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Student Performance in Virtual Schooling: Looking Beyond the Numbers

Abstract – Seven 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 these teachers, there is concern that the opportunities provided by this virtual school are "second rate." 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, geographic location and subject area to determine whether or not students are succeeding in the virtual high school environment at the same rate as their classroom counterparts.

In the 1970s, and 1980s, the Government of Newfoundland and Labrador published reports outlining the problems rural schools experienced with offering their students the same level of educational opportunity as their larger, urban counterparts (e.g., Crocker & Riggs, 1979; House, 1986; Riggs, 1987). Based upon these recommendations, the province implemented a program of distance education for rural high school students in September 1988 using an audio-graphics system[1]. The main purpose of the program was to provide secondary level students with courses that were important for post-secondary admission but that were difficult to offer in rural schools due to low levels of student enrollment.

In its first year of operation in 1988-89, the Newfoundland and Labrador distance education program consisted of just one course: Advanced Math 1201. Over the next three years, additional courses were developed until the entire advanced mathematics curriculum was available. Following the release of a series of Government-sponsored reports (i.e., Crocker, 1989; Williams, 1993), the program was again expanded to include the complete physics and chemistry programs and upper level French as a second language program. Over a period of twelve years, the program grew from an enrollment of 36 students in 13 rural schools in a single course to 11 courses with 898 course enrollments representing a total of 703 students in 77 different rural schools by 1999-2000 (Brown, Sheppard, & Stevens, 2000).

However, there were still calls from Government-sponsored reports for a more comprehensive distance education program (i.e., Williams, 1993). One of the reasons for needing a more comprehensive approach was outlined by Mulcahy (2002) when he indicated that this current system of distance education "demonstrated that many students taking distance courses required and received a significant amount of pedagogical assistance with 'matters of content'

[1] An audiographics or telematics system used 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 would appear on monitors at remote locations.

from school based personnel" (Classroom Teachers: A Mediating Role, ¶ 5). Essentially, students were successful in the previous distance education model because of the significant amount of tutoring provided by local teachers in these rural schools. There were also concerns about the nature of students who could be successful in this form of distance education environment. Brown et al. (2000) illustrated this second reason when they described how school administrators, teachers, and even parents were well aware that students enrolled in distance education needed to be successful academically, possess self-discipline, have academic ability and have demonstrated that ability in class, and be prepared for extra independent work. The distance education program in place at that time could not accommodate students who did not possess these skills and habits.

The Centre for Distance Learning and Innovation (CDLI) was created in 2000 based upon a recommendation of a ministerial panel (Sparkes & Williams, 2000), and offered its first courses during the 2001-02 school year. The CDLI was designed to have the potential to include students of all ability levels, particularly with the decision made by the CDLI to develop a number of less rigorous academic courses, such as Art Technologies 1201, Communications Technology 2104/3104, and World Geography 3202. In this study we examined whether this potential has been realized by comparing student performance in these distance education courses with traditional brick-and-mortar based upon the variables of geographic location and subject area.

Literature Review

Similar to the experience with the early distance education program in Newfoundland and Labrador, many distance education programs across North America have been designed to be primarily available to 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). The courses developed by the VHS illustrate this trend. For example, courses 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.

Research literature also substantiates this trend. Based upon a 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). Clark, Lewis, Oyer and Schreiber (2002) found that the Illinois Virtual High School (IVHS) had a completion rate of only 53% during its first year of operation and 80% the following year. They also found that students who were "highly motivated, high achieving, self-directed and/or who liked to work independently" typically did well in the online environment (p. 41). Bigbie and McCarroll (2000) found that over half of the students who completed Florida Virtual School (FLVS) courses scored an A in their course and only 7% received a failing grade. However, they also found that between 25% and 50% of students had dropped out of their FLVS courses over the previous two-year period.

Kozma, Zucker and Espinoza (1998) found that the vast majority of students in their courses were planning to attend a four-year college. They also reported that two thirds of the teachers indicated that the VHS students were less likely to drop out of school than students in their classroom-based courses. These findings led the evaluators to conclude that "the current

VHS curriculum [was] dominated by advanced courses that cater to students who are successful, independent, and college bound" (p. 49). The following year, Espinoza et al. (1999) reached similar conclusions when they stated that "VHS courses are predominantly designated as 'honors,' and students enrolled are mostly college bound" (p. 49). These finding were not surprising to the evaluators, as they indicated that the VHS' own faculty handbook promoted this kind of selectivity when it stated: "Although all students should have access to the VHS catalog, we recommend that the school site coordinator and guidance counselors select students who can work independently and handle responsibility" (p.50).

Cavanaugh, Gillan, Bosnick, Hess and Scott (2005) speculated that the virtual school students who did take the assessment may have been more academically motivated and naturally higher achieving students. In a similar study of student performance McLeod, Hughes, Brown, Choi and Maeda (2005) found that the virtual school students performed better on an assessment of algebraic understanding than their classroom counterparts. These authors speculated, probably accurately, that the reason was due to the high dropout rate in virtual school courses. Simply, many of the low-achieving virtual school students had already been removed from the sample prior to the assessment. They also indicated that the majority of virtual school students in the sample were doing the course for the second or third time, so familiarity with the content and the motivation to take advantage of their "last chance" were also potential factors in the differences that were found.

Haughey and Muirhead (1999) described the preferred characteristics of K-12 students involved in virtual schooling to include the highly motivated, self-directed, self-disciplined, independent learner who could read and write well, and who also had a strong interest in or ability with technology. Ballas and Belyk (2000) found that the participation rate in the

assessment among virtual students ranged from 65% to 75% compared to 90% to 96% for the classroom-based students, leading them to speculate that the sample of virtual school students did not reflect the total population of these students. Findings such as these have led some to question whether web-based distance education is suitable for all secondary-level students (Mulcahy, 2002).

Methodology

We obtained the standardized public examination scores and the final course scores for every student in the Province of Newfoundland and Labrador from 2001-02 to 2005-06. Using the Statistics Canada definitions for rural and urban communities[2], we coded schools in the province based upon their geographic location. The data were combined with information from the High School Distance Education Course Report, allowing us to code courses as being offered using web-based distance education or in the traditional classroom environment. Statistical analysis was conducted to determine if there were performance differences based on the method of delivery, location of the student, and subject area.

We initially considered utilizing a statistical comparison of means, such as a T-test or an analysis of variance. However, the disparity between the sample sizes (i.e., 267,823 classroom-based cases vs. 4779 web-based cases) would have rendered such an analysis statistically suspect. Instead we chose to constrain our analyses to descriptive statistics. In most instances this would have limited our results, but given that we were working with data from a population, and not a sample, we were confident in this method.

While the original data included the complete population, in some instances there were schools that had a number of students registered in a classroom version of a specific courses and

[2] Urban area include Census Metropolitan Areas, Census Agglomerations and other communities 5,000 and over (Government of Newfoundland, 2002).

also had one of two students who are unable to fit the classroom delivered version into their schedule and were registered in the CDLI's web-delivered course. In these situations, the data did not allow us to determine which one or two students of the twenty or thirty students were the CDLI students, so all of the students in that specific course at that specific school were 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. Previous studies had excluded from 2.5% to 5% of the total population (Barbour & Mulcahy, 2006, 2007); however, in this study 10% of the cases were excluded.

In our earlier analysis, we found that there were no performance differences between web-based or virtual school students and classroom-based or brick-and-mortar students in both the public examination and final course scores in the first four years of CDLI data (see Author & Author, 2007). This assumption remained constant when the 2005-06 data were added (see Table 1).

[Table 1 about here]

It was important to verify that as the CDLI continues to grow and include more, and a wider range of student, that student performance was the same for CDLI students as for classroom students. As it indicated in Table 1 the overall performance based on this variable was virtually the same. This allows us confidence in suggesting that any differences found from further analysis could be attributed to the geographic or subject matter variables.

Results and Discussion

The purpose of this study was to determine if there were performance differences based on the location of the student and the method of delivery in specific subject areas. Table 2 indicates the final course averages for all the students registered in courses offered by the CDLI

from the 2001-02 school year to the 2005-06 school year, sorted by subject area, student location, and delivery method of the course.

[Table 2 about here]

While there is a great deal of consistency between the final course scores in most of these subject areas based upon location and delivery method, there are three that are inconsistent: mathematics, science, and social studies. The web-based students in the mathematics courses performed better than the classroom-based students, with the web-based urban students having a higher average than the web-based rural students. However, classroom-based students performed better than web-based students in both the science courses and the social studies courses, and in the social studies the web-based rural students scored lower than any other group (although there were only five web-based urban students).

In addition to the final course averages, in Newfoundland and Labrador certain academic grade twelve courses have required province-wide, standardized exams. These exams include a multiple-choice portion and an essay portion; a single marking committee grades the latter. 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 CDLI students from 2002-03 to 2005-06 compared to their classroom counterparts based on subject area, student location, and delivery method of the course is found in Table 3.

[Table 3 about here]

There were more inconsistencies in the public exam scores than we found in the final course scores. Similar to the previous table, web-based students performed better in mathematics than classroom-based students, and the rural web-based students were among the highest in that group of students. Also similar to the final course scores, classroom-based students also performed

better than web-based students on their science public exam scores, with the rural web-based students performing among the lowest in both measures. Finally, classroom-based students performed better than web-based students on the English language arts public exam scores.

In an earlier study that focused on Advanced Placement (AP) students in Newfoundland and Labrador, Barbour and Mulcahy (2006) found that rural web-based students performed better on the standardized AP exam than their classroom and urban counterparts. However, a smaller percentage of rural web-based students (and rural students in general) actually challenged for the AP exam. In addition, the rural web-based students also had the lowest retention rates of any of the four groups of students. This led the authors to conclude that many of the rural web-based students who would have performed poorly on the AP exam had either chosen not to take the exam or had already dropped out of the course. While these findings were inconsistent with the data from this study, this concern is one that is shared by many of the other comparative studies available.

The mathematics results in this study, with web-based students performing better than classroom-based students, were consistent with Cavanaugh et al. (2005) and McLeod et al. (2005), both of whom found that virtual school students in their studies performed better on assessments of algebraic understanding that their classroom counterparts. However, Cavanaugh et al. speculated that the virtual school students who did take the assessment may have been more academically motivated and naturally higher achieving students. McLeod et al. also speculated that the reason was due to the high dropout rate in virtual school courses. Simply, many of the low-achieving virtual school students had already been removed from the sample prior to the assessment. They also indicated that the majority of virtual school students in the sample were doing the course for the second or third time, so familiarity with the content and the

motivation to take advantage of their "last chance" were also potential factors in the differences that were found. These potential limitations were not in consideration with the population of students in this study, as the only students who were excluded were a small number of urban students attending urban schools where both web-based and classroom-based students were enrolled.

In their evaluation of student achievement and performance in online learning in Alberta, Ballas and Belyk (2000) found that the performance of virtual and classroom students were similar in English and social studies courses, but that classroom students performed better overall in all other subject areas (i.e., biology, chemistry, mathematics, and physics). These results were similar to the students in Newfoundland and Labrador in English language arts (at least in terms of the final course scores) and the three science courses. However, these results were also quite different than their eastern counterparts in this study in the mathematics and social studies. In Alberta there were no differences in student performance in social studies, whereas the classroom-based students performed better than the web-based students in Newfoundland and Labrador. In mathematics, classroom-based students in Alberta performed better, while web-based students performed better in Newfoundland and Labrador. It should be noted that like the Cavanaugh et al. and McLeod et al. studies, Ballas and Belyk also indicated that the participation rate in the assessment among virtual students ranged from 65% to 75% compared to 90% to 96% for the classroom-based students. This led them to speculate, probably quite accurately, that the sample of virtual school students did not reflect the total population of these students.

The potential limitation in all of these comparison studies, as all of the authors have speculated, is that the virtual school students who take the assessment are more academically motivated and naturally higher achieving students than their classroom counterparts. This was

consistent with the findings of Rosenthal and Rosnow (1975), who in their literature review of the studies that relied upon volunteers as subjects found that volunteers "are likely to show higher levels of achievement that their less achievement-motivated colleagues" (p. 40) and "although there are a good many results (15) showing no relationship between volunteering and intelligence, there are even more (20) showing volunteers to be significantly more intelligent, while only 2 results show volunteers to be significantly ($p < .10$) less intelligent" (p. 66). Essentially those virtual school students who completed these assessments would be those who had a greater desire to achieve and who were more likely to succeed in school. This was not the case with the students in Newfoundland and Labrador, and may account for the differences that were present between this population of students and those in other jurisdictions.

It should be noted that the Statistics Canada definition for urban is quite broad. The official classification of what constitutes an urban community is:

> 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 CSDs that meet at least one of the following criteria: 1. the CSD falls completely or partly inside the 13 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, 2002)

Thus in Canada, a community is considered rural if it has less than 5000 people residing in the community and less 50% of the population is employed in a neighboring urban area. This moves many students from smaller communities into the classification of urban students. For example, students attending Templeton Academy in Meadows, with a population of 700, were classified as urban because Meadows falls into the census agglomeration of Corner Brook (which only has a population of 20,103), a community approximately 15 miles away.

Conclusions and Recommendations

When students in distance courses have scored better than their classroom counterparts it has been attributed to a greater degree of student selectivity found in the distance education program (i.e., the distance program served better performing students). Based upon this trend it was reasonable for us to surmise that when a distance education program was accessible to students with a wide variety of abilities levels, these K-12 distance students would score lower than their classroom counterparts. However, the findings from the first four years of data with the CDLI did not follow this pattern (see Barbour & Mulcahy, 2007). While there are a variety of reasons that may explain this difference, the first step was to determine whether or not this trend continues in all subject areas. The authors hypothesized that students enrolled in elective courses (such as art or music) in the virtual school would have a much higher level of performance than their classroom counterparts, while the students enrolled in required courses (such as English, mathematics or science) in the virtual school would have a much lower level of performance than their classroom counterparts. However, this was not the case. This indicated that the

students enrolled in the CDLI had a relatively consistent performance in all subject areas as their brick-and-mortar colleagues. Therefore subject area was not a useful variable in determining differences in student performance.

The data in this study indicated that there continued to be no difference in student performance based upon geographic location or method of course delivery. There were small performance differences found in the mathematics, science, and social studies (each of which had a difference of approximately 3%). Students in the web-based classes performed better than those in the classroom in mathematics, while students in the classroom performed better than those in web-based classes in science and social studies. The performance differences in the fine arts and technology courses were all less than 2%. While there was an almost 6% difference between web-based and classroom-based students in the general studies courses, there were only 36 web-based students (all from rural locations) – so this difference may have been due to the lack of population size in the rural web-based category. The inclusion of smaller communities that get caught into census metropolitan areas, census agglomerations, or census subdivisions into the rural categories, if it were possible, would assist this situation. Clearly this line of inquiry needs to continue to allow for the annual increase in the number of virtual school students added to this population.

In addition to continuing this line of inquiry, further research is also needed address the concerns that even within the model utilized by the CDLI, that the virtual school students in Newfoundland and Labrador are simply a more selective group of students than their classroom counterparts – as has been found in other jurisdictions. A study that compared virtual school and classroom-based students overall average or average in specific subject areas to determine if the mean of the virtual school students is consistent with the mean of classroom-based students is

required. Unfortunately, the data were linked to personalized health care identification numbers in the Province of Newfoundland and Labrador, and the Government is not allowed to release that data with those identifiers. This will limit our future consideration of student performance with this virtual school, but provides a blueprint for other researchers working with other virtual schools.

Finally, unlike their American counterparts who have to deal with the reality of local authority over education, it is more common for district-wide, consortium or provincial virtual schools in Canada to offer synchronous classes during the school day in a delivery method that utilizes a combination of both asynchronous and synchronous instruction.[3] The method of delivery utilized by the CDLI provides, depending on the subject area, anywhere from 30% to 80% of the students' scheduled time (which is 10-one hour periods over a fourteen day cycle) in synchronous instruction using the voice over Internet protocol software, *Elluminate Live*® (Elluminate Inc, 2006). This software allows for two-way voice over the Internet, a shared, interactive whiteboard, instant messaging, application sharing, breakout rooms, and interactive quiz and survey management. Through this software, teachers are able to provide synchronous instruction in much the same way that they would in a traditional classroom. As Barbour (2008) found, the vast majority of instruction occurs during the allocated synchronous time and students appeared to rarely use this time to complete CDLI work, instead, they used this time to talk to friends, explore the Internet, or engage in other off-task behavior. There have been some discussions within the CDLI about moving towards a more asynchronous method of delivery (M. Barry, personal communication, May 19, 2006), as was the original intention for the CDLI (Sparkes and Williams, 2000). One wonders if the decrease in the allocation of synchronous

[3] It should be noted there are many virtual schools in Canada that also operate using one of the other two methods of delivery – only that the use of the synchronous method tends to be more common in Canada than the United States.

instructional time will affect the student performance so that it experiences a greater degree of consistency with the experience in the United States.

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Table 1. Average student performance for the 2001-02 to 2005-06 school years

	Rural	Urban	Web-based	Classroom
Public Exam	61.93	62.76	62.22	62.41
Final Course	68.52	67.85	68.86	68.14

Table 2. Student performance on final course scores by location, delivery and subject area

	Rural Web	Urban Web	Rural Classroom	Urban Classroom
English Language Arts	67.98 (n=250)	65.19 (n=16)	66.91 (n=15,040)	66.20 (n=18,570)
	67.81 (n=266)		*66.52 (n=33,610)*	
Fine Arts	73.00 (n=460)	61.67 (n=6)	74.98 (n=4,243)	71.97 (n=6,338)
	72.84 (n=436)		*73.18 (n=10,581)*	
French	71.72 (n=485)	70.11 (n=9)	71.60 (n=7,096)	72.74 (n=7,582)
	71.69 (n=494)		*72.19 (n=14,678)*	
General Studies	76.00 (n=36)	0.0 (n=0)	70.81 (n=2,366)	70.28 (n=2503)
	76.00 (n=36)		*70.53 (n=4,869)*	
Mathematics	69.95 (n=1,500)	72.97 (n=37)	66.33 (n=32,882)	65.21 (n=48,480)
	70.02 (n=1,537)		*65.66 (n=81,362)*	
Sciences	64.86 (n=1,299)	63.11 (n=46)	67.13 (n=27,595)	68.19 (n=38,147)
	64.80 (n=1,345)		*67.75 (n=67,041)*	
Social Studies	65.47 (n=318)	73.80 (n=5)	70.62 (n=21,309)	70.56 (n=20,518)
	65.60 (n=323)		*70.59 (n=41,827)*	
Technology	73.64 (n=322)	73.80 (n=10)	72.54 (n=8,302)	70.83 (n=6,898)
	73.64 (n=342)		*71.76 (n=15,200)*	
Total	***68.89 (n=4,650)***	***67.86 (n=129)***	***68.50 (n=118,833)***	***67.85 (n=148,990)***

Table 3. Student performance on public exam scores by location, delivery and subject area

	Rural Web	Urban Web	Rural Classroom	Urban Classroom
English Language Arts	59.12 (n=33)	35.00 (n=1)	59.69 (n=3,750)	62.35 (n=4,868)
	58.41 (n=34)		*61.19 (n=8,618)*	
French	67.90 (n=203)	65.00 (n=2)	66.79 (n=2,123)	70.62 (n=2,252)
	67.87 (n=205)		*68.76 (n=4,375)*	
Mathematics	63.41 (n=409)	62.67 (n=9)	61.95 (n=7,563)	61.86 (n=12,230)
	63.39 (n=418)		*61.90 (n=19,793)*	
Sciences	59.12 (n=505)	62.47 (n=15)	60.05 (n=5,803)	62.39 (n=8,607)
	59.22 (n=520)		*61.45 (n=14,410)*	
Social Studies	62.41 (n=56)	69.75 (n=4)	63.72 (n=4,771)	62.49 (n=5,804)
	62.90 (n=60)		*63.04 (n=10,575)*	
Total	***62.20 (n=1,206)***	***62.74 (n=31)***	***61.92 (n=24,010)***	***62.76 (n=33,761)***