers since the best chances at getting a job are usually in a small school/rural setting."

"Put the university students in a situation where they have to teach two science classes in the same period, with very little equipment available to them."

"The major disadvantage to teaching science in a small school in my experience has been a lack of laboratory space and materials. Prospective teachers must learn to compensate for these shortages if they must. Also, resource facilities aren't often accessible, so they need to find out who and what is available through various information sources."

"Fall back methods ie. how to improvise: substituting simple materials for expensive equipment. eg. using a comb and flashlight instead of a $100 ray box."

"Help prepare you for the lack of both materials and support for a good science program. Provide effective alternatives for the more expensive materials."

"Student teaching in small schools, in a rural setting, is essential for starting teachers towards their preparation for teaching in situations such as mine."

"Give teachers more time teaching in the work environment. More practical and 'hands on' instruction is required."

"A good approach would be to offer more internship training in small schools (in remote areas). . . . perhaps the best way to go would be to split the internship practice between rural and urban areas."

"Offer a longer internship program; offer more conferences with other student interns during the program who teach in rural schools; have all interns do some teaching in a rural school."

"The only practical way is to provide training in the school setting. There is no other way to experience the types of problems encountered. The expertise of people who have taught in small schools could be used. Brainstorm people who are presently teaching."

"Instead of teaching science as distinct disciplines science should be taught as a whole. Most teachers in small schools end up teaching many different sciences and other courses."

"I think that Memorial should make a science instruction course mandatory for the B. Ed. program."

"Teachers need a good background in most sciences rather than being an expert in 1 or 2 areas."

"Course(s) on teaching several areas of science instead of present system of required two. Re: Science teachers in small schools are expected to teach many different science subject areas (even those with no formal training in)."

Other suggestions included that teachers; be required to complete more methods courses, learn classroom discipline, prepare themselves for the social context of the small rural school, be provided with curriculum ideas for rural areas, and be trained to deal with special needs students. One teacher indicated that the first thing MUN needed to do was acknowledge the existence of small schools within the province. Some of the comments regarding these recommendations included the following:

"Cover the following ideas/topics:

- what to expect/what you'll find
- how to cope with any deviations from norm
- variations in student attitudes
- specific curriculum ideas for rural interest"

"some training on the social effects vs. school behaviour"

"Small schools typically have either small classes or larger multi-grade classes. In either situation there is a wide cross section of students because there often are not alternative course choices. Teachers often need help in 'modifying' programs to make them appropriate for remedial students and other students who don't cope at grade level. There is often a shortage of remedial staff."

"We need more experience in smaller areas and ways of dealing with the culture they possess."

"Develop applications for multi-grade teaching within the same period. Develop applications for modifying science courses for special services students. Developing applications for dealing with a lack of equipment. Provide applications for less than perfect teaching practice."

Teachers were also asked about their internship experience. One teacher commented on the usefulness of the internship program offered at MUN:

"Teachers should be taught the skills needed, to actually teach in the classroom. Past experiences have indicated to me that I gained little from the courses taken at Memorial. The most useful element of the program in Education was the internship."

Only seven teachers (12.5%) had completed their internships in small rural schools. When questioned if they had requested to do their internship in a small/rural school one teacher commented that they had not known any better, suggesting that they felt they should have. Another teacher made the following comment:

"Most teachers believe they will teach in larger schools, why would they intern at a smaller school?"

Of the other 50 teachers, 5 (10%) had requested to complete their internship in a small rural school and had been refused permission to do so. These teachers reported that they had been told that to complete their internship in a small rural school would be too expensive or that the school was too far away from MUN and, therefore, completing their internship in that school was not feasible.

Of the 7 teachers who had completed their internship in a small rural school, 5 reported that the experience had helped prepare them for teaching in a small school situation. These teachers stated that the internship had taught them teaching strategies which could be employed in small schools and had exposed them to the lack of resources which small schools often experienced. One teacher indicated that the internship had provided them with experience in a multi-grade situation. Teachers who had completed internships in small/ rural schools made these comments regarding their internship experience:

> "I realized that small schools do not have the facilities or equipment to do a complete and comprehensive program."

> "First of all I realized that small schools lack much of the needed resources and it forced me to come up with other means of teaching the concepts of science."

> "How to deal with multi-grades. How to cope and what to expect to a degree. Remember every year, grade is different. Experience is the only

answer."

"It prepared me for the practical aspects of teaching. However, it did not prepare me for the multi-grade situation which I am presently in."

Thus, it would appear that MUN has done little to prepare teachers for the realities of teaching in small rural schools. It seems, though, that teachers presently teaching in small school situations are well aware of how teachers could, in fact, be better prepared to teach in small schools.

Present Teaching Duties

Teachers were asked about their present teaching situation in terms of grades taught, courses taught, multi-grade situations and overall job satisfaction.

When asked why they were presently teaching in a small school, over half of the teachers (33 or 58.9%) said that it was the only teaching position available to them. Fourteen teachers (25.0%) indicated that they were in the school because of the geographical area, while 12 teachers (21.4%) said they wanted to be near their family. Only 7 teachers (12.5%) said the reason they were teaching in a small school was for the small school experience.

Other reasons that teachers gave for teaching in a small rural school were personal preference for small schools/

communities, that it had been their first job and they had stayed because they liked the school, or for monetary reasons (better pay, lower living expenses). One teacher indicated that teaching in a small school provided them with an opportunity for both administration as well as teaching experience.

With respect to the number of years they had been teaching in their present school, 28 teachers (50.0%) had been there less than five years. For 13 teachers (23.2%) it was their first year in the school. Only three teachers had been teaching in their school for more than 20 years.

The grades/levels taught by teachers who responded are as follows: grade 7 (29 or 51.8%); grade 8 (40 or 71.4%); grade 9 (42 or 75.0%); Level I (37 or 66.1%); Level II (38 or 76.9%); Level III (36 or 64.3%). Other grades taught include grade 6 (9 or 16.1%), grade 5 (6 or 10.7%), grade 4 (5 or 8.9%), grade 3 (2 or 3.6%), grade 2 (1 or 1.8%), grade 1 (1 or 1.8%), kindergarten (1 or 1.8%) and adult education (1 or 1.8%).

More than half of the respondents (29 teachers or 51.8%) indicated that they would transfer to a school in a larger community if they were given the opportunity.

Table 5 represents the science courses currently being taught in grade 7 to Level III by the teachers who responded. Examination of the table shows that the earth sciences and chemistry courses are not being taught by very many of these teachers. Of the academic sciences, biology is taught most frequently, followed by physics. Other science courses taught, but not included in the table, include computers in junior high grades and science in grades K-6.

In addition to teaching science, 51 teachers (91.1%) indicated that they teach a variety of other courses as well. The number of other courses for which these teachers were responsible varied considerably, from 1 to 48, indicating large differences in teachers' preparation and workload. Teachers with extremely large course loads are teaching in multi-grade situations and responsible for most, if not all, courses in several grades. Fifty percent of the teachers (28) are responsible for up to six courses in addition to the science courses which they teach. More than 20% of the teachers (13 or 23.2%) were responsible for an additional 15 or more courses, with 5 teachers responsible for all of the courses in as many as 2 to 6 grades.

Table 5

Science Courses Taught by Teachers in Small Rural Schools

Science Course	Number of Teachers	Percentage of Teachers
Grade 7 Science	26	46.4
Grade 8 Science	36	64.3
Grade 9 Science	37	66.1
General Science 1200	3	5.4
Physical Science 2205	12	21.4
Environmental Science 3205	9	16.1
Biology 2201	16	28.6
Biology 3201	17	30.4
Earth Science 2203	5	8.9
Geology 3203	2	3.6
Chemistry 2202	6	10.7
Chemistry 3202	4	7.1
Physics 2204	10	17.9
Physics 3204/3214	10	17.9

Table 5 (cont.)

Science Courses Taught by Teachers in Small Rural Schools

Science Course	Number of Teachers	Percentage of Teachers
Science, Technology and Society 2206	1	1.8
Microcomputer Systems 1100	6	10.7
Computer Applications 2100	5	8.9
Keyboard./Word Proc. 1101	9	16.1
Adv. Word Proc. 2101	2	3.6
Computer Technology 3200	0	0

An examination of the total courses (all subject areas) for which these teachers were responsible showed a range from 4 courses (in two conjoint schools - Elwood Regional High in Deer Lake and J. R. Smallwood Regional High School in Wabush) to more than 50. Only nine teachers (16.1%) had six or fewer courses for which they were responsible. Sixteen teachers (28.6%) were responsible for 15 or more courses.

Instances of multi-grading seem to be quite common as 26 teachers (46.4%) indicated that they teach at least one class of science which is multi-graded. Four teachers had four multi-grade situations, while two teachers had three multi-grade situations.

The most common multi-grade combination for science was a grade 8 and 9 combination, which was reported by seven teachers. Combining science in grade 7 and 8 was reported by four teachers, as was combining science in grades 7, 8 and 9. Most of the multi-grade combinations (29 different combinations) did not involve senior high grades; however, in some instances senior high courses were combined (eg. Environmental Science 3205 and Earth Science 2203) or were offered in conjunction with other grades (eg. Science in grades 7, 8, 9 and Earth Science 2203). Six instances of multi-grading involving senior high courses was reported.

Most of the multi-grade classes reported involved only two grade/course combinations (25 instances). However, some of the multi-grade classes reported involved as many as four grades/courses (4 instances).

Not only did teachers report that they teach more than one science course in a class at the same time, but several reported that they teach science as well as other non-science courses at the same time in the same class. Six teachers (10.7%) reported such situations. Subject combinations included: math and computers; language arts, math and science; science and health; combinations of subjects in grades 8 and 9; combinations of subjects in grades 7, 8, 9, and Level I.

Thirty-nine teachers (69.6%) reported having special needs students in the science courses which they teach. Comments made by two teachers describing their multi-grade situations gives an idea of the combinations some teachers are faced with:

> "General Science is taught in one class and Physics is taught in distance education, but three classes a week they are in the classroom. However, work is assigned by their other teacher. I have the TMH students in my class with a student assistant three classes in the morning."

> "I teach science to all four grades [grades 5, 6, 7, and 9] during the same period."

Teachers were asked about their satisfaction with their overall teaching situation. Factors discussed were class size, number of courses taught, number of grades taught, preparation time and teaching resources. Teachers were asked to rate each factor from 1-5 (1 being very satisfied, 5 being very dissatisfied).

Of the factors discussed, teachers seem to be most satisfied with their class size, as 38 teachers (67.9%) indicated that they were very satisfied. Fifty-three teachers (94.6%) rated their satisfaction with class size between 1 and 3. Teachers were also fairly satisfied with the number of grades they taught as 45 teachers (80.4%) rated their satisfaction between 1 and 3. Teachers were less satisfied with the number of courses they were teaching. More than half of the teachers (29 (51.8%)) rated their satisfaction between 3 and 5 , 11 of whom were very dissatisfied. Teachers were also dissatisfied with the amount of preparation time they had. Twenty-one teachers (37.5%) reported that they were very dissatisfied. More than half of the teachers (38 or 67.9%) rated their satisfaction with preparation time between 3 and 5. Another facet of their job situation which teachers are not satisfied with is the availability of teaching resources. Forty-four teachers (78.6%) rated their satisfaction with teaching resources between 3 and 5.

Thus, overall, teachers are generally satisfied with their small class size and number of grades taught, yet dissatisfied with the number of courses they teach, their lack of preparation time and the lack of available teaching resources.

Science Lab Facilities

Teachers were asked about the lab facilities within their school, their accessability and whether or not they are adequately equipped.

Teachers were asked to rate the lab facilities to which they had access, on a scale from 1 to 5 (1 being very satisfied, 5 being very dissatisfied). Most teachers were less than satisfied with their school's lab facilities. Teacher satisfaction was rated between 3 and 5 by 41 teachers (73.2%).

Unfortunately, a number of schools are still lacking a designated science lab as 11 teachers (19.6%) indicated that there were no science laboratories in their school. One teacher made the following comment regarding the number of science labs in their school:

> "None actually. There is a multi-purpose room (lab/library/classroom) which does not classify as an adequate lab facility."

Most teachers (40 or 71.4%) indicated that there was one science lab in their school, while 5 teachers (8.9%) indicated that their school had two science labs.

Even though schools may have a designated science laboratory, often these labs are not functional, in that they are too small, poorly equipped, or used for non-science courses as well. Of the teachers who responded, 34 (60.7%) indicated that their science lab was large enough to seat all of their students. However, 15 teachers (26.8%) reported that their lab was too small.

With respect to equipment, slightly more than half of the teachers (32 or 57.1%) indicated that they have access to all of the recommended pieces of equipment for the science courses they taught. However, the remainder (24 or 42.9%) indicated that there was equipment/material which they needed, to which they did not have access.

When asked about the equipment they were lacking, a large number of teachers (14 or 25.0%) said that they lacked most of the recommended equipment/material. Twelve teachers (21.4%) reported that there were specific pieces of equipment which they needed. The equipment referred to ranged from large pieces of expensive equipment, such as ripple tanks, wave generators and fume hoods, to small, basic, frequently used pieces like scissors, glassware and microscope slides. Many teachers reported a lack of bunsen burners, chemicals, dissecting specimens and microscopes, yet these materials are essential to almost any science course. Five teachers (8.9%) said that they needed more class sets of equipment such as dissecting kits. Three teachers (5.4%) expressed a need for more computer hardware/software. Three teachers reported that there were no gas hook ups in their labs (although this number is expected to be higher due to the number of teachers who reported a lack of bunsen burners) and one teacher reported a lack of safety equipment.

Some of the comments made by teachers regarding the lack of science equipment/material in their schools are as follows:

> "For the most part we improvise and use simple materials to cover the same purpose."

"There's not enough space here nor is there enough time. Most of the lab equipment I have can be put in a fish tote box and carried around in that fashion. Chemicals are almost non-existent."

"Having the equipment is not the problem. The number of sets of equipment is a problem. eg. 4 sets between 32 students."

"We have: 3 microscopes; 1 hand lens; 4 partial dissecting kits."

"There are too many things to list! We usually borrow any essential materials form the schools in Burgeo or Ramea. However, there are some things which we should have, but do not have the budget to get."

"No gas supply here in our area. No point. Expensive for so few."

"Much of the apparatus necessary to carry out a physics program or a chemistry program is not available."

". . . there is <u>considerable</u> material for core labs that is missing."

"Most of my courses require materials for core labs. In all courses the materials are lacking."

"Presently I have done several labs without the necessary equipment but have improvised and used something else. I'm sure as the year goes by I'll be in the same predicament many times. This is my first year teaching."

"3 classrooms/11 grades - Funding for small schools is not adequate."

One teacher made the following comment regarding the lack of funding which results in equipment shortages in small schools:

"In any all grade school (K-12) the funds are not provided to be able to do a job (100%). Cost is a factor. Government puts money into larger schools, more than rural schools. It is unfair and schools in St. John's and other large centers have all facilities near by that they need for visits and resources. Therefore, to be put on par they (government) need to put more money into rural areas. The teachers are very capable, but lack resources."

The most frequently stated reason for not having equipment was a lack of money, as stated by 27 teachers (48.2%). Only four teachers (7.1%) stated that they were not sure how/where to order the equipment they needed. Several teachers referred to the fact that the equipment needed was simply too expensive to supply for such a small number of students. In other cases, the teacher responding was new to the school and not yet fully aware of what equipment was needed or why the school did not have various pieces of equipment.

Most teachers (40 or 71.4%) reported having adequate access to a science lab. The 16 teachers (28.6%) who reported inadequate access, gave a variety of reasons for the inadequate access. The most frequently given reason for inadequate access (eight teachers) was that the science lab was used as a regular classroom. Six other teachers stated that there was no real lab as such, but that they brought the needed materials to their classrooms to do lab work. Five teachers reported that timetabling was a problem and four teachers stated that the problem was too few labs in the school.

Thus, it seems that there are still schools throughout the province which have no science lab, or in which student access is limited for a variety of reasons. Many schools also appear to have science labs which are inadequately equipped.

Distance Education

Teachers were asked about the distance education programs in their school, from the point of view of problems students were encountering.

Distance education was being offered in 28 (50.0%) of the schools. Twelve teachers (21.4%) reported that they were aware of problems which students were experiencing with distance education courses. The most frequently cited problem students experienced (reported by 7 teachers) was in dealing with the lack of contact/guidance from the coordinating distance education teacher. Three teachers reported that students were having problems with the responsibilities of independent study, while two teachers reported that students experienced difficulty in keeping pace with the courses. Three teachers reported that students were having technical difficulties. Only one teacher reported students missing parts of regular classes due to scheduling problems.

Responding teachers made the following comments regarding problems students encountered:

> "Lack of contact with the instructor (of course this is the nature and obvious drawback of distance education). And what about visiting resource

personnel?"

"Students having trouble communicating with teachers on the teleconferencing equipment. It becomes difficult to get help. We are encouraged not to help the distance education students."

"The students are on their own with no immediate person present to ensure that they don't fall behind in their work. I've faxed many assignments and labs on the last possible due date or even late. We do not have a secretary or assistant, so all faxing of work and photocopying/ distribution of materials must be done by myself or the principal."

"Faxing their assignments on time is a problem. Many times they have come to me for help. I do the best I can, but I don't have a strong background in Physics. I must refresh my memory constantly. With my own workload it is quite difficult."

"Losing time from other courses while on line and finding it hard to catch up."

One teacher commented on the problems encountered by students, but remarked on the value of distance education as a whole:

> "First problem which is to be overcome (this being the first year) is lack of personal contact with the instructors. Second, couldn't run to instructor immediately when a problem arose. Overall, the programs are great and students will be greatly prepared for secondary education."

Thus, student problems reported by teachers are similar to those reported by principals, in that most are related to the concept of independent study and meeting the required expectations.

Professional Development

Teachers were asked about their professional development activities involving both science and small schools.

Only 28 teachers (50.0%) have access to professional science magazines/periodicals through their school or school board.

A large number of teachers (37 or 66.1%) have attended science in-services sponsored by their school board within the past five years. One teacher commented that he was ineligible to attend such in-services due to the fact that he was not a full-time science teacher.

A smaller number of teachers (19 or 33.9%) had attended

NLTA Science Council Conferences held throughout the province in the past five years. Of those teachers who had not attended these conferences only one teacher had requested leave to attend the conferences and been denied. The differences in attendance between board sponsored in-service and NLTA Science Conferences may be due to the costs involved. The cost of most school board in-services would likely be paid for by the board, unlike the NLTA Science Conferences.

None of the teachers who responded had attended the Small Schools Conference held in Gander in October 1992. Only one teacher had requested leave to attend the conference and his request had been denied. Only seven teachers (12.5%) had attended any professional development programs/in-services which dealt specifically with teaching science in small schools.

It would seem then, that very few teachers are receiving in-servicing dealing with either science or small schools.

A question, asking teachers to rank the factors which determine whether or not they attend an in-service or conference, could not be interpreted as intended, as many teachers rated the factors instead of ranking them. A total of 24 teachers answered the question by ranking the factors as was intended. Responses from teachers who did not answer the question as was intended were omitted. Each factor will be discussed in terms of how it was ranked (1 being most important, 7 being least important).

The following numbers and percentages of teachers (out of 24) ranked the stated factors between 1 and 3: lack of funding: 18 (75.0%); too few in-service days: 18 (75.0%); distance: 17 (70.8%); lack of substitutes: 12 (50.0%); family obligations: 4 (16.7%); not informed about the in-services: 3 (12.5%).

Other factors which were mentioned by teachers, but were ranked below 4 included not being a full time science teacher (thus in-service in science was not as important as other subjects), topic interest, and the amount of work involved in preparing for a substitute. Several teachers from Labrador and the south coast referred to the time and distance involved in travelling via Lab Air or the south coast ferry.

Comments made by several of these teachers include the following:

> "There are no substitutes if I leave the school, therefore the students would have no school. We are isolated."

> "Leaving several days work for a substitute in multi-grade/course situations is a daunting task."

> "Living in an isolated Labrador community means travelling Lab Air out to Happy Valley - Goose Bay,

then a Dash 8 to St. John's. The Lab Air part is not enjoyable."

"Infrequency of ferry service = long time away."

Thus it seems that lack of funding, small number of in-service days and long distances are major factors which prohibit the attendance of teachers at in-services around the province.

Only five teachers (8.9%) have attended science related professional programs such as those offered by SEEDS or the KEY Foundation. Of these five teachers, two had attended a Shell Institute, two had attended a SEEDS Institute, and one teacher had attended a Physics Institute. Of the teachers who had not attended such programs, only one had ever applied to attend such a program and had not been accepted.

Teaching Resources

Teachers were asked about the teaching resources available to them. Questions concerning assistance from science coordinators, STEM-Net, and use of computers, were asked to determine the types of teaching resources teachers find most useful.

Teachers were asked how often they see the science coordinator from their school board. Fifteen teachers (26.8%) said that they see the coordinator approximately three times a year. Eleven teachers (19.6%) reported seeing the coordinator twice a year, while the same number reported that they saw the coordinator whenever they requested. Nine teachers (16.1%) reported that they see the coordinator only once a year. Four teachers reported seeing the coordinator once a month, while two teachers reported seeing the coordinator as frequently as once a week. Several teachers who reported seeing the coordinator frequently commented that their school was situated next to the school board office, or within the same community.

Teachers were asked about the type of assistance which their coordinator provided. Responses were as follows: curricular information: 43 (76.8%); science fair information: 40 (71.4%); in-service information: 35 (62.5%); obtaining equipment: 28 (50.0%); teaching strategies: 20 (35.7%); equipment usage: 11 (19.6%). Other types of assistance included computer troubleshooting, helping to set up STEM~Net, and any information requested of them. Several teachers inferred that their coordinator was of little or no use and that they were rarely, if ever, seen.

A rank order question on sources of assistance to teachers could not be interpreted as intended, as many teachers rated the sources instead of ranking them. A total of 19 teachers answered the question by ranking the sources as was intended. Responses from teachers who did not answer the question as was intended were omitted. Each source will be discussed in terms of how it was ranked (1 being most useful; 8 being least useful).

The following numbers and percentages of teachers (out of 19) ranked each of the stated sources of assistance between 1 and 3: other teachers: 16 (84.2%); principal/vice principal: 14 (73.7%); coordinator: 12 (out of 18 as one teacher was acting coordinator as well) (66.7%); department head: 6 (out of 12 as 7 schools had no department head) (50.0%); other professionals (eg. Dept. of Forestry): 4 (21.1%); MUN: 2 (10.5%); other sources (eg. TV, films, Department of Education): 2 (10.5%); parents: 1 (5.3%). Thus, other teachers, school administrators and school board coordinators appear to be the most useful sources of assistance to teachers.

Not all of the teachers who responded had heard of STEM~Net. Fifty-one teachers (91.1%) reported that they had heard about STEM~Net. Of these teachers, 11 (19.6%) stated that they didn't know if STEM~Net would serve as an important link/resource for teachers in small schools, whereas 42 teachers (75.0%) felt that it would.

Teachers were questioned about their use of computers in the classroom as well as their own personal use. Fifty-three teachers (94.6%) stated that they were familiar with the use of computers, yet computers were available for instructional use in all of the schools from which teachers responded.

Teachers reported the frequency with which they use computers in their teaching as follows: never: 1 (1.8%); rarely: 13 (23.2%); sometimes: 18 (32.1%); often: 9 (16.1%); almost daily: 15 (26.8%). The frequency with which their science students make use of computers in their science courses were reported by teachers as follows: never: 3 (5.4%); rarely: 17 (30.4%); sometimes: 24 (42.9%); often: 8 (14.3%); almost daily: 4 (7.1%). Thus, 32 teachers (57.1%) are not making frequent use of computers in their teaching. Even fewer teachers (44 (78.6%)) are requesting frequent computer use by their science students.

Several teachers commented on their use of computers in their teaching:

> "I am in the process of learning how to use the computer. I am getting one of my own soon. We have class schedules drawn up in our school for computer use and there is time for students to use it on their own."

> "We recently received a CD-Rom, therefore this [usage] will change now. Another reason [for lack of usage] is the curriculum is not geared to very much computer use in grades 7, 8 and 9."

"Rarely - need software, costs money and time needed to use."

"Computer access is a problem."

Tables 6, 7 and 8 indicate the ways in which teachers use computers in their teaching. Table 6 represents student computer use, Table 7 represents teacher computer use and Table 8 represents general instructional use.

With respect to both student and teacher use, computers appear to be used mostly for word processing and graphing. Instructionally, computers are used widely for simulation games, drill and practice, data collection, and lab simulations. However, a large number of teachers do not have their own personal computer at home, as only 21 teachers (37.5%) indicated owning their own computer.

Table 6

Student Computer Usage

Purpose	Number of Schools	Percentage of Schools
word processing	42	75.0
data bases	13	23.2
spread sheets	14	25.0
graphing	24	42.9
graphics	14	25.0

Table 7

Teacher Computer Usage

Purpose	Number of Teachers	Percentage of Teachers
word processing	40	71.4
data bases	10	17.9
spread sheets	13	23.2
graphing	21	37.5
graphics	12	21.4

Table 8

General Instructional Usage of Computers

Purpose	Number of Teachers	Percentage of Teachers
data collection	19	33.9
interfacing	9	16.1
telecommunications	8	14.3
tutorials	14	25.0
drill and practice	21	37.5
simulation games	30	53.6
programming	2	3.6
robotics	1	1.8
lab simulation	17	30.4
exams	1	1.8

When asked to describe resources which teachers use and find useful, the most frequent response teachers gave (37 teachers or 66.1%) was visual media such as videos and filmstrips. The second most frequently used resource was computer software (14 teachers or 25.0%) followed by commercially prepared teaching aids (9 teachers or 16.1%) and written material such as text books and reference materials (8 teachers or 14.3%). Other, less frequently cited resources included other teachers, professionals, journals, Department of Education, CD Roms/laser disks, field trips and overhead transparencies.

Several teachers commented on the lack of available resources, or their inability to make use of resources which were available:

> "The course load is packed full for the most part so this limits the time you can use on such devices and still cover the required materials. (It barely leaves time to do required labs.)"

> "Resources are not available due to the lack of funding. We have a motto in our school. 'If it's not free we can't afford it.'"

Teachers were also asked to describe those resources which they felt could help them to be more effective science teachers. The resource cited most frequently by teachers was more science equipment and storage facilities (13 teachers or 23.2%). Twelve teachers (21.4%) cited computer hardware and software and nine teachers (16.1%) cited in-services. Eight teachers (14.3%) felt that a more appropriate curriculum would help them to be more effective in the classroom. Less frequently cited resources included commercially prepared teaching aids (7 teachers or 12.5%), STEM-Net (5 teachers or 8.9%), and teacher mentors (4 teachers or 7.1%). More videos were cited twice and CD Roms/laser disks and field trips were each cited once. One teacher said that the presence of a science lab in the school would be a useful resource. One would think that such a basic resource would be present in all schools, but apparently this is not the case (as was discussed earlier).

Comments made by teachers regarding types of resources which would help them to be more effective include the following:

> "A less restrictive budget which would allow for more lab supplies, and more teacher resources such as prepared overhead transparencies, puzzle sheets, practice problem sheets, etc."

> "1. More lab equipment for demonstrations and experiments.
> 2. Other teachers to act as mentors to help in practising alternative teaching techniques.
> 3. Computers and interfacing equipment."

> "We have computers but very little software related to my courses so you really have no use for the computer. If we are going to be expected to

use such resources they should be provided by the Department of Education, and not rely on the schools having to fund raise to get money to buy them."

"A well-stocked lab and good computer simulations."

"Computers: more in-service in how to interface and recommended software for different subject areas made available."

"More in-services to share ideas with other teachers. (This in my opinion is the best.)"

"More in-service time (when I have the opportunity) - in most cases distance is a major concern. In-service lecturers come to our school. This is really my only opportunity for science in-service to date."

"Equipment; network; in-service with other science teachers; resource base for science courses."

"More in-services (probably teleconferencing) or videos related to teaching science in multi-graded classrooms."

"A better suited curriculum for science 7-9 and ones with more flexibility (less volume) in such courses as Biology."

"In-service would be great; up to date texts; more talks with other teachers (most valuable)."

"Where I am the only science teacher in the school I feel I need more ideas from other teachers and people in the field. I need resources and materials also. The first need can be met by a network where teachers could communicate their bank of science ideas."

Several comments made by teachers left the impression that physical resources were not necessarily the type of resource which they would prefer:

"A qualified science teacher and I'll do the social studies."

"I think I have resources enough. Shorter on time and energy."

Thus, it appears that teachers are making relatively good use of the resources to which they have access, improvising where possible, but in many cases are lacking essential, basic resources.

Teaching Strategies

Teachers were asked about the amount of time they spend preparing for the various science courses which they teach. As well, they were questioned about the teaching strategies which they use in single-grade classes as well as those used in multi-grade classes.

Preparation Time

It has often been said that science teachers must put extra hours into their work in terms of lab preparation and marking. As well, teachers in small schools often spend extra time due to a lack of resources. Thus, teachers were asked to indicate which science courses they taught and the number of hours of preparation per week they spent on each course.

With respect to the lower grades, teachers taught from 1 to 6 science courses in primary, elementary and junior high, with the average number of science courses taught per teacher being three. Seventeen teachers taught two courses and the same number of teachers taught three courses. The total amount of time per week spent preparing for these courses ranged from 1 to 15 hours. The average teacher spent 6.2 hours per week preparing for these courses, which translates into approximately 2.4 hours per week per course.

With respect to senior high courses, teachers taught from 1 to 6 science courses, with the average number of science courses taught being three. Ten teachers each taught two senior high science courses and nine teachers taught four courses. The total amount of time per week spent preparing for these courses ranged from 1 to 28 hours. The average teacher spent 10.5 hours per week preparing for these courses, which translates into 3.6 hours per week per course.

Thus, it seems that the average teacher who teaches senior high science courses spends more time per week preparing for these courses than for science courses in the lower grades. A teacher with three junior high and three senior high science preparations would spend approximately 17 hours per week preparing for their courses (3.4 hours/day). One must keep in mind however, the number of courses for which these teachers are responsible, and that many are teaching non-science courses as well.

Comments made by two teachers are indicative of the amount of time science teachers in small schools spend preparing for classes:

> "Because I am doing other courses as well as principalship, I cannot determine the number of hours. I teach full time, 42 periods in 6 days - night work stops when I get tired - <u>usually bedtime</u>."

"For all courses I spend about as much time preparing as I do in class."

Teaching Strategies

Single-grade classes.

Teachers who teach in single-grade classes were asked to describe the particular teaching strategies that they use which have helped them to cope with teaching in a small school. Twenty-eight teachers responded to this question, 13 of whom stated that they used hands-on activities quite frequently. Other common strategies included discussions (6 teachers), group work (6 teachers), and demonstrations (5 teachers).

Other less frequently cited strategies included using alternate/locally available materials, relating the course material to the local setting, using computer-aided instruction, field trips, projects, providing students with specific course objectives, lectures, co-operative teaching, individual reading/seat work, altering methodology to student ability, using overhead transparencies and giving frequent quizzes.

In responding to this question many teachers referred to how a lack of materials/equipment affected their teaching methodologies:

"You cannot always do what is in the book. You must be able to adopt to your own situation."

"In some cases I use computer simulations to replace some of the labs that include materials I don't have. I also have to modify objectives and activities as equipment dictates."

"Generally course length and material often limits how much time you can spend in the lab. (Courses should be more lab oriented and more time set aside for these activities.)"

"Use groups of 5 or 6 because of shortage of lab materials. Sometimes shortage means I will demonstrate the lab rather than having students do it themselves."

One teacher commented on how a lack of preparation time affected his teaching:

"Because there is virtually NO preparation time during the school day, students sometimes have to be assigned seat work in the lab to give the teacher time to set up for an activity or demonstration in the class or classes following."

Many teachers referred to the fact that they used as many hands-on activities as possible and related course material to the local setting in order to maintain student interest and appeal to the wide range of ability within their classes:

"As many demonstrations/activities/labs/field studies as I can reasonably fit into my classroom schedule are attempted and serve to maintain the interest and involvement of the students. They are definitely learning by doing.

I supplement course material and set much higher expectations for students, still cognizant of the needs of all students."

"As a teacher who works in small classrooms in a small school, a hands-on approach with manipulatives is the only sensible approach or method that keeps interest in the student. Students today will not be interested in 40 minutes of lecture."

"Attempt to use local situations/settings/ topics which both lend to the students understanding and interest of the topic.

Altering methodology to cater to a wide range of student capabilities while at the same time providing a challenge to the exceptional students."

"1) Try to relate principles, concepts covered to the local setting.

2) Use materials available locally - as efficiently as possible - eg. in science unit on electricity - use home appliances (toasters, hair dryers, etc.) for hands-on investigation."

"1) Student objective sheets. At the beginning of each unit of work the students are given a list of objectives and text page references. Helps keep them and me on track.

2) Students learn the content of some units in Biology from a computer program. Maximum 2 students to a computer. Stimulates interest and provides better graphics than I could ever provide on the board.

3) When delivery of notes is required I do it by overhead which frees me up (not back to the class)."

Multi-grade classes.

There are several approaches which teachers in multi-grades use. One is to keep students in distinct grade levels/ subjects. Another is to use a cross-grade approach. A third is to use a thematic approach. Multi-grade teachers were asked to indicate which approaches they followed as science teachers. The types of approaches and the numbers of teachers which use them are as follows: distinct grade levels/subjects: 8 teachers; cross-grade approach: 18 teachers; thematic approach: 7 teachers; alternating approach: 5 teachers. Thus, it seems that most multi-grade teachers use the cross-grade approach as their preferred teaching strategy.

Several teachers teaching in multi-grade situations explained the teaching strategies they use in teaching science:

> "I teach science to grades 4 and 5 so I follow department suggestions and choose lessons from both texts. By the end of two years we have all material covered."
>
> "Courses taught as if all students are up to date. Grade 7's will cover *Science Plus I* next year."
>
> "One course is taught to two grades and the following year the other course is taught."
>
> "We alternate the science program from one year to the next. Because the classroom has three grade levels, at the end of the junior high

students' life, he/she will have covered all three 'grades' of science. Due to the level of some of the incoming grade 7's, it was felt that this method would have to be altered slightly."

"Thematic - eg. LIGHT - experiments, questions, etc. vary to grade levels."

Personal Data

Of the 56 teachers who responded, 47 (87.5%) were male and only 7 (12.5%) were female. Teachers ranged in age from 23 years old to 60 years old. More than 80% of the teachers were 40 or younger, and 28 teachers (50.0%) were less than 31 years of age.

Number of years teaching experience ranged from less than one year to over 27 years. Ten teachers (17.9%) were in their first year of teaching. More than 60% of the teachers had fewer than ten years of experience, with 50.0% having less than 7 years experience. Only 12 teachers (21.0%) had more than twenty years of teaching experience.

Thus, it appears that the science teachers in small rural schools are predominately male, relatively young, with relatively little teaching experience.

General Comments

As with the principal surveys, many teachers added general comments/concerns which reflected their frustrations with such things as the lack of equipment/material, their workload, or of being in a multi-grade situation with virtually nowhere to turn for advice. These comments are included here by the researcher because it was felt that they would further explain the situation experienced by many of the province's teachers.

> "No teacher can do a good job with science teaching when there are four or five grade levels in one classroom. This is frustrating all the way."

> "Labs generally are not as well designed or as well equipped as should be.
> Generally teaching a lot of courses, so a lot of time spent preparing outside of school.
> No time to set up labs or do work in the lab so everything must be done outside of school. It all adds up to more work to do the same job for the same pay."

> "I feel such a survey is long overdue. I wish you all the luck in your thesis and pray that this may influence respective educators in curriculum

development, teacher training and school planning to make these essential changes in our science education as soon as possible."

"Much of the school science program is left uncovered. Lack of money for materials, lack of time for preparation of lab activities, lack of science fairs, etc. means that our students get a patch work of science.

Our teachers are required to teach courses in which they have little or no training. It is about time for someone to realize that teacher work load (number of courses required to teach) is a real issue. Small, multi-graded schools are perfect places for small classes, however when it comes to work load it's 'hell' for teachers. It is a small wonder that we have a very large turn over of teachers - three or four out of seven is the average. We get first year teachers (usually) and they are often amazed about the work (course) load they are faced with.

An example: My Language teacher teaches French grades 4-9, Language grades 4-12, Literature grades 6-12. If this is not a heavy load, then I'm not sure what you would call it."

"I often feel inadequate teaching science, more so than any other area. I also think that the *Searching for Structure* series is grossly unsuited to my situation. I know learning in science should be more resource/experiment based, but I seem unable to use this method effectively. I don't know why. It could be my lack of scientific background, a lack of resources or the usefulness of *Searching for Structure*. This is my first year with grade 6 (Addison Wesley) and my level of frustration is much lower."

"First, teachers in small schools are very qualified to teach. When it comes to a comparison (CTBS) rural areas fall short. Reasons: LACK of funds and equipment. Larger centers have all the resources they need next door. Rural areas lack funds, equipment and resources, not because the teachers are not as good."

"Presently eleven grades are taught at our school by three teachers. I have been informed by the school board that next year our staff may be cut to two.

It is difficult to appreciate our situation without experiencing it. However, I believe it will be extremely difficult to cope with such a large amount of the curriculum shared between two teachers. Presently, it is very challenging to conduct science experiments in four different courses while other subjects are taught at the same time."

"I wonder about what is now most important - to ensure that we offer 14 credits per year with reduced teacher time available to students, or to offer 10-12 credits with the teacher always available to assist."

"Lack of funding and, hence, resources cause science teachers in rural communities the most headaches. Coupled with this is a lack of support and extracurricular services that could enhance science education. For example, in a bigger centre, one has access to more facilities (example marine lab, fluvarium) and resource personnel (wildlife, forestry dept. officials, etc.). In isolated communities, the situation is worse, since you are restricted in terms of travel."

"Since this is my first year teaching, I feel the responsibility of preparing the students for the public exams very difficult with the lack of lab equipment. However, so far so good. I'm teaching computers in which I have a very weak background, but in the past three months I have not only taught a great deal, but I, myself have learned a lot.

To tell the truth, I am very pleased to complete this survey. It is a way to let out some of my frustrations. In a multi-grade school, you have to teach subjects you don't feel qualified to handle. However, you have to learn how to adapt quickly in order to give students your best effort.

So, after three months, I have learned to give it my best. If there are things I don't know, I will have to learn them first, before I can teach my students. The work load is tremendous. I look back on my internship and the bigger school and envy how easy they have it.

It is very hard to cope with the work load. The only, and I stress only, advantage to these schools is, there are less discipline problems."

"We are a small school and located in a rural area but we have the facilities of most larger areas because our board is so economically sound and supports science. Areas such as Port Hope Simpson, Labrador (where I taught for one year) need a great deal of help in this area."

"The stress of being watched and judged day in and day out by the community adds extra stress (x 10) to teaching in this situation. The people don't realize the value of education, especially science education. There is little support for our science projects, or fund raisers for the science department, both by students and parents."

One teacher commented that although small schools are disadvantaged in some ways, there are definite advantages to both teaching and learning in small schools:

"Idea that small schools are drawbacks to the overall education system should be repressed! Many persons believe that the quality of education must be lower in such a small school than in larger centres, but as shown by our school in comparison to provincial averages, the students perform as well or better than others across the province. A better teaching atmosphere (smaller classes), better rapport with students, etc. all lead to this fact. The student body as a whole benefits much more than they are disadvantaged by such a situation. The numbers speak for themselves!!"

A number of teachers, teaching in schools which are conjoint (and therefore technically not a small school) or in close proximity to larger centres offered the following comments:

"I do not feel limited in any way teaching in this particular rural school. Its close proximity to a larger center helps in availing me with any materials I should need.

This school is also fortunate enough to have a library which is, in fact, the town library. Therefore, I have access to enormous amounts of print resources and visual resources. The school library resources are better than the library resources available in Corner Brook's schools."

"Our school, J. R. Smallwood Collegiate, is a combination of two sides sharing facilities between the R. C. School Board and the Integrated School Board. This helps considerably in terms of resources."

Several teachers also offered suggestions as to how the provision of science in small schools could be improved:

"1) Special budgetary monies should be made available to small schools, specifically for the science department.

2) Because of the extra time needed for work in lab preparation, science teachers should have more 'preparation periods' made available to them and/or corridor supervision should be replaced with slotted preparation times (or as Crocker suggests, pay us more)."

"Distance education needs to be more widely available to the more capable, independent students."

"Any resource help needed for me personally would not take the form of things but rather communication. Someone to observe sometimes, ask questions, get feedback, etc."

"Develop courses that are set to our Newfoundland society and weather with emphasis on activity oriented curricula."

Summary

This chapter has presented the findings of the surveys received from the principals and teachers of small schools throughout the province. The following chapter will examine recommendations for improving the provision of science education in the province's small rural schools.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

Overview of the Chapter

The purpose of this chapter is to examine ways in which the provision of science in small rural high schools in Newfoundland can be improved. Results of the principal and teacher surveys have revealed many areas where the provision of science curriculum is seriously lacking in our small rural high schools. This chapter includes recommendations for improving science curriculum provision as well as related areas in which further studies are necessary. Both recommendations and suggested research are based on the findings of the study.

Science Facilities

Perhaps the most obvious way in which the science curriculum can be improved in our small rural high schools is by improving the facilities in which teachers must teach and students must learn. Despite recommendations made by the *Small Schools Project* (Riggs, 1987) and the recent task forces, survey results showed a serious lack of available resources for the teaching of science.

Of the 56 teachers who responded almost 20% reported that there were no designated science labs in their schools.

Others reported inadequate access to the science lab and many reported that their labs/schools were poorly equipped to teach the science courses offered. In many instances the type of equipment/materials which teachers were lacking were basic pieces of equipment, essential to any science course.

Thus, by ensuring that **all schools** have a **minimum of one well-equipped** science lab, we can improve our provision of science to students in small schools. This, however, is going to require a great deal of money being allocated to smaller schools to allow for the building of an adequate science lab in some cases, or for the purchase of needed science equipment in many cases.

Science Curriculum

With respect to the actual science courses offered within our province's small schools, it seems unreasonable to suggest that all prescribed science courses be offered in each of the schools, as this is not economically feasible. However, there are several ways by which curriculum offerings could be increased.

Teacher Allocation

According to the principal survey results science course offerings were limited as a result of several factors, including inadequate facilities, a lack of qualified staff, or an insufficient number of staff. The problem of inadequate facilities has already been discussed and the lack of qualified staff will be discussed later in this chapter.

With respect to an insufficient number of staff, this problem could be alleviated simply by increasing staff allocations in small schools throughout the province. This would then allow schools to increase the number of science and other courses offered. For this to be done fairly, the Department of Education must change its allocation policy to reflect a truer reporting of student enrolment.

As discussed in Chapter 3, school boards report their enrolment in all small schools, including those which are designated as joint service schools and which,in fact, may not be small when enrolments of both denominations are considered. Additional teaching units are allocated to school boards for these and other small schools, but yet these units may be placed in schools at the school boards discretion and thus may, in fact, not be placed in the small schools for which they were intended. Steps should be taken to ensure that additional teachers are allocated only for schools which are small, based on total enrolment, and that these teachers are placed within these designated schools. What is disturbing, is the fact that teacher allocations are currently being reduced throughout the province. This is resulting in fewer program offerings and an increase in the number of multi-grade classrooms.

School Consolidation

With respect to joint service schools, several principals and teachers indicated that their schools' curricula offerings had been increased as a result of consolidation of services between schools and school boards. In identifying the sample population it was found that there are still numerous situations whereby two or more small schools exist within close proximity of one another, each with inadequate facilities and limited course offerings. Steps should be taken by the Department of Education to eliminate such situations by encouraging the consolidation of such schools, thus maximizing both human and material resources.

Curriculum Development

Many teachers and principals complained about the science curriculum which they were expected to teach given their resources, both human and material. It seems reasonable to suggest that consideration be given to the development of a science curriculum for small schools and multi-grade classrooms. Similar recommendations have been made by Cutler (1989) and the 1989 Task Force on Math and Science (Crocker, 1989).

With respect to the junior high science program, many of the smaller schools indicated that their approach is to rotate courses, whereby the science courses offered are alternated each year. The effect of offering science courses in an order other than that which was intended, is an area in which further research is necessary. In the meantime, one solution would be to develop a junior high science curriculum especially for use in multi-grade classrooms.

At the senior high level there are more than twenty science courses approved by the Department of Education. As stated earlier, an increase in teacher allocations would allow a school to offer more science courses. A recommendation made by the 1989 Task Force on Math and Science, to develop a core science course for use in small schools, also seems to be a reasonable solution. However, this suggestion has yet to be implemented. Such a science course could integrate topics from each of the academic science areas.

As well, at present students need only complete four credits in science in order to graduate. This number should be increased to six, such that all students would be required to complete at least one science course in each year of senior high school. Such an increase in science credits would increase student participation and likely improve achievement as well.

A problem which was identified in both the junior and senior high science programs in small schools was the large variation in instructional time. With respect to the junior high science program, the recommended instructional time for science is 140 min/week. However, instructional time varied from 100 to 240 min/week in grades 7 and 8 and from 45 to 225 min/week in grade 9. In the senior high program the recommended instructional time for two credit courses is 200 min/week and 100 min/week for one credit courses. For two credit courses instructional time varied from 100 to 270 min/week. For one credit courses instructional time varied form 90 to 264 min/week. This is a huge variation, with some students receiving less than one half the recommended amount of instruction in science.

Steps should be taken by the Department of Education to decrease this variation in instructional time between schools and ensure that **all** schools are delivering the **minimum** recommended minutes of instruction/week to students. Further research is also needed to determine how widespread this problem is, and to determine the effects of reduced instructional time on student achievement in science.

A further curriculum problem which was exposed during this study was that of providing a suitable science curriculum to students in the province's native schools. As was indicated by one principal, the present curriculum is geared to English-speaking students, thus presenting a language barrier to native students who learn English as a second language. Consideration should be given to the development of a science curriculum suitable for use in the province's (or country's) native schools.

A further problem related to native schools was the large decline in student enrolment in the higher grades. Statistics received from the Department of Education concerning enrolments showed a significant decline in student enrolment beyond grade 6 in the native schools. In a K-12 school one would expect the K-6 population to be approximately equal to the 7-12 population. However, in several cases the 7-12 population accounted for less than one third of the total population. The reasons for such a decline in student enrolment should be examined and steps taken to decrease the number of native students who drop out of school.

Distance Education

Another means by which the science curriculum can be improved in our province's small rural schools is through distance education courses. However, this seems only feasible for senior high courses. There were many problems with the current distance education program revealed through both the teacher and principal surveys.

One recurring problem with the current distance education program is that of timetabling. Many principals referred to the problems they had in trying to accommodate distance education courses and arrange their schools' timetables so as to coincide with times that distance education courses were offered. Often, in order to accommodate distance education courses, schools experienced problems with busing, scheduling and students missing parts of other classes. These problems were especially prevalent in Labrador, due to the difference in time zones.

Considering that distance education courses were initially developed to improve curriculum offerings in small and remote schools, more effort should be made by the Department of Education to consider busing and timetabling problems experienced by these schools. Courses should be scheduled and offered at times convenient to all schools throughout the province taking into consideration the time difference experienced by schools in Labrador.

Principals and teachers also referred to the extra workload placed on them as a result of offering distance education courses within their schools. School staff were expected to be responsible for monitoring student performance, faxing and photocopying materials for students, and monitoring students for testing. Considering that many small schools do not have a school secretary, and that teachers and principals have full workloads with little or no preparation time, these additional duties place an extra burden on an already overworked staff. In contrast, schools where distance education courses are transmitted from, have been given funding to allow them to hire an individual to perform secretarial duties for the distance education teachers.

The Department of Education should consider providing schools which offer distance education courses with funding which would allow them to hire an individual to carry out secretarial duties each day. In many cases it may only be necessary to hire a person for one hour/day. As well, provision should be made for the hiring of an individual to supervise students during testing, as many small schools do not have a teacher free to supervise student testing when necessary.

Both teachers and principals expressed concerns over the difficulty students were having with respect to independent learning. In light of these problems the Department of Education should develop guidelines for student selection and provide students with advice on how to approach distance education learning.

Many principals indicated that monitoring of student progress had become one of their additional responsibilities, during an already hectic day. Thus, consideration should be given to hiring an individual to monitor student progress weekly, or in providing remuneration to teachers/principals who monitor student progress.

Pre-service Training

A major criticism of both teachers and principals was the inadequate training which teachers had received to prepare them for small school, multi-grade situations. Both teachers and principals suggested ways in which Memorial University of Newfoundland (MUN) could better prepare teachers to become rural science teachers. Survey results revealed the fact that many of the rural science teachers have an inadequate background in science and little training in the area of multi-grade teaching. Suggestions were made by teachers and principals to improve both.

With respect to improving pre-service training in science, many respondents suggested that teachers be required to complete more science courses as part of their pre-service training. It was also suggested that teachers be required to complete a wider variety of science courses, such that teachers would be science generalists rather than specialists. Another recommendation was that teachers be required to complete more science education courses, rather than the prescribed one to three. Unfortunately the requirements for a conjoint degree in science and education have been changed in recent years, such that students are required to complete fewer science methodology and science education courses. Considering that many of the potential teachers completing a degree at Memorial University will teach in the province's smaller schools and will likely teach one or more science courses, this seems to be a definite step in the wrong direction. In fact, teachers completing education in all curriculum areas should have some science training.

Suggestions were also made to increase the pre-service training with respect to teaching in small schools and multi-grade situations. As such, consideration should be given to the development of a course by Memorial University's Faculty of Education which addresses the problems associated with teaching in small rural schools. Such a course could cover such topics as integration of subjects, grades and student abilities. Ideally, the development of such a course for science teachers would be the best solution. However, a general course for all prospective teachers would be a beginning.

At present, Memorial University requires that all prospective teachers complete an internship program, whereby the student spends a significant amount of one term within the school system. Many respondents indicated that MUN should increase the number of placements in small rural schools. This would provide these prospective teachers with more hands-on, in-class experience. Such a practice would not only better prepare teachers for positions in small rural schools, but also, as suggested by many researchers, improve the selection, recruitment and retainment of qualified teachers by these schools.

Not only is the pre-service training for teachers in small schools lacking, but such training for administrators of small schools is also an issue. As was suggested by Fennell (1990) there is limited training available for rural administrators. Prospective rural administrators face problems unique to small rural schools associated with budget, curriculum and staffing. As such, the Faculty of Education at MUN should consider the development of a course which considers these issues as part of the Masters program in Administration. School boards throughout the province could then require all administrators within their small schools to complete the course as part of their professional development.

Professional Development

Suggestions were made by both principals and teachers as to how professional development could be improved for the province's science teachers in small rural schools. Many suggestions were already made by recent studies, particularly the 1992 Royal Commission *Our Children Our Future*. Unfortunately, many recommendations made previously have yet to be implemented.

In-servicing

Many principals and teachers complained of a lack of available in-servicing, for various reasons. In the province's smaller schools, one teacher is rarely limited to a particular curriculum area such as science. Often science teachers in small schools are not science majors and have little or no science background. Yet, these teachers are often denied leave to attend science workshops, as they are not seen by their board as being science teachers. Thus, teachers who are teaching perhaps one or two science courses, should receive in-servicing with respect to the science courses they are teaching, **especially** if science is not their area of expertise.

Other reasons for lack of in-servicing included distance and time. Many teachers on the south coast and in Labrador complained about the cost and time needed to travel to in-servicing which usually occurred far from their schools. As well, many of these teachers were teaching in multi-grade situations or had workloads which would require a tremendous amount of preparation for a substitute, if, in fact, a substitute were available to them. Special consideration for in-servicing should be given to these teachers. Extra time should be granted to these teachers for in-servicing, over and above the five days of leave for professional development granted by the Department of Education, to accommodate their travel time. As well, special funding should be made available, either through school boards, the Department of Education or the NLTA, to offset their travel expenses.

In cases where no substitutes are available and classes or a school must be closed, permission should be granted to do so, up to a maximum number of days, to be determined by the Department of Education. Such situations are very real in remote areas of the province. Recommendations such as those made by the 1992 Royal Commission, calling for the development of a Professional Development Centre to meet the needs of rural teachers would be ideal. However, such recommendations have not yet been implemented. Through these recommendations, professional development would be taken to the teacher.

The Department of Education and school boards need to research and assess the needs of rural science teachers. This will ensure that their needs can then be addressed through professional development, either through the NLTA, individual school boards or the Department of Education. However, it should be kept in mind that in order to be effective, such in-servicing must be long-term, needs-based and actively involve the participants, namely rural science teachers. Too often in-servicing is short-term, with little or no follow-up. Often in-servicing has little relevance to the rural science teacher, who has needs quite different from those of the urban teacher in a larger school.

STEM-Net

STEM-Net is one way by which professional development, in the form of ideas, contacts and information can be brought to rural teachers. Many rural teachers complained of the isolation they felt, and of their frustration with their lack of contact with other teachers. Many expressed the view that contact with other teachers would be a welcome resource and a means by which they could share their ideas and vent their frustrations. As such, the use of STEM-Net by rural science teachers should be promoted to allow for professional expansion.

Surprisingly, a large number of teachers made limited use of computers in their teaching. Thus, if STEM-Net is to be widely used as a resource and a professional link between teachers, it will need to be strongly promoted and teachers will need to feel comfortable using the computer as a daily resource. As such, teachers will need to be in-serviced in the general use of computers and in the specific use of STEM-Net. In the next few years the use of STEM-Net as a means of reducing professional isolation will need to be examined so as to determine the specific role of STEM-Net among rural teachers.

Professional Periodicals

An easy way to help reduce professional isolation among rural science teachers is to ensure that all rural schools have access to professional science teaching magazines/ periodicals. One would think that such material would be found in the staff room of every school in the province, however, only 50% of the respondents had access to such material through their school or board office. Such material provides teachers with valuable information on teaching methods and resources and acts as a forum for professional discussion. Perhaps their apparent lack of availability is due to ignorance on the part of the teacher of their existence, or to a lack of funding available. Often, when funds are scarce, purchase of teaching materials overrides the purchase of professional development materials. In any event, school boards and the NLTA should ensure the existence of such material in all schools.

Teacher Upgrading

In terms of upgrading through Memorial University, this is next to impossible, unless one is prepared to forfeit a semester or year's salary. Very few pure science courses are offered by the Science Faculty during the summer semester. As well, few teaching institutes are offered to teachers in various science fields by the Education Faculty. Several institutes have been offered in past years, but were cancelled because of lack of interest. With the increased enrolment at MUN over the past several years, one would expect that such courses could be offered and be viable for the university. Other options would be to offer such courses through correspondence or via teleconferencing. If such courses were made available to teachers, initiatives for the Department of Education or school boards to cost share tuition would certainly encourage teacher participation.

National Science Institutes

In addition to provincial and district professional development, there are several national science institutes available to science teachers, such as those offered by SEEDS and the KEY Foundation. Yet, less than 10% of the respondents had heard of, or participated in, these worthwhile programs. Thus, effort should be made to inform rural science teachers of these programs and to encourage their participation, perhaps through partial funding to share tuition and travel costs.

Workload

Perhaps one of the most disturbing findings of this study was the tremendous workload with which rural science teachers are faced. Science teachers in general have relatively heavy workloads, as they are responsible for the upkeep of a laboratory in addition to their regular course preparation. However, rural science teachers have a particularly heavy workload due to several factors.

Often rural science teachers are not science majors, which means they must first learn the material they are expected to teach. Second, these teachers often have to alter course material/labs due to a lack of available materials. Third, these teachers often teach in schools which are multi-graded. Thus, they do not usually teach the normal course load of six to eight courses. Survey respondents were responsible for as many as 48 preparations, in addition to the science courses they taught. Several teachers were responsible for all courses in several grades. Although these teachers would have small numbers of students, the preparation time needed for a course is the same, regardless of the number of students taught. As well, in the smaller schools these teachers have little or no scheduled preparation time during the school day. There should be some effort made by school boards to reduce the excessive workload experienced by these teachers, or to compensate them for their extra time and effort.

One way the Department of Education could reduce the workload of all teachers in the smaller schools would be to hire an individual to perform corridor/playground supervision. Such an individual could also act as a teacher aide, thereby providing the teacher with some free time and assisting in course preparation. In cases where scheduled preparation time for teachers cannot be arranged, a bonus should be paid to these teachers for their extra preparation and time worked.

In small schools, heavy workloads are not limited to teachers. Many administrators have full course loads in addition to their administrative duties. This is unfair to the administration, as small rural schools often face unique administrative challenges such as timetabling and budgeting which must be dealt with. School boards should ensure that rural administrators have reduced teaching assignments, thus allowing the administrators time for curriculum development and other administrative duties.

Of course, the easiest way for school boards to do this would be to increase teacher allocation in small schools. However, this solution is unlikely to occur. At present, principals of large schools, with few if any teaching duties, receive bonuses based on student enrolment. Principals in small schools, with fewer students, but most likely more responsibility, receive lower bonuses. If principals in small schools are to have full course loads, then they, too, should receive an additional bonus for their increased workload and additional time and effort.

Gender

A disturbing statistic revealed by this study was the low percentage of female science teachers in small rural schools, as well as the low percentage of female administrators in these schools. With respect to teachers, only 7 of the 56 respondents (12.5%) were female. Of the 71 principals who responded, only 7 (9%) were female. These statistics show a shockingly low representation of females. A common complaint of science education in general, is the low number of female participants in the senior grades. One suggested way to increase the number of female participants is to provide them with female role models. This does not seem to be the case in our small rural schools.

Although gender representation was not a major focus of this particular study, it is an area which warrants further research. Steps should be taken to determine the actual representation of female science teachers and administrators in small rural schools. As well, the participation rate of female students in science courses in small rural schools should be examined, to determine if, in fact, there is any correlation. In the meantime, steps should be taken to improve the ratio of female to male science teachers and administrators in the province's small rural schools.

List of Recommendations

The following recommendations have been made based on the results of the principal and teacher surveys administered throughout the province:

1. Each and every small school in the province, regardless of size, be provided with a science lab containing adequate seating, running water, sinks, fume hoods, propane and proper storage facilities.
2. Each small school be given monies to equip their science lab with such basic equipment as outlined in the provincial course descriptions, for all science courses offered in their school.
3. Teacher allocations for small schools be increased and the Department of Education ensure that these additional units are placed directly in those schools which are designated as small, based on total student enrolment.
4. Where possible, small schools within close proximity of each other be consolidated so as to maximize resources.
5. A junior high science curriculum be developed for use in multi-grade classrooms.
6. A core science program, incorporating biology, chemistry and physics, be developed for implementation in small senior high schools.

7. The number of science credits required for graduation be increased from four to six.

8. The Department of Education take steps to reduce the variation in instructional time for science between schools and ensure that students receive a minimum number of minutes of instructional time in their science courses.

9. A science program cognizant of the language barrier faced by native students be developed for implementation in the province's (or country's) native schools.

10. The Department of Education examine busing and timetabling problems experienced by schools offering distance education courses and ensure that these courses are transmitted at times convenient to all schools within the province.

11. The Department of Education provide funding to schools receiving distance education courses which would allow the hiring of an individual to perform secretarial duties for students.

12. The Department of Education provide funding to schools receiving distance education courses which would allow them to hire an individual to supervise student testing (as is done for public exams).

13. The Department of Education examine the process of student selection for distance education courses and

develop guidelines to assist schools in selecting students.

14. The Department of Education develop a program to assist students with their approach to distance education (independent learning).

15. The Department of Education provide funding to schools receiving distance education courses which would allow them to hire an individual to monitor student progress, or provide remuneration to teachers/principals for monitoring students.

16. The requirements for a conjoint B. Sc. and B. Ed. at Memorial University be changed to include a wider range of science courses.

17. The requirements for a conjoint B. Sc. and B. Ed. at Memorial University be changed to include a larger number of science education and methods courses.

18. The requirements for any B. Ed. at Memorial University be changed to include the completion of a number of science courses.

19. The Faculty of Education at Memorial University develop a course(s) geared to prospective teachers in small schools which would address integration of subjects, grades and abilities.

20. The Faculty of Education at Memorial University increase the number of teacher interns placed in small rural

schools.

21. The Faculty of Education at Memorial University develop a course as part of the M. Ed. Program in Administration which would address the problems faced by rural administrators throughout the province.

22. School boards require all administrators to complete the above recommended course, as part of their professional development.

23. School boards ensure that the non-science majors who are teaching science courses, are in-serviced for the science courses which they are teaching.

24. Teachers in remote areas of the province be granted additional professional development days, beyond the five days presently provided, to allow for travel time.

25. The Department of Education, the NLTA or school boards, provide funding to teachers from remote schools attending professional development.

26. School boards be granted special permission by the Department of Education to close small schools for a maximum number of days (to be determined by the Department of Education) to allow for teacher in-servicing in remote areas where there are no available substitutes.

27. Rural science teachers be in-serviced on the use of computers both as a teaching tool and as a tool for

professional development.

28. STEM~Net be promoted among rural science teachers, with emphasis on its ability to reduce professional isolation.
29. School boards or the NLTA ensure that professional science/teaching magazines/periodicals are made available in all schools.
30. The Department of Education, or school board, encourage the upgrading of rural science teachers by developing a cost share program for teacher tuition.
31. The Faculty of Science at Memorial University offer a variety of pure science courses during the summer semester, to accommodate teacher upgrading.
32. The Faculty of Education at Memorial University offer a variety of summer institutes in the teaching of various sciences to accommodate teacher upgrading.
33. The Department of Education, the NLTA and school boards communicate to rural science teachers the occurrence of national science institutes.
34. The Department of Education, the NLTA or school boards encourage the participation of rural science teachers in national science institutes by providing financial assistance to offset costs.
35. In the smaller schools (e.g. less than five teachers or where extensive multi-grading exists) the Department of Education hire an individual to perform corridor/

playground supervision, so as to allow teachers some preparation time.

36. In the smaller schools (as above) the Department of Education hire teacher aides to assist teachers in course preparation, thereby reducing teacher workload.

37. In small schools where scheduled preparation periods cannot be arranged for teachers, the Department of Education or school boards pay teachers a bonus for their extra preparation and workload.

38. School boards ensure that principals of small schools have reduced teaching assignments so as to allow time for curriculum development and other administrative duties.

39. In small schools where principals have full teaching assignments, a bonus be paid to these administrators for their additional workload.

40. The Department of Education and schools boards take steps to increase the ratio of female to male science teachers in small rural schools.

41. The Department of Education and school boards take steps to increase the ratio of female to male administrators in small rural schools.

Suggestions for Further Research

The following suggestions for further research have been made based on the results of the principal and teacher surveys administered throughout the province:

1. The effect of offering junior high science courses in an order other than that which was intended be studied, so as to develop a multi-grade curriculum approach suitable for use in junior high.
2. The variation in instructional time of science courses in all schools be examined so as to determine the extent of variation and the effects of this variation on student achievement.
3. The student drop out rate in native schools be examined to determine the causes so as to reduce this rate.
4. The use of STEM~Net among rural science teachers be examined so as to determine how STEM~Net can best be used to reduce professional isolation among rural teachers and promote professional development.
5. The specific needs of rural science teachers be researched and assessed, so as to develop long term in-servicing based on the their needs, and in which they are actively involved.
6. The actual representation of female science teachers in small rural schools be determined and correlated with the female participation rate in science to determine the

relationship, if any, which exists.

7. The actual representation of female administrators in small rural schools be determined.

Summary

This chapter has made a number of suggestions for improving the provision of science curriculum in the small rural schools of Newfoundland and Labrador. Such improvements would involve the Department of Education, Memorial University of Newfoundland, the NLTA and individual school boards throughout the province. It is hoped that the suggestions for science curriculum improvement and suggested areas for further research made in this study will be pursued, such that we may move closer to the goal of equalized educational provision for the students in small rural schools of our province. Only then can we expect science participation and achievement by rural students to improve.

Recent years have seen some emphasis placed on science education, and education in general, in small rural schools. The existence of studies such as the 1987 *Small Schools Study Project*, and the references to small schools in studies such as the 1989 Math and Science Task Force report *Towards an Achieving Society*, and the 1992 Royal Commission report *Our Children Our Future* are encouraging. However, it is discouraging that many of the recommendations for improvement made with respect to small schools have not yet been implemented.

Recent years have also seen the development of the Small Schools Special Interest Council by the NLTA. The council was developed following the National Small Schools Conference held in Deer Lake in 1992. This special interest council has held provincial conferences in the past several years, although attendance has been limited, perhaps due to reasons outlined by this study.

The provincial government, acting on recommendations made by the 1992 Royal Commission has been attempting to reduce the number of school boards and small schools throughout the province through educational reform. However, this reform and consolidation has received much opposition by the churches, schools and communities in general. Perhaps the government should examine the advantages of small schools and work to improve these schools and the education they provide rather than eliminate them.

It is hoped that these study results will influence the thinking of some, and that attention will be paid to the concerns voiced by the province's science teachers in small rural schools. By addressing these concerns we can improve curriculum provision, thus improving science education in small schools throughout our province.

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Appendix A

School Boards Key

SCHOOL BOARDS KEY

101	Vinland - Straits of Belle Isle Integrated
103	Deer Lake - St. Barbe South Integrated
104	Green Bay Integrated
105	Exploits Valley Integrated School District
106	Notre Dame Integrated
107	Nova Consolidated School District
109	Bonavista - Trinity - Placentia - Integrated
110	Avalon North Integrated
112	Burin Peninsula Integrated
113	Bay D'espoir - Hermitage - Fortune Bay Integrated
114	Port Aux Basques Integrated
115	Western Integrated
117	Labrador East Integrated
118	Labrador West Integrated
502	Burin Peninsula Roman Catholic
504	Western Avalon Roman Catholic
506	Exploits - White Bay Roman Catholic
508	Gander - Bonavista - Connaigre Roman Catholic
509	Humber - St. Barbe Roman Catholic
510	Labrador Roman Catholic
512	Appalachia Roman Catholic
401	Pentecostal Assemblies Board
701	Seventh Day Adventist

Appendix B

Schools via School Boards

SCHOOLS VIA SCHOOL BOARDS

101 Vinland - Straits of Belle Isle Integrated

Cook's Harbour - James Cook Memorial

Englee - H.G. Fillier All Grade

Forteau - Mountain Field Central High

Griquet - Truman Eddison Memorial

Lodge Bay - St. James Integrated

Main Brook - Mary Simms All Grade

Mary's Harbour - St. Mary's All Grade

Norman Bay - Norman Bay Integrated

Pinsent's Arm - Pinsent's Arm Integrated

Port Hope Simpson - Bayview Integrated

Raleigh - Pistolet Bay School

Red Bay - Basque Memorial

Roddickton - Roddickton All Grade

St. Lewis - St. Lewis All Grade

William's Harbour - William's Harbour Integrated

103 Deer Lake - St. Barbe South Integrated

Daniel's Harbour - Holy Cross All Grade

Hampden - Hampden All Grade

Harbour Deep - St. Peter's All Grade

Hawke's Bay - Ingornachoix Bay Elementary

Howley - Howley Elementary

Parson's Pond - St. Francis Elementary

River of Ponds - St. Peter's All Grade

Trout River - Jakeman All Grade

Woody Point - Bonne Bay Central High

104 Green Bay Integrated

Beaumont - Long Island Academy

King's Point - Valmont Academy

Little Bay Islands - H.L. Strong Academy

Purbeck's Cove - St. George's Elementary

Westport - St. Peter's Academy

105 Exploits Valley Integrated School District

Badger - Avoca Collegiate (J.S) (506)

Buchans - Buchans Public High (J.S) (506)

Cottrell's Cove - Cottrell's Cove Academy (J.S.) (506)

106 Notre Dame Integrated

Change Islands - A.R. Scammell Academy

Norris Arm - Norris Arm Integrated Elementary

107 Nova Consolidated School District

Eastport - Holy Cross School Complex

Glenwood - Lakewood Academy (J.S.) (508)

Greenspond - Heritage Academy

Lumsden - Lumsden School Complex

109 Bonavista - Trinity - Placentia - Integrated

Arnold's Cove - St. Michael's Integrated

Sunnyside - R.K. Gardner All Grade

Swift Current - Swift Current All Grade

110 Avalon North Integrated

Heart's Delight - Epiphany Elementary (J.S.) (504)

Western Bay - Jackson Walsh Central

112 Burin Peninsula Integrated

Grand Le Pierre - St. Thomas' School

Jacques Fontaine - Jacques Fontaine All Grade

Monkstown - Frampton Elementary

113 Bay D'espoir - Hermitage - Fortune Bay Integrated

English Harbour West - Fitzgerald Academy

Francois - St. Simon and St. Jude All Grade

Gaultois - Victoria All Grade

Harbour Breton - King Academy

Hermitage - John Watkins Academy

McCallum - St. Peter's All Grade

Pool's Cove - Florence M. William's School

Rencontre East - St. Stephen's All Grade

Seal Cove - John Loveless All Grade

114 Port Aux Basques Integrated

Grand Bruit - Grand Bruit All Grade

Isle Aux Morts - Le Gallais Memorial All Grade

Lapoile - Douglas Academy

Petites - Ocean View Elementary

115 Western Integrated

Grey River - All Saints All Grade

Lark Harbour - St. James All Grade

McKay's - E.A. Butler All Grade

Ramea - St. Boniface All Grade

117 Labrador East Integrated

Cartwright - Henry Gordon Academy

Mud Lake - Mud Lake Elementary

Northwest River - Lake Melville School

Paradise River - St. George's School

Hopedale - Amos Comenius All Grade (N)

Makkovik - J.C. Erhardt (N)

Nain - Jens Haven Memorial (N)

Rigolet - Northern Lights Academy (N)

118 Labrador West Integrated

Wabush - J.R. Smallwood All Grade (J.S) (510)

502 Burin Peninsula Roman Catholic

English Harbour East - St. George's School

Lawn - Holy Name of Mary Academy

Petite Forte - St. J. Fisher and T. More School

Rushoon - Christ the King All Grade

St. Bernard's - St. Bernard's All Grade

South East Bight - St. Anne's School

Terrenceville - St. Joseph's All Grade

504 Western Avalon Roman Catholic

Bay de Verde - St. Joseph's Central High

Dunville - St. Anne's Academy (J.S.) (110)

Long Harbour - Xavier Central High

Mount Carmel - Our Lady Mount Carmel Central High

Northern Bay - Corpus Christi Central High

Southern Harbour - Our Saviour King Academy

St. Joseph's - Enright all Grade

506 Exploits - White Bay Roman Catholic

Badger - Avoca Collegiate (J.S.) (105)

Bishop's Falls - Leo Burke Academy

Brent's Cove - La Rochelle Central High

Buchans - St. Theresa's All Grade (J.S.) (105)

Cottrell's Cove - St. Anne's Elementary (J.S.) (105)

Norris Arm - Carmel Collegiate

508 Gander - Bonavista - Connaigre Roman Catholic

Gambo - Sacred Heart Elementary (J.S.) (107)

Glenwood - Lakewood Academy All Grade (J.S.) (107)

Harbour Breton - St. Joseph's All Grade

St. Brendan's - St. Gabriel's All Grade

509 Humber - St. Barbe Roman Catholic

Conche - Sacred Heart All Grade

Croque - St. Joseph's All Grade

Deer Lake - Elwood Regional High (J.S.) (103)

Goose Cove - St. Mary's Elementary

510 Labrador Roman Catholic

Black Tickle - St. Peter's School

Wabush - J.R. Smallwood Collegiate (J.S.) (118)

West. Ste. Modeste - Our Lady of Labrador

Sheshatshit - Peenamin McKenzie (N)

Utshimassits - Nukum Mani Shan (N)

512 Appalachia Roman Catholic

DeGrau/Cape St. George - Ecole Notre Dame du Cap

DeGrau - Our Lady of the Cape

Mainland - Ecole Ste. Anne

St. Fintans - Cassidy Memorial

401 Pentecostal Assemblies Board

Badger - Badger Elementary

Burlington - M.W. Jeans Academy

Charlottetown - William Gillett Academy

Creston North (Marystown) - Creston Academy

Deer Lake - Deer Lake School

Goobies - Goobies Elementary

Hawke's Bay - Ralph Harnum Memorial All Grade

Middle Arm - John Thomas All Grade

Port de Grave - Port de Grave Pentecostal School

Port Hope Simpson - D.C. Young School

Roddickton - A.C. Palmer Collegiate

St. Lunaire - A. Garrigus Collegiate

Stephenville - L.S. Eddy Memorial Collegiate

Victoria - Bethel Academy

Robert's Arm - R. W. Parson's All Grade

Postville - B. L. Morrison School (N)

701 Seventh Day Adventist

Bay Roberts - Lyndale Academy

Botwood - Exploits Valley Adventist Academy

Corner Brook - Highview Academy

Marystown - Crestview Academy

St. John's - St. John's Academy

Appendix C

Schools Key

SCHOOLS

101 Vinland - Straits of Belle Isle Integrated

Community	School	Grades	Population Total (7-12)
Cook's Harbour	James Cook Memorial	K-12	103 (49)
Englee	H. G. Fillier All Grade	K-12	179 (85)
Forteau	Mountain Field Central High	7-12	148
Griquet	Truman Eddison Memorial	K-12	181 (72)
Lodge Bay	St. James Integrated	K-9	14 (6)
Main Brook	Mary Simms All Grade	K-12	117 (59)
Mary's Harbour	St. Mary's All Grade	K-12	121 (60)
Norman Bay	Norman Bay Integrated	K-9	11 (3)
Pinsent's Arm	Pinsent's Arm Integrated	K-9	23 (5)
Port Hope Simpson	Bayview Integrated	K-9	34 (11)
Raleigh	Pistolet Bay School	K-9	87 (23)
Red Bay	Basque Memorial	K-12	68 (31)
Roddickton	Roddickton All Grade	K-12	198 (99)
St. Lewis	St. Lewis Academy	K-12	80 (40)
William's Harbour	William's Harbour Integrated	K-9	8 (3)

103 Deer Lake - St. Barbe South Integrated

Community	School	Grades	Population Total (7-12)
Daniel's Harbour	Holy Cross All Grade	K-12	129 (81)
Hampden	Hampden All Grade	K-12	228 (115)
Harbour Deep	St. Peter's All Grade	K-9	31 (8)
Hawke's Bay	Ingornachoix Bay Elementary	K-7	37 (4)
Howley	Howley Elementary	K-8	51 (9)
Parson's Pond	St. Francis Elementary	K-7	88 (10)
River of Ponds	St. Peter's All Grade	K-9	41 (6)
Trout River	Jakeman All Grade	K-12	175 (82)
Woody Point	Bonne Bay Central High	7-12	70

104 Green Bay Integrated

Community	School	Grades	Population Total (7-12)
Beaumont	Long Island Academy	K-12	89 (43)
King's Point	Valmont Academy	K-12	220 (119)
Little Bay Islands	H. L. Strong Academy	K-12	40 (21)
Purbeck's Cove	St. George's Elementary	K-9	9 (3)
Westport	St. Peter's Academy	K-12	133 (60)

105 Exploit's Valley Integrated School District

Community	School	Grades	Population Total (K-12)
Badger	Avoca Collegiate	K-12	49 (34)
Buchans	Buchans High	7-12	121
Cottrell's Cove	Cottrell's Cove Academy	K-12	59 (32)

106 Notre Dame Integrated

Community	School	Grades	Population Total (7-12)
Change Islands	A.R. Scammell Academy	K-12	106 (49)
Norris Arm	Norris Arm Integrated	K-9	101 (43)

107 Nova Consolidated School District

Community	School	Grades	Population Total (7-12)
Eastport	Holy Cross School Complex	K-12	310 (163)
Glenwood	Lakewood Academy	K-12	239 (109)
Greenspond	Heritage Academy	K-7	40 (5)
Lumsden	Lumsden School	K-12	249 (120)

109 Bonavista - Trinity - Placentia - Integrated

Community	School	Grades	Population Total (7-12)
Arnold's Cove	St. Michael's Integrated	K-12	278 (156)
Sunnyside	R.K. Gardner Integrated	K-12	179 (107)
Swift Current	Swift Current Integrated	K-12	153 (83)

110 Avalon North Integrated

Community	School	Grades	Population Total (7-12)
Heart's Delight	Epiphany Elementary	K-7	37 (4)
Western Bay	Jackson Walsh Central High	7-12	120

112 Burin Peninsula Integrated

Community	School	Grades	Population Total (7-12)
Grand Le Pierre	St. Thomas School	K-9	76 (20)
Jacques Fontaine	Jacques Fontaine All Grade	K-12	261 (162)
Monkstown	Frampton Elementary	K-12	6 (3)

113 Bay D'Espoir - Hermitage - Fortune Bay Integrated

Community	School	Grades	Population Total (7-12)
English Harbour West	Fitzgerald Academy	K-12	318 (188)
Francois	St. Simon and St. Jude All Grade	K-12	50 (27)
Gaultois	Victoria All Grade	K-12	111 (47)
Harbour Breton	King Academy	K-12	282 (148)
Hermitage	John Watkins Academy	K-12	180 (104)
McCallum	St. Peter's All Grade	K-12	31 (18)
Pool's Cove	Florence M. Williams School	K-9	33 (10)
Rencontre East	St. Stephen's All Grade	K-12	51 (20)
Seal Cove (Fortune Bay)	John Loveless All Grade	K-12	90 (48)

114 Port Aux Basques Integrated

Community	School	Grades	Population Total (7-12)
Grand Bruit	Grand Bruit All Grade	K-12	10 (7)
Isle Aux Morts	Le Gallais Memorial	K-12	238 (124)
Lapoile	Douglas Academy	K-12	26 (11)
Petites	Ocean View School	K-9	19 (7)

115 Western Integrated

Community	School	Grades	Population Total (7-12)
Grey River	All Saints All Grade	K-12	53 (23)
Lark Harbour	St. James All Grade	K-12	258 (153)
McKay's	E.A. Butler All Grade	K-12	284 (169)
Ramea	St. Boniface All Grade	K-12	284 (169)

117 Labrador East Integrated

Community	School	Grades	Population Total (7-12)
Cartwright	Henry Gordon Academy	K-12	144 (78)
Mud Lake	Mud Lake Elementary	K-9	9 (3)
North West River	Lake Melville School	K-12	124 (72)
Paradise River	St. George's School	K-?	6 (1)
Hopedale (N)	Amos Comenius All Grade	K-12	164 (51)
Makkovik (N)	J.C. Erhardt	K-12	96 (37)
Nain (N)	Jens Haven Memorial	K-12	352 (163)
Rigolet (N)	Northern Lights Academy	K-12	101 (50)

118 Labrador West Integrated

Community	School	Grades	Population Total (7-12)
Wabush	J.R. Smallwood All Grade	K-12	284 (169)

502 Burin Peninsula Roman Catholic

Community	School	Grades	Population Total (7-12)
English Harbour East	St. George's All Grade	K-8	45 (16)
Lawn	Holy Name of Mary Academy	K-12	277 (143)
Petite Forte	St. J. Fisher and T. More School	K-9	32 (7)
Rushoon	Christ the King All Grade	K-12	178 (100)
St. Bernard's	St. Bernard's All Grade	K-12	178 (100)
South East Bight	St. Anne's School	K-?	31 (13)
Terrenceville	St. Joseph's All Grade	K-12	264 (156)

504 Western Avalon Roman Catholic

Community	School	Grades	Population Total (7-12)
Bay de Verde	St. Joseph's Central High	7-12	145
Dunville	St. Anne's Academy	7-12	40
Long Harbour	St. Francis Xavier Central High	7-12	123
Mount Carmel	Our Lady of Mount Carmel Central High	7-12	133
Northern Bay	Corpus Christi Central High	7-12	110
St. Joseph's	Enright Memorial	K-12	181 (93)
Southern Harbour	Our Saviour the King All Grade	K-12	196 (96)

506 Exploits - White Bay Roman Catholic

Community	School	Grades	Population Total (7-12)
Badger	Avoca Collegiate	K-12	138 (81)
Bishop's Falls	Leo Burke Academy	K-12	321 (161)
Brent's Cove	La Rochelle Central High	6-12	89 (71)
Buchans	St. Theresa's All Grade	K-12	99 (55)
Cottrell's Cove	Cottrell's Cove Academy	K-12	24 (17)
Norris Arm	Carmel Collegiate	K-12	98 (51)

508 Gander - Bonavista - Connaigre Roman Catholic

Community	School	Grades	Population Total (7-12)
Gambo	Sacred Heart Elementary	K-8	52 (15)
Glenwood	Lakewood Academy	K-12	58 (35)
Harbour Breton	St. Joseph's All Grade	K-12	277 (149)
St. Brendan's	St. Gabriel's All Grade	K-12	96 (43)

509 Humber - St. Barbe Roman Catholic

Community	School	Grades	Population Total (7-12)
Conche	Sacred Heart All Grade	K-12	97 (42)
Croque	St. Joseph's All Grade	K-12	69 (30)
Deer Lake	Elwood Regional High	10-12	63
Goose Cove	St. Mary's Elementary	K-8	61 (7)

510 Labrador Roman Catholic

Community	School	Grades	Population Total (7-12)
Black Tickle	St. Peter's All Grade	K-12	63 (28)
Wabush	J.R. Smallwood Collegiate	K-12	193 (130)
West Ste. Modeste	Our Lady of Labrador	K-12	101 (49)
Sheshatshit (N)	Peenamin McKenzie	K-12	332 (94)
Utshimassits (N)	Nukum Mani Shan	K-12	176 (38)

512 Appalachia Roman Catholic

Community	School	Grades	Population Total (7-12)
DeGrau/Cape St. George	Ecole Notre Dame du Cap	K-12	93 (38)
DeGrau	Our Lady of the Cape	K-12	245 (140)
Mainland	Ecole Ste. Anne	K-8	71 (17)
St. Fintan's	Cassidy Memorial	K-12	166 (72)

401 **Pentecostal Assemblies Board**

Community	School	Grades	Population Total (7-12)
Badger	Badger Elementary	K-8	42 (13)
Burlington	M.W. Jeans Academy	K-7	82 (12)
Charlottetown (Labrador)	William Gillett Academy	K-12	79 (35)
Creston North (Marystown)	Creston Academy	K-8	36 (9)
Deer Lake	Deer Lake School	K-12	324 (165)
Goobies	Goobies Elementary	K-8	37 (4)
Hawke's Bay	Ralph Harnum Memorial	K-12	204 (131)
Middle Arm	John Thomas All Grade	K-12	223 (138)
Port de Grave	Port de Grave School	K-9	106 (35)
Port Hope Simpson	D.C. Young School	K-12	117 (50)
Roddickton	A.C. Palmer Collegiate	7-12	81
St. Lunaire	A. Garrigus Collegiate	7-12	106
Stephenville	L.S. Eddy Collegiate	7-12	82
Victoria	Bethel Academy	K-9	89 (30)
Robert's Arm	R.W. Parsons All Grade	K-12	299 (238)
Postville (N)	B.L. Morrison School	K-12	54 (25)

701 Seventh Day Adventist

Community	School	Grades	Population Total (7-12)
Bay Roberts	Lyndale Academy	K-9	21 (4)
Botwood	Exploits Valley Academy	K-12	41 (18)
Corner Brook	Highview Academy	K-12	43 (17)
Marystown	Crestview Academy	K-9	20 (6)
St. John's	St. John's Academy	7-12	82

Appendix D

Joint Services Schools

JOINT SERVICES SCHOOLS

Community	School	School Boards
Badger	Avoca Collegiate	105 Exploits Valley Integrated 506 Exploits - White Bay Roman Catholic
Buchans	Buchans High	105 Exploits Valley Integrated 506 Exploits - White Bay Roman Catholic
Cottrell's Cove	Cottrell's Cove Academy	105 Exploits Valley Integrated 506 Exploits - White Bay Roman Catholic
Deer Lake	Elwood Regional High	103 Deer Lake - St. Barbe South Int. 509 Humber - St. Barbe Roman Catholic
Dunville	St. Anne's Academy	110 Avalon North Int. 504 Western Avalon R.C.
Gambo	Sacred Heart Elementary	107 Nova Consolidated 508 Gander - Bonavista - Connaigre R.C.
Glenwood	Lakewood Academy	107 Nova Consolidated 508 Gander - Bonavista - Connaigre R.C.
Heart's Delight	Epiphany Elementary	110 Avalon North Int. 504 Western Avalon R.C.
Wabush	J.R. Smallwood Collegiate	118 Labrador West Int. 510 Labrador R. C.

Appendix E

Joint Service School Statistics

JOINT SERVICE SCHOOL STATISTICS

Badger - Avoca Collegiate

105 Exploits Valley Integrated

506 Exploits - White Bay R.C.

Stats - 105 K-12 (49)

506 K-12 (138)

Buchans - Buchans High

105 Exploits Valley Integrated

506 Exploits - White Bay R.C.

Stats - 105 7-12 (121)

506 K-12 (99)

Cottrell's Cove - Cottrell's Cove Academy

105 Exploits Valley Integrated

506 Exploits - White Bay R.C.

Stats - 105 K-12 (58)

506 K-12 (24)

Deer Lake - Elwood Regional High

103 Deer Lake - St. Barbe South Integrated

509 Humber - St. Barbe Roman Catholic

Stats - 509 10-12 (63)

103 10-12 (380)

Dunville– St. Anne's Academy

110 Avalon North Integrated

504 Western Avalon Roman Catholic

Stats - 110 7-12 (40)

504 K-12 (438)

Gambo - Sacred Heart Elementary

107 Nova Consolidated School District

508 Gander - Bonavista - Connaigre Roman Catholic

Stats - 508 K-8 (52)

107 K-8 (275)

Glenwood - Lakewood Academy

107 Nova Consolidated School District

508 Gander - Bonavista - Connaigre Roman Catholic

Stats - 107 K-12 (239)

508 K-12 (58)

Heart's Delight - Epiphany Elementary

110 Avalon North Integrated

504 Western Avalon Roman Catholic

Stats - 504 K-7 (37)

110 K-7 (118)

Wabush - J.R. Smallwood Collegiate

118 Labrador West Integrated

510 Labrador Roman Catholic

Stats - 118 K-12 (284)

510 K-12 (193)

Appendix F

Native Schools

NATIVE SCHOOLS

Community	School	School Board
Hopedale	Amos Comenius All Grade	117 Labrador East Integrated
Makkovik	J.C. Erhardt	117 Labrador East Integrated
Nain	Jens Haven Memorial	117 Labrador East Integrated
Rigolet	Northern Lights Academy	117 Labrador East Integrated
Postville	B.L. Morrison School	401 Pentecostal Assemblies Board
Sheshatshit	Peenamin McKenzie	510 Labrador Roman Catholic
Utshimassits	Nukum Mani Shan	510 Labrador Roman Catholic

Appendix G

Teacher Questionnaire

SCIENCE IN SMALL SCHOOLS

TEACHER SURVEY QUESTIONNAIRE

This questionnaire may be completed by all teachers who are teaching Science in small schools. The focus is on Science in Grades 7 to Level III.

EDUCATIONAL BACKGROUND:

1. University Degrees Held (check as many as apply):

    (1) No Degree _____

    (2) B.A.(Ed) Primary _____

    (3) B.A.(Ed) Elementary _____

    (4) B.Ed. High School _____

    (5) B.A. _____

    Major:___________________

    (6) B.Sc. _____

    Major:___________________

    (7) M.Ed. _____

    Program:_________________

    (8) M.A. _____

    (9) M.Sc. _____

    (10) Other _____

    Please Specify:___________________________________

2. Please indicate which Science education courses you have completed (check as many as apply):

(1) 2182 An Introduction to the Teaching of Science in the Primary and Elementary Grades _____

(2) 3170 Foundations of Science Education _____

(3) 3171 An Introduction to the Teaching of Science _____

(4) 3270 Science in the Primary Grades _____

(5) 3275 Science in the Elementary Grades _____

(6) 3276 The Teaching of Science in the Junior High _____

(7) 3277 The Teaching of Environmental Science _____

(8) 4168 The Teaching of Computer Science in the Secondary School _____

(9) 4170 The Teaching of Physics in the Secondary School _____

(10) 4171 The Teaching of Chemistry in the Secondary School _____

(11) 4172 Advanced Science Education Methodology _____

(12) 4270 The Teaching of Biology in the Secondary School _____

(13) 4271 The Teaching of Earth Science in the Secondary School _____

(14) Other _____

Please Specify: ______________________________

3. Please indicate the number and type of Sciences in which you have completed university training:

	< 5	6 - 10	11 - 15	>15
Biology............	_____	_____	_____	_____
Chemistry..........	_____	_____	_____	_____
Physics............	_____	_____	_____	_____
Geology............	_____	_____	_____	_____
Computer Studies....	_____	_____	_____	_____
Psychology..........	_____	_____	_____	_____
Biochemistry........	_____	_____	_____	_____
Math................	_____	_____	_____	_____

4. Have you completed any university institutes or courses in the past five years or since you graduated from university?

Yes _____ No _____

5. If **yes**, please indicate below which institutes or courses you have completed.

____

____

____

____

6. Did you complete any of these through distance education via teleconferencing?

   Yes ____ No ____

PRE-SERVICE TRAINING FOR SMALL SCHOOLS:

7. During your teacher education at MUN or another university did you do any courses which directly or indirectly prepared you specifically for Science teaching in a small/rural school?

   Yes ____ No ____

8. If **yes**, please indicate briefly how you were prepared and in which course.

   ____

   ____

   ____

   ____

   ____

   ____

9. How do you think Memorial could help to better prepare future teachers for teaching Science in small schools?

   ____

   ____

   ____

10. Did you do your internship/student teaching in a rural/small school?

Yes _____ No _____

11. If **no**, did you request to do your internship/student teaching in a small/rural school?

Yes _____ No _____

12. If **yes**, why were you not placed in a small/rural school?

____

____

____

____

13. If you did your internship/student teaching in a small/rural school, did this experience help to prepare you for teaching in a small school situation?

Yes _____ No _____

14. If **yes**, please explain briefly how your experience helped prepare you for teaching in a small school.

____

____

____

____

PRESENT TEACHING DUTIES:

15. Why are you presently teaching in a small/rural school? (check as many as apply):

    (1) it was the only teaching position available _____

    (2) to be near family _____

    (3) to experience teaching in a small school _____

    (4) geographical area _____

    (5) other _____

    Please Specify: ________________________________

16. How many years have you been teaching in this school?

    ____

17. What grades/levels are you presently teaching? (check as many as apply):

    (1) 7 _____ (2) 8 _____

    (3) 9 _____ (4) Level I _____

    (5) Level II _____ (6) Level III _____

    (7) Others _____

    Please Specify: ________________________________

18. Would you transfer to a school in a larger centre if you were given the opportunity?

    Yes _____ No _____

19. Which Science courses are you presently teaching? (check as many as apply):

(1) Grade 7 Science _____

(2) Grade 8 Science _____

(3) Grade 9 Science _____

(4) General Science 1200 _____

(5) Physical Science 2205 _____

(6) Environmental Science 3205 _____

(7) Biology 2201 _____

(8) Biology 3201 _____

(9) Biology 2211 _____

(10) Biology 3211 _____

(11) Earth Science 2203 _____

(12) Geology 3203 _____

(13) Chemistry 2202 _____

(14) Chemistry 3202 _____

(15) Physics 2204 _____

(16) Physics 3204 _____

(17) Physics 3214 _____

(18) Microcomputer Systems 1100 _____

(19) Computer Applications 2100 _____

(20) Keyboarding/Word Processing 1101 _____

(21) Advanced Word Processing/Desktop Publishing 2101 _____

(22) Computer Technology 3200 _____

(23) Other (ex. local courses or advanced placement courses)

Please Specify:______________________________

____

20. Are you teaching courses other than Science?

Yes ______ No ______

21. If **yes**, please list the courses/grade levels you are also teaching.

____

____

____

____

22. Are any of your Science courses multi-graded? (That is you teach more than one grade/level or course in the same class at the same time. For example Grade 7 and Grade 8 Science)

Yes ______ No ______

23. If **yes**, please list the courses/grades which are multi-graded:

____

____

____

____

24. Is there a situation in which you are teaching Science with other non-science courses in the same class? (For example English 1101 and Biology 2201)

Yes ______ No ______

25. If **yes**, please list the courses/grade levels below.

____

____

____

26. In the Science courses which you teach, are there any special needs students?

Yes _____ No _____

27. On a scale of 1 to 5 (**1** being **very satisfied, 5** being **very dissatisfied**) how would you **rate** each of the following for your teaching situation?

(1)	class size	1	2	3	4	5
(2)	number of courses taught	1	2	3	4	5
(3)	number of grades taught	1	2	3	4	5
(4)	preparation time	1	2	3	4	5
(5)	teaching resources	1	2	3	4	5

SCIENCE LAB FACILITIES:

28. On a scale of 1 to 5 (**1** being **very satisfied, 5** being **very dissatisfied**) how would you **rate** the lab facilities to which you have access?

1 2 3 4 5

29. How many Science labs are present in your school?

____

30. Is/are the Science lab/s you use large enough to seat all of the students in the class?

Yes _____ No ______

31. For any of the Science courses which you are teaching are there any specific pieces of equipment/materials which are recommended by the Department of Education in the various Curriculum Guides, to which you do not have access?

Yes _____ No _____

32. If **yes**, please list them below.

____

____

____

____

____

33. Why do you not have these pieces of equipment?

(1) lack of money _____

(2) not sure where/how to order them _____

(3) other _____

Please Specify: _______________________________

34. Do you feel that you have adequate access to a Science lab for the Science courses you teach?

Yes _____ No _____

35. If **no**, why is access inadequate? (check as many as apply):

(1) timetabling problems _____

(2) too few labs _____

(3) lab used as regular classroom _____

(4) other _____

Please Explain: ________________________________

DISTANCE EDUCATION:

36. Are distance education courses currently being received in your school?

Yes _____ No _____

37. Are you are aware of any problems that students are experiencing with Distance Education?

Yes _____ No _____

38. If **yes**, please explain below.

____

____

____

____

____

PROFESSIONAL DEVELOPMENT:

39. Do you have access to professional science magazines/ periodicals such as "Science and Children"?

    Yes _____ No _____

40. In the past five years, have you attended any science inservices sponsored by your school board?

    Yes _____ No _____

41. In the past five years, have you attended any of the annual Newfoundland and Labrador Teachers Association Science Council Conferences?

    Yes _____ No _____

42. If **no**, did you request leave to attend any of the Conferences?

    Yes _____ No _____

43. Did you attend the Small Schools Conference held in Gander last year?

    Yes _____ No _____

44. If **no**, did you request leave to attend the conference?

    Yes _____ No _____

45. Have you attended any professional development programs/ inservices which dealt specifically with teaching Science in small schools?

Yes _____ No _____

46. How would you **rank** the following factors in determining whether or not you attend an inservice or conference?

(1 - most important ; 7 - least important)

(a) lack of substitutes _____

(b) too few inservice days _____

(c) lack of funding _____

(d) distance _____

(e) not informed about them _____

(f) family obligations _____

(g) other _____

Please Explain:_____________________________________

47. Have you attended any other professional development programs that were Science related, such as SEEDS or KEY Foundation?

Yes _____ No _____

48. If **yes**, please list them below, with dates.

____

____

49. If **no**, have you applied to attend any such programs?

Yes _____ No _____

RESOURCES:

50. How often do you see your Science Coordinator?

(1) once a week _____

(2) once a month _____

(3) three times a year _____

(4) twice a year _____

(5) once a year _____

(6) whenever you request _____

51. What type of assistance does the Science Coordinator provide? (check as many as apply):

(1) curriculum information _____

(2) teaching strategies _____

(3) inservice information _____

(4) obtaining equipment _____

(5) using equipment _____

(6) Science Fair information _____

(7) other _____

Please Specify: ______________________________

52. How would you **rank** each of the following as a source of assistance to you as a Science teacher?

(1 - most useful; 8 - least useful)

(a) coordinator _____

(b) principal/vice-principal _____

(c) department heads _____

(d) other teachers _____

(e) M.U.N. _____

(f) parents _____

(g) other professionals such as Dept. of Forestry _____

(h) other _____

Please Specify: ______________________________

53. Have you heard of STEM ~ Net?

Yes _____ No _____

54. If **yes**, do you think it will serve as an important link/ resource for teachers in small schools?

Yes _____ No _____ Don't Know _____

55. Are you familiar with the use of computers?

Yes _____ No _____

56. Are there computers available for instructional use in your school?

Yes _____ No _____

57. How often do you make use of the computer yourself in your teaching?

(1) never _____

(2) rarely _____

(3) sometimes _____

(4) often _____

(5) almost daily _____

58. How often do your Science students make use of the computer in your Science courses?

(1) never _____

(2) rarely _____

(3) sometimes _____

(4) often _____

(5) almost daily _____

59. Please indicate how you make use of the computer in your instruction (check as many as apply):

(1) student word processing ____

(2) teacher word processing ____

(3) student-prepared data base ____

(4) teacher-prepared data base ____

(5) student-prepared spread sheet ____

(6) teacher-prepared spread sheet ____

(7) student-prepared graphs ____

(8) teacher-prepared graphs ____

(9) student-prepared graphics ____

(10) teacher-prepared graphics ____

(11) data collection ____

(12) interfacing ____

(13) telecommunications ____

(14) tutorials ____

(15) drill and practice ____

(16) simulation games ____

(17) programming ____

(18) robotics ____

(19) lab simulation ____

(20) other ____

Please Specify: ________________________________

60. Do you have your own personal computer at home?

Yes _____ No _____

61. Please describe any other resources which you find useful (videos, resource packages, computer simulations, etc.).

____

____

____

____

____

62. What other resources do you feel would help you to be a more effective Science teacher?

____

____

____

____

____

TEACHING STRATEGIES:

63. It has often been said that Science teachers must put extra hours into their work in terms of lab preparation, marking, etc. As well, teachers in small schools often spend an extra amount of time preparing due to a lack of resources. As a Science teacher in a small school how many hours per week do you spend preparing for the Science courses which you teach?

Course Name	**Number of Hours Preparation**
____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________
____________________	____________________

Please answer the following question **only** if you are teaching Science in a **single-grade** situation.

64. As a Science teacher in a small school, what particular teaching strategies do you use which you feel have helped you to cope in your teaching situation?

Please answer the following question **only** if you are teaching Science in a **multi-grade** situation.

65. There are several approaches which teachers in multi-grade classes use. One is to keep students in distinct grade levels/subjects. Another is to use a cross-grade approach. A third approach is to use a thematic approach. Which of these, if any, do you use as a Science teacher, or do you follow an entirely different approach? (check as many as apply):

    (1) distinct grade levels _____

    (2) cross-grade approach _____

    (3) thematic approach _____

    (4) alternating approach _____

    (5) other _____

    Please Explain:___________________________________

    ____
    ____
    ____
    ____
    ____
    ____

PERSONAL DATA:

66. Sex:

(1) Male _____

(2) Female _____

67. Age: _____

68. Number of Years Teaching Experience: _____

Name: ____

Address: ____

____

____

Telephone: Home: ____________________ Work: _______________

School Name: ____

School Address: ____

____

____

69. Are there any other comments or concerns which you have concerning teaching Science in a small/rural school which you feel need to be addressed? If so please feel free to comment below.

____

____

____

____

____

____

____

____

Appendix H

Principal Questionnaire

SCIENCE IN SMALL SCHOOLS

PRINCIPAL SURVEY QUESTIONNAIRE

This questionnaire may be completed by all principals of small schools which offer Grade 7 or above. The focus is on Science in Grades 7 to Level III.

GENERAL INFORMATION:

1. Which Grades are offered in your school?

    ____

2. How many students are presently enrolled in your school?

    ____

3. How many of these students are in Grades 7 to Level III?

    ____

4. How many teachers do you presently have on staff?

    ____

5. Does your school have a guidance counsellor or share a guidance counsellor with another school?

    Yes ____ No ____

6. Does your school have one or more teachers for special needs students?

Yes _____ No _____

SCIENCE PROGRAM:

7. Which of the following Science courses are presently offered or will be offered next year in your school?

	Currently (1993-94)	Planned (1994-95)
(1) Grade 7 Science	_____	_____
(2) Grade 8 Science	_____	_____
(3) Grade 9 Science	_____	_____
(4) General Science 1200	_____	_____
(5) Physical Science 2205	_____	_____
(6) Environmental Science 3205	_____	_____
(7) Biology 2201	_____	_____
(8) Biology 3201	_____	_____
(9) Biology 2211	_____	_____
(10) Biology 3211	_____	_____
(11) Earth Science 2203	_____	_____
(12) Geology 3203	_____	_____
(13) Chemistry 2202	_____	_____
(14) Chemistry 3202	_____	_____
(15) Physics 2204	_____	_____
(16) Physics 3204	_____	_____

(17) Physics 3214	_____	_____
(18) Microcomputer Systems 1100	_____	_____
(19) Computer Applications 2100	_____	_____
(20) Keyboard/Word Processing 1101	_____	_____
(21) Advanced Word Processing/ Desktop Publishing 2101	_____	_____
(22) Computer Technology 3200	_____	_____
(23) Other (ex. local or AP courses) (Please Specify):	__________	__________

8. For each of the Science courses currently offered in your school, please indicate the number of minutes of instruction **per five day week.**

Course	**# of min. Instruction**
__________	__________
__________	__________
__________	__________
__________	__________
__________	__________
__________	__________
__________	__________
__________	__________

9. Are there any Science courses which your school would like to offer, but cannot due to a lack of facilities?

Yes _____ No _____

10. If **yes**, please list them below.

____

____

____

____

11. Are there any Science courses which your school would like to offer, but cannot due to a lack of qualified teachers?

Yes _____ No _____

12. If **yes**, please list them below.

____

____

____

____

13. Are there any Science courses which your school would like to offer, but cannot due to an insufficient number of staff?

Yes _____ No _____

14. If **yes**, please list them below.

____

____

____

____

15. Please **rank** the following factors as to how they would affect the decision as to which Science courses are offered in your school. (**1 - most important; 7 - least important**)

(a) lab facilities _____

(b) qualified teachers _____

(c) student choice _____

(d) prerequisites for post-secondary institutions _____

(e) student ability _____

(f) teacher allocation _____

(g) other _____

Please Specify: ____________________________

DISTANCE EDUCATION:

16. Is distance education being offered in your school?

    Yes _____ No _____

17. If **yes**, are there any Science courses offered through distance education in your school?

    Yes _____ No _____

18. If **yes**, please list below the Science courses which are offered via distance education.

    ____

    ____

19. How many students are enrolled in each of the distance education Science courses?

Course	**# of Students**
____________________	__________
____________________	__________
____________________	__________
____________________	__________

20. When students choose to do distance education courses in Science are there any prerequisites they must meet before being permitted to do the course? (check as many as apply):

(1) high academic ability _____

(2) independent learner _____

(3) other _____

Please Specify: ______________________________

21. Are students counselled re distance education learning prior to instruction?

Yes _____ No _____

22. Is the progress of distance education students monitored during the school year?

Yes _____ No _____

23. If **yes**, is there a teacher assigned to monitor the students' progress?

Yes _____ No _____

24. If **yes**, is this teacher assigned time each day to carry out the duties of monitoring distance education students?

Yes _____ No _____

25. Is your school experiencing any specific problems with the distance education program (ex. timetabling, bus schedules)? Please comment.

____

____

____

____

____

26. Are Science students experiencing any specific problems with the distance education program? Please comment.

____

____

____

____

27. Besides obtaining a valuable course, do you think distance education courses have provided your Science students with any other advantages? (check as many as apply):

(1) broader course offerings _____

(2) increased knowledge of technology _____

(3) increased independent learning skills _____

(4) other _____

Please Specify: ______________________________

28. Have distance education courses provided your school/staff with any other advantages? (check as many as apply):

(1) FAX machine services ____

(2) teleconferencing site ____

(3) availability of continuing education courses ____

(4) other ____

Please Specify: ______________________________

29. If distance education is not currently offered in your school would you like to offer it in the future?

Yes ____ No ____

30. Have you heard of STEM - Net?

Yes ____ No ____

31. If **yes**, do you think it will serve as an important link/ resource for teachers in small schools?

Yes ____ No ____ Don't Know ____

BUDGET:

32. Does your school qualify for extra funding because of low student enrolment?

Yes ____ No ____

33. If **yes**, how much money per student does your school receive?

____

34. Approximately how much money was spent last year to purchase Science supplies in your school?

____

35. Do you feel that your school's budget is large enough that you can spend what is necessary in order to offer a complete Science program?

Yes _____ No _____

36. If, for a particular Science course, you need equipment/ supplies which your school cannot afford how do you obtain them? (check as many as apply):

(1) you don't _____

(2) purchased by school board _____

(3) students fund raise _____

(4) LEC _____

(5) parents/PTA fund raise _____

(6) other _____

Please Specify: __________________________________

TEACHER HIRING:

37. Please **rank** each of the following factors as you would consider them when hiring a new Science teacher. (**1 - most important; 9 - least important**)

(a) possess a B.Sc./B.Ed. _____

(b) possess a M.Sc./B.Ed _____

(c) teaching experience _____

(d) small school experience _____

(e) multi-grade teaching experience _____

(f) willing to participate in extracurricular _____

(g) applicant known through substituting etc. _____

(h) ability to teach a wide variety of courses _____

(i) other _____

Please Specify:______________________________

PERSONAL DATA:

38. **Sex:**

(1) Male _____

(2) Female _____

39. **Age:** _____

40. **Number of Years Teaching Experience:** _____

Name:____

Address: ____

____

____

____

Telephone: Home:________________ Work:________________

School Name: ______________________________________

School Address: ________________________________

____

____

41. If you have any other comments or concerns which you wish to raise concerning the provision of Science in your school please feel free to do so below:

____

____

____

____

____

____

____

____

Appendix I

Cover Letter

Linda Barr
c/o Dr. D. Mulcahy
Faculty of Education
Memorial University
St. John's, Nf.
A1B 3X8

Dear Principal,

I am a graduate student at Memorial University's Faculty of Education. My advisor is Dr. D. Mulcahy. I am currently working on my thesis entitled Science in Small Schools. As part of my thesis I wish to survey teachers and principals currently teaching in the small/rural schools of the province. The purpose of the study is to assess the current provision for Science curriculum in small/rural schools of our province.

I have enclosed one copy of the Principal Survey, one copy of the Teacher Survey, four copies of the consent form and two return envelopes. Could you please pass along the Teacher Survey, two copies of the consent form and one return envelope to the teacher on your staff who teaches the most Science in your school. Would you please complete the Principal Survey and return it along with one copy of the consent form in the envelope provided.

I would greatly appreciate it if you both could return the completed surveys to me within two weeks of having received them. I would like to thank you both in advance for your anticipated cooperation and participation.

Sincerely,

Linda Barr

Appendix J

Consent Form

Linda Barr
c/o Dr. D. Mulcahy
Faculty of Education
Memorial University
St. John's, Nf.
A1B 3X8

Dear Educator:

I am a graduate student at Memorial University's Faculty of Education. My advisor is Dr. D. Mulcahy. I am currently working on my thesis entitled Science in Small Schools. As part of my thesis I wish to survey teachers and principals currently teaching in the small/rural schools of the province. The purpose of the study is to assess the current provision for Science curriculum in small/rural schools of our province.

Your participation will consist of completing the attached questionnaire. This should take approximately 30 minutes of your valuable time. I realize that your time is limited, especially since you are teaching in a small school, thus your participation will be greatly appreciated.

All information gathered in this survey is strictly confidential. At no time will your identity be disclosed. Your participation is voluntary and you may choose not to answer any questions you wish. This study has received approval of the Faculty of Education's Ethics Review

Committee. If you wish to inquire about this research you may contact Dr. Patricia Canning, Associate Dean of Research and Development, Memorial University of Newfoundland.

If you agree to participate in the study please sign below and return one copy with your survey. The second copy is for yourself. I would appreciate it if you could return the completed survey in the enclosed, stamped envelope as soon as possible. If you would like access to the results of this research please feel free to contact me through Dr. Dennis Mulcahy at Memorial University (737-7917).

Sincerely Yours,
Linda Barr

I ______________________________ hereby consent to take part in the study of Science curriculum provision in small/ rural schools undertaken by Linda Barr. I understand that participation is entirely voluntary. All information is strictly confidential and no individual will be identified.