

An Inquiry into Achievement Differences In Traditional and Virtual High School Courses

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Abstract – Four years ago the Centre for Distance Learning and Innovation began a virtual high school within the Canadian province of Newfoundland and Labrador. Designed primarily to provide courses in specialized areas to students in rural areas, where schools have difficulty in attracting second language, mathematics and science teachers. However, there has been some concern that the opportunities provided by this virtual high school are “second rate” or only able to cater to independent, self-motivated students. The purpose of the study is to examine the student achievement in standardized public exams and final course scores in the province between different delivery models to determine whether or not students are succeeding in the virtual high school environment at the same rate as their classroom counterparts.

The province of Newfoundland and Labrador is located on the east coast of Canada. The province, which has both an island and mainland portions, has a total area of approximately 500,000 square kilometers and a population of a little more than 500,000 people. With about 60% of the population living within a 150 kilometer radius of the provincial capital, St. John’s, the remainder of the province is sparsely populated, particularly the mainland portion. The majority of the approximately 300 schools are located in these rural areas, one third of which are designated as necessarily existent (i.e., a term used to describe a school that cannot be closed because it is located so far from another school that it makes bussing the students not feasible due to distance).

As with rural jurisdictions across North America, many of the schools in Newfoundland and Labrador do not have enough teachers and are unable to provide sufficient variety in the course offerings of the provincially mandated curriculum. In this environment, rural schools are unable to offer their students the same level of educational opportunity as their larger, urban

counterparts. It is for this reason that rural schools have relied upon distance education to provide their students with the same opportunities as urban students.

The Problem of Rural Schooling

In April 1979, the Government of Newfoundland and Labrador's Task Force on Education released its final report entitled *Improving the Quality of Education: Challenge and Opportunity* (Crocker & Riggs, 1979). The report confirmed the reality of inequity of educational opportunity within the province's school system, specifically stating that not all schools were able to offer the same variety of courses to their students and many were not able to offer programs in home economics, music industrial arts, guidance, arts, and even some sciences. The authors of the report concluded that there was "little doubt that increased school size [had] the effect of increasing the variety of program options available" and that there was also a "problem of the range of competence of staff in smaller schools" (Crocker & Riggs, 1979, p. 104). Basically, smaller schools did not have the size of the teacher expertise to provide equal opportunities to their students as schools in larger and more urban areas.

This report spurred a series of studies conducted by government and academic institutions investigating the problem of small and rural schooling, along with a number of interventions initiated by the provincial Department of Education and individual school districts over the past two and a half decades. The first of these studies was the Royal Commission on Employment and Unemployment's final report, *Education for Self-Reliance: A Report on Education and Training in Newfoundland*, which found "glaring differences in educational attainment between urban and rural areas... [and that] rural Newfoundlanders are less educated than their urban counterparts, and it appears that the gap is growing" (House, 1986, p. 52). A year later the Small Schools Study Project was given a mandate to study challenges facing small

schools in the province and recommend ways to enhance the educational opportunities for rural school students. The project staff surveyed administrators, teachers, and students from the 160 smallest schools in the province, while also conducting a national literature review and inviting written submissions from provincial school board and other stakeholders. Similar to the findings of the Task Force on Education eight years earlier, Riggs (1987) concluded that the number and variety of courses offered in small schools were limited, and that rural schools had difficulty acquiring and retaining qualified teachers due to more attractive incentives to teach in larger centers. This reality meant that rural schools were typically staffed by inexperienced teachers who were generally required to teach a wider selection of courses. Rural teachers were also found to be teaching more often outside of their subject area training than their counterparts in larger centers. To address these problems, the creation of a distance education school was recommended.

Distance Education in Newfoundland and Labrador

In 1988, the province implemented a program of distance education for rural high school students. The main purpose was to provide access for students in small schools to secondary level courses that were important for post-secondary admission but that were difficult to offer in rural schools due to low levels of student enrolment. In its first year of operation the program consisted of just one course: Advanced Math 1201. This course had an enrolment of 36 students in 13 rural schools. Over the next three years, additional courses were developed until the entire advanced mathematics curriculum was available for delivery. This distance education program utilized an audiographics system known as the Telemedicine and Educational Technology Resources Agency (Tele-medicine/TETRA). This system operated using bridging technology to provide conference calling facilities that were accompanied by the use of a telegraphic device for

reproducing handwriting by converting the manually controlled movements of a pen into signals that control the movements of a similar pen. Students would spend 50% to 80% of their instructional time using this synchronous distance education system and the remainder of their time completing correspondence-style work using fax machines to send their work to their distance education teacher.

In 1989, the Task Force on Mathematics and Science Education released its final report, *Towards an Achieving Society*. In this report, Crocker (1989) indicated that due to low enrolment and lack of specialized teachers, rural students were still not receiving the same mathematics and science opportunities as their urban counterparts. Shortly after the Royal Commission of Inquiry into the Delivery of Programs and Services in Primary, Elementary, Secondary Education in 1993 (i.e., Williams, 1993), the provincial distance education program was expanded to include the complete physics and chemistry programs and upper level French as a second language courses. The distance education experiment proved successful and the program grew to 11 courses with 898 course enrolments in 1999-2000. A total of 703 students in 77 different rural schools were taking one and sometimes two courses (Brown, Sheppard, & Stevens, 2000). However, the nature of this distance education program was that it was only intended for a certain type of student. The selection of more academically advanced courses such as the higher level mathematics and sciences excluded many students from the outset. In their comprehensive study of distance education in Newfoundland and Labrador, Brown et al. (2000) described how school administrators, teachers, and even parents were well aware that students enrolled in distance education needed to be successful academically, to possess self-discipline, to have academic ability and have demonstrated that ability in class, and to be prepared for extra independent work.

Selectivity Problems in Distance Education for High School Students

Although few of the states in the USA faced geographic challenges as severe as those in the Canadian Province of Newfoundland and Labrador, distance education opportunities for high school students were also being explored in the United States while their Canadian counterparts were exploring distance education options as described above. As was the case with the audiographics distance education system in Newfoundland and Labrador, many of the early examples of distance education programs across North America were primarily designed for a select group of high school students, specifically those with higher aptitudes, higher achievement, and greater aspirations for postsecondary education.

For example, in their second year evaluation of the Virtual High School (VHS), Espinoza, Dove, Zucker and Kozma (1999) stated that “it was found that VHS was serving a fairly narrow range of students, those who were academically advanced and college bound” (p. 48). One of the ways this was evidenced was the course that was actually developed by the VHS, such as “Advanced Placement Statistics”, “Environmental Ethics”, and “Russian, Soviet, and Post-Soviet Studies”, were designed and implemented in such a way that these courses excluded all but the most talented and motivated high school students.

Based upon their own review of the literature, Roblyer and Elbaum (2000) concluded, “only students with a high need to control and structure their own learning may choose distance formats freely” (p. 61). In those programs where student selectivity is not maintained, retention rates decrease significantly (Ballas & Belyk, 2000; Barker & Wendel, 2001; Bigbie & McCarroll, 2000; Kozma, Zucker, Espinoza, McGhee, Yarnall, Zalles & Lewis, 2000; Roblyer, 1999; Roblyer & Elbaum, 2000). These findings have led some to question whether web-based distance education is suitable for all secondary-level students (Mulcahy, 2002).

In an analysis of 19 studies investigating the effectiveness of interactive distance education technologies in K-12 education that included over 900 participants from 1980 to 1998, Cavanaugh (2001) found that there was “a small positive effect in favor of distance education” (p. 73). More recent studies by Cavanaugh, Gillan, Kromrey, Hess and Blomeyer (2004), Cavanaugh, Gillan, Bosnick, Hess and Scott (2005), and McLeod, Hughes, Brown, Choi and Maeda (2005) have yielded similar results. However, given the reality outlined Haughey and Muirhead (1999), that students involved in virtual schooling were primarily highly motivated, self-directed, self-disciplined, independent learners who could read and write well and also has a strong interest in or ability with technology, it should not surprise anyone that these comparative studies in K-12 distance education yielded better results than most other comparative studies in technology-based fields. (The “no significant differences” problem that usually occurs when innovative educational technologies are compared with traditional approaches has been well documented by Clark (1983), Reeves (2005) and Russell, (1997) among others.)

Simply put, the difference in results between distance education students and traditional classroom students in secondary education contexts may be largely explained by the selectivity of students registered in distance education programs. While there is no specific research evidence of this, based upon the current literature it seems plausible that the students enrolled in these distance education programs were more capable of handling the independent nature of these learning opportunities. It may also be that the students who would not have performed well in the distance education courses had already elected to drop the course before the outcome data were collected. But plausibility is not sufficient for educational research, and thus more rigorous investigations are needed to explore the reasons for why distance education high school students seem to do better than their regular classroom peers in some contexts and not in others.

The Specific Context for this Research Study

After a series of individual school districts and provincial web-based distance education projects in mathematics, science and technology, the Government of Newfoundland and Labrador appointed a ministerial panel to, among other things, “examine the current educational delivery model and consider alternative approaches” in 1999 (Sparkes & Williams, 2000, p. 2). In their report, the ministerial panel recommended the creation of the Centre for Distance Learning and Innovation (CDLI) to be based upon the web-based model that had been evolving throughout the province. The vision of the CDLI was to provide access to educational opportunities for students, teachers and other adult learners in both rural and urban communities in a manner that rendered distance transparent; eliminated geographical and demographic barriers as obstacles to broad, quality educational programs and services; and developed a culture of e-learning in the schools which is considered to be an integral part of school life for all teachers and students.

The CDLI came into existence in 2000 and offered its first courses during the 2001-02 school year. During that first year a limited number of enrollments were made available in an effort to field test the method of delivery and the content material that had been developed. Beginning with the 2002-03 school year, any student from across the province was given permission to enroll in courses offered by the CDLI. No longer was secondary distance education just for the elite students. Indeed, with their decision to develop a number of non-highly-academic courses, such as Art Technologies 1201, Communications Technology 2103/3103, and World Geography 3202, their student population has come to include students of all ability levels. Given these developments, the CDLI is an ideal context for conducting the research study described below.

Performance in Web-based Distance Education in Newfoundland and Labrador

In preparation for writing this research project, final course scores and the standardized public exam scores for every student in the Province of Newfoundland and Labrador for the school years 2001-02 to 2004-05 were obtained from the provincial Department of Education. This data was combined with information from the *High School Distance Education Course Report* to determine which schools offered what courses using web-based distance education and which schools offered what courses in the traditional classroom environment. Table 1 indicates the average final course scores for all the students registered in courses offered by the CDLI sorted by the method of delivery for the course and the location of the student.

Table 1. Students' final course averages based upon delivery model and location by year

	2001-02	2002-03	2003-04	2004-05
Web delivered rural	71.3 (n = 291)	68.1 (n = 886)	69.3 (n = 1,143)	69.6 (n = 1,132)
Web delivered urban ¹	64.2 (n = 12)	56.5 (n = 20)	67.5 (n = 10)	71.8 (n = 39)
Classroom delivered rural	68.2 (n = 11,233)	68.1 (n = 21,334)	68.5 (n = 26,601)	69.0 (n = 31,022)
Classroom delivered urban	67.1 (n = 13,390)	66.6 (n = 27,227)	67.8 (n = 35,555)	68.5 (n = 38,857)
# of missing cases	259 (1%)	464 (1%)	1366 (2%)	3693 (5%)
Total # of cases	25,185	49,931 ²	64,675	74743
# of courses ³	11	21	24	30

The data above indicate that for each of the first three years that the CDLI has been in operation, students from rural areas in the web-based courses and during the fourth year students from both the rural and urban web-based performed as well or better than any of their other

¹ The designation of an urban area follows that definition utilized by Statistics Canada, see Appendix A for a list of communities that were designated as urban for each of these four years.

² The dramatic increase in the number of cases was due to the increase in the number of courses offered by the CDLI. For example, adding Art Technology 1201 in 2002-03 increased the number of web-based cases by seventy-eight web-based cases and classroom cases by 1578, or English 1201 in 2003-04 which added 19 web-based cases and 5306 classroom cases.

³ See Appendix B for a list of courses offered by the CDLI for each of these four years.

counterparts. In certain level three (i.e., grade twelve) courses, students are required to take a standardized public exam consisting of 50% multiple-choice responses and 50% constructed responses. Beginning in the 2002-03 school year, the CDLI began to offer certain courses that required students to take the public exam. A summary of the results of these CDLI students compared to their classroom counterparts can be found in Table 2.

Table 2. Students' public exam scores based upon delivery model and location by year

	2002-03	2003-04	2004-05
Web delivered rural	61.4 (n = 210)	60.5 (n = 323)	63.4 (n = 293)
Web delivered urban	71.0 (n = 1)	60.5 (n = 2)	66.4 (n = 8)
Classroom delivered rural	60.6 (n = 3,919)	64.5 (n = 4,907)	61.7 (n = 6,558)
Classroom delivered urban	61.4 (n = 5,623)	64.7 (n = 8,153)	62.6 (n = 9,304)
# of missing cases	40 (0.5%)	189 (1%)	800 (5%)
Total # of cases	9,793	13,574	16,963
# of courses with public exams	5	6	7

Like the final course averages, during the 2002-03 the web-based students in rural areas performed as well as any other group of students (excluding the single urban student who was enrolled in a web-based CDLI course). However, during the 2003-04 school year the performance of both rural and urban students in the web-based courses scored lower on their public exams than students who received their instruction in a traditional classroom. This past year this trend was reversed, with both rural and urban students in web-based courses scoring higher on their public exams than classroom-based students. While an annual comparison of the students' public exam scores and final course averages is useful, a comparison of the total four year period is also in order. Table 3 provides such a comparison.

Table 3. Students' scores based upon delivery model and location

	Public Exam	Final Course Average
Web delivered rural	61.7 (n = 826)	69.3 (n = 3,452)
Web delivered urban	65.7 (n = 11)	66.3 (n = 81)
Web delivered total	61.8 (n = 837)	69.2 (n = 3533)
Classroom delivered rural	62.3 (n = 15,384)	68.5 (n = 90,190)
Classroom delivered urban	63.1 (n = 23,080)	67.7 (n = 115,029)
Classroom delivered total	62.8 (n = 38464)	68.1 (n = 205219)
# of missing cases	1,029 (2.6%)	5,650 (2.6%)
Total # of cases	40,330	214,402

This combined analysis indicates that over the four year period the CDLI has been in operation there has been some fluctuation in both performance measures when both delivery model and location are considered, but little difference in the overall performance of students based upon delivery model on both their public exam scores and final course averages. It should be noted that while the overall number of missing cases is relatively low, indicating that the sample utilized for this student represented 97.4% of the total number of cases in the population, these missing cases have been increasing fairly dramatically in recent years. This is a growing limitation of this particular research project and, as this number increases, it will eventually render this kind of analysis unusable. Unfortunately this number will continue to increase with the current data sources, as it represents situations where a school has a number of students registered in a classroom version of a specific courses, but also has one of two students who are unable to fit the classroom version into their schedule and the school simply registers them in the CDLI's web-based version. Within the data received from the Department of Education, the researchers are unable to determine which one or two students of the twenty or thirty students

registered in a specific course at a specific school are registered in the web-based version, so all of the students in question are excluded. Initially this was a practice common in only a few urban high schools, but in recent years has become more common in both urban and larger, regional rural schools.

Discussion and Conclusions

The individual yearly data comparisons indicate that rural students who accessed their courses from the CDLI performed better or the same as their classroom counterparts on final course scores in all four years. This trend was consistent in the first and third years of public exam data. These findings, combined with the lack of differences between the overall student performance based on delivery model, are somewhat puzzling and raise several important issues. As was discussed earlier, in instances where distance education students score higher than their classroom counterparts it may be due to a greater degree of student selectivity found in most distance education programs. It also seems reasonable to surmise that where there is no student selectivity in the distance education program, distance students will score about the same as or even lower than their classroom counterparts. But it is essential to repeat that such speculations do not constitute good educational research. What is clearly needed is a study that specifically addresses the reasons for high school student achievement in distance education.

Given the fact that some of performance results of distance education students in Newfoundland and Labrador run counter to what is traditionally found in the literature, i.e., “no-significant differences,” discovering what factors account for these results is an important undertaking, specifically, this study will examine the factors students feel affect their performance in web-based courses. The results of this line of inquiry may have useful implications for web-based distance education programs in many jurisdictions. In one of the

largest meta-analyses ever conducted related to distance education, Bernard, Abrami, Lou, Borokhovski, Wade, Wozney, Wallet, Fiset, and Huang (2004) found a very small, but statistically significant, positive mean effect size for interactive distance education over traditional classroom instruction on student achievement and a small, but statistically significant, negative effect for retention rate. While this meta-analysis is one of the best of its kind, its findings, as well as those derived from other related meta-analyses (Cavanaugh, 2001; Cavanaugh, *et al.*, 2004; Machtmes & Asher, 2000; Ungerleider & Burns, 2003), do not go far enough in specifying design guidelines for practitioners. Studies with interpretivist goals of the kind outlined here are clearly needed to reveal the reasons for such findings. Once we know the reasons why some students are successful in distance education, we will have a better foundation for designing more effective web-based learning opportunities for all students.

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Appendix A

Courses Offered by the CDLI by Year

2001-02

Academic Mathematics 2204
 Advanced Mathematics 2205
 Canadian History 1201
 Chemistry 2202
 Communications Technology 2104
 Communications Technology 3104
 Enterprise Education 3205
 French 2200
 Mathematics 1204
 Physics 2204
 Writing 2203

2002-03

Academic Mathematics 2204
 Academic Mathematics 3103
 Academic Mathematics 3204 *
 Advanced Mathematics 2205
 Advanced Mathematics 3205 *
 Advanced Mathematics 3207
 Art Technologies 1201
 Canadian History 1201
 Chemistry 2202
 Chemistry 3202 *
 Communications Technology 2104
 Communications Technology 3104
 Enterprise Education 3205
 French 2200
 French 3200 *
 French 3201
 Mathematics 1204
 Physics 2204
 Physics 3204 *
 Science 1206
 Writing 2203

* denotes course with public examination

2003-04

Academic Mathematics 2204
 Academic Mathematics 3103
 Academic Mathematics 3204 *
 Advanced Mathematics 2205
 Advanced Mathematics 3205 *
 Advanced Mathematics 3207
 Art Technologies 1201
 Canadian History 1201
 Career Exploration 1100
 Chemistry 2202
 Chemistry 3202 *
 Communications Technology 2104
 Communications Technology 3104
 English 1201
 Enterprise Education 3205
 French 2200
 French 3200 *
 French 3201
 Mathematics 1204
 Physics 2204
 Physics 3204 *
 Science 1206
 World Geography 3202 *
 Writing 2203

2004-05

Academic Mathematics 2204
 Academic Mathematics 3103
 Academic Mathematics 3204 *
 Advanced Mathematics 2205
 Advanced Mathematics 3205 *
 Advanced Mathematics 3207
 Art and Design 3200
 Art Technologies 1201
 Biology 2201
 Canadian Economy 2203
 Canadian History 1201
 Career Exploration 1100
 Chemistry 2202
 Chemistry 3202 *
 Communications Technology 2104
 Communications Technology 3104
 English 2201
 English 3201
 Enterprise Education 3205
 Experiencing Music 2200
 French 2200
 French 3200 *
 French 3201
 Integrated Systems 1205
 Mathematics 1204
 Physics 2204
 Physics 3204 *
 Science 1206
 World Geography 3202 *
 Writing 2203

* denotes course with public examination

Appendix B

In Newfoundland and Labrador the official classifications of rural and urban are made based upon the definitions provided by Statistics Canada. An urban area includes

Census Metropolitan Areas (CMA), Census Agglomerations (CA) and other communities 5,000 and over. A CMA is defined as the main labor market area of an urban area (the urbanized core) of at least 100,000 population, based on the previous census. CMAs are comprised of one or more census subdivisions (CSDs) that meet at least one of the following criteria: 1. the CSD falls completely or partly inside the urbanized core; 2. at least 50% of the employed labor force living in the CSD works in the urbanized core; or 3. at least 25% of the employed labor force working in the CSD lives in the urbanized core... A CA is defined as the main labor market area of an urban area (the urbanized core) of at least 10,000 population, based on the previous census. CAs are comprised of one or more census subdivisions (CSDs) that meet at least one of the following criteria: 1. the CSD falls completely or partly inside the urbanized core; 2. at least 50% of the employed labor force living in the CSD works in the urbanized core; or 3. at least 25% of the employed labor force working in the CSD lives in the urbanized core” (Government of Newfoundland and Labrador, 2002).

Urban Areas (with Population) by Year

2001-02

St. John's (CMA)		174,051
Bauline	380	
Bay Bulls	1,063	
Conception Bay South	19,265	
Flatrock	1,087	
Logy Bay-Middle Cove-Outer Cove	1,881	

	Mount Pearl	25,519	
	Paradise	7,960	
	Petty Harbour-Maddox Cove	954	
	Portugal Cove-St. Phillip's	5,773	
	Pouch Cove	1,885	
	St. John's	101,936	
	Torbay	5,230	
	Witless Bay	1,118	
Corner Brook (CA)			27,945
	Corner Brook	21,893	
	Humber Arm South	1,991	
	Irishtown-Summerside	1,424	
	Massey Drive	736	
	Meadows	737	
	Mount Moriah	748	
	Steady Brook	416	
Gander (CA)			12,021
	Appleton	572	
	Gander	10,364	
	Glenwood	893	
	Division No. 6, Subd. E	192	
Grand Falls-Windsor (CA)			20,378
	Badger	997	
	Botwood	3,613	
	Grand Falls-Windsor	14,160	
	Northern Arm	422	
	Peterview	862	
	Division No. 6, Subd. C	324	
Labrador City (CA)			10,473
	Labrador City	8,455	
	Wabush	2,018	
Bay Roberts			5,472
Carbonear			5,168
Channel-Port aux Basques			5,243
Clarenville			5,335
Deer Lake			5,222
Happy Valley-Goose Bay			8,655
Marystown			6,742
Placentia			5,013
Stephenville			7,764

2002-03

St. John's (CMA)		172,918
Bauline	364	
Bay Bulls	1,014	
Conception Bay South	19,772	
Flatrock	1,138	
Logy Bay-Middle Cove-Outer Cove	1,872	
Mount Pearl	24,964	
Paradise	9,598	
Petty Harbour-Maddox Cove	949	
Portugal Cove-St. Phillip's	5,866	
Pouch Cove	1,669	
St. John's	99,182	
Torbay	5,474	
Witless Bay	1,056	
Corner Brook (CA)		25,747
Corner Brook	20,103	
Humber Arm South	1,800	
Irishtown-Summerside	1,304	
Massey Drive	770	
Meadows	676	
Mount Moriah	700	
Steady Brook	394	
Gander (CA)		11,254
Appleton	576	
Gander	9,651	
Glenwood	845	
Division No. 6, Subd. E	182	
Grand Falls-Windsor (CA)		18,981
Badger	906	
Botwood	3,221	
Grand Falls-Windsor	13,340	
Northern Arm	375	
Peterview	811	
Division No. 6, Subd. C	328	
Labrador City (CA)		9,638
Labrador City	7,744	
Wabush	1,894	
Bay Roberts		5,237
Clarenville		5,104
Happy Valley-Goose Bay		7,969
Marystown		6,742
Placentia		5,908
Stephenville		7,109

2003-04

St. John's (CMA)		172,918
Bauline	364	
Bay Bulls	1,014	
Conception Bay South	19,772	
Flatrock	1,138	
Logy Bay-Middle Cove-Outer Cove	1,872	
Mount Pearl	24,964	
Paradise	9,598	
Petty Harbour-Maddox Cove	949	
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St. John's	99,182	
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Witless Bay	1,056	
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