DMI-ELS ETSB Laptop Research Project:

Report on the Grade Three Students

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Summary

This report summarizes the results of a yearlong effort to integrate laptop computers among all the students and teachers in grade three of the Eastern Townships School Board. Pretest data were collected from Cycle One (Grade Two) students from ETSB elementary schools in the second year of project implementation (2004-2005). In year three (2005-2006), posttest data were collected from these same students, now in Cycle Two (Grade Three). The board provided trained personnel to administer the tests.

- *Grade 2:* The pretest measure, administered to students in May 2005, was the Canadian Achievement Test, Version Three (CAT-3), level 12 (Basic Battery for Reading and Language).

- *Grade 3:* The posttest measure, administered in May 2006, was the CAT-3, level 13 (Basic Battery for Reading and Language).
- Grade three teachers completed the Technology Implementation Questionnaire (TIQ) also in May 2006.

Twenty-eight grade three teachers provided complete TIQ results. Four hundred and fifty-eight students (224 girls and 234 boys) had both CAT-3 pretest (end of grade two) and posttest (end of grade three) scores. The student data were compared to the CAT-3 national norms.

There were expected improvements in achievement on the CAT-3 achievement test from Grade 2 to Grade 3. Much of the improvement in learning for the experimental group using laptops matched the gains by the Grade 2 and Grade 3 CAT-3 norms (i.e., the norming sample was used as the control group). Overall, there was a tendency for the ETSB students to close the gap in achievement over the years of the study (with the exception of reading). But we cannot attribute readily any learning gains to using technology given what we learned from the TIQ and by relating TIQ responses to CAT-3 scores.

The only significant relationship we found was a negative relationship between the reading subscale and three categories of technology use—communicative, creative and evaluative. We found no significant positive relationships between the TIQ and the CAT-3 subscales. In general, the more technology was used, especially for administrative and traditional purposes, the lower student learning. This is not to downplay the importance of non-instructional computer usage; it is just that if these uses predominate over instructional uses, there is little chance of a positive effect on student learning.

Finally, teachers' open-ended responses called for an increased amount of professional development, especially training focusing on more innovative pedagogical uses of technology.

In light of these findings, we make two related and tentative suggestions to the Board:

1. we suggest that the Board find ways to increase the quantity of instructional uses of technology, relative to other uses;
2. we suggest that the Board find ways to improve the quality of the use of technology.

This might be achieved by further support for teachers through consultants, workshops, and other development opportunities, including exposure to software tools that increase engagement in meaningful learning.

Computer technologies have long been known to increase administrative efficiencies and, in more recent years, have come to be a very reliable and useful means for people to communicate with each other. Where we still struggle is in the use of technology for effective teaching and learning. The literature is still mixed as to whether it helps children learn in the areas of reading, language and math, or whether it is neutral, or whether it actually impedes learning in these areas. What does seem clear is that we cannot expect to see a generalized "technology effect" on student achievement simply by adding technology to a classroom. Not only must there be a plan for the physical and practical integration of technology, but also a plan for pedagogical integration that takes advantage of the unique affordances of the technology.

These findings suggest that the breakthrough in innovation has not yet arrived but they most emphatically do not suggest that the breakthrough will not arrive. Instead, they offer as objective and complete an analysis as we could muster of where things stand and what lies ahead—more innovation may be needed, but in new and different directions.

As the latest report from the Canadian Council on Learning (2007) so forcibly underlies, we have much to do to bring the essential skills of Canadians to the levels that will allow them to help make Canada a leader in the Information Age and Knowledge Society. What we have done before has not succeeded as it should; we need to do a better job of education. Let us therefore applaud, support, and encourage those who are brave enough to try and make a difference in the lives of our children.

Introduction

The purpose of this study, one phase of a multi-year project, was to explore changes in teaching and student learning resulting from the Denis McCullough Initiative – Enhanced Learning Strategy (DMI-ELS) at the schools of the Eastern Townships School Board (ETSB). Spread over a three-year period, DMI-ELS involves providing every ETSB student from elementary Cycle Two (Grades Three and Four) to Secondary Five (final year of high school) with a laptop computer. Three schools piloted the initiative in May 2003 and in October 2003, in the first wave of implementation; computers were distributed to Cycle Three students in the board's twenty elementary schools and Secondary Five students in the three high schools. The remaining computers—about 5000—were deployed subsequently.

The goals of DMI-ELS were to increase student achievement, to empower personnel, and to promote excellence throughout the learning community (DMI/ELS 2003). Consistent with these goals, the initial intentions of the longitudinal evaluation plan were to:

- Explore the nature and extent to which technology affords or impedes student learning, motivation, attitudes, self-concept, and self-regulation;
- Identify best practices for technology integration, including professional development approaches, classroom practices, and teacher expectancies regarding technology;
- Critically describe the key elements of the university, school (including the role of school administration), and industry partnerships in the DMI-ELS initiative; and
- Summarize the process of conducting research for a project of this scale (CSLP, 2006).

A multi-year evaluation of DMI-EMS was needed to understand the full impact of the one-to-one laptop program. At the outset, the evaluation team at the Centre for the Study of Learning and Performance (CSLP) at Concordia University collaborated with both the ETSB and a control school board, the Sir Wilfrid Laurier School Board (SWLSB), to design a comprehensive evaluation plan, which was initially funded by a grant from Industry Canada. This plan was linked to the objectives of both boards and provided for the reporting of useful results to them. Importantly, however, the plan provided unequivocal third-party autonomy in analyses and interpretations to the CSLP. A summary of the evaluation was published in the *Canadian Journal of Learning and Technology* (Sclater, Sicoly, Abrami & Wade; 2006).

Since the outset of the DMI-ELS initiative there have been two important developments that have impacted substantially on the longitudinal evaluation. First, the control board was unable to continue its participation and a replacement was not identified. Second, Industry Canada's mandate was changed and it was no longer able to fund the longitudinal evaluation. Consequently, the scope and size of the evaluation plan needed to be dramatically reduced. Following discussions with the ETSB a revised evaluation plan was agreed on, that included a reduction in the number of students and teachers studied and a reduction in the number and variety of instruments and measurements.

This report describes the progress to date of that revised evaluation, focusing on the third year of implementation among grade three students. The report summarizes the pertinent literature, describes the methodology used to evaluate the progress of DMI-EMS, reports and analyzes the results gathered, and presents a brief discussion of the findings.

Literature Review

Welcomed or spurned, technology use in education is increasing. Enthusiasm for, as well as apprehension regarding, the use of e-learning, appears widespread as we herald the arrival of the Information Age. To some, e-learning can be used as a powerful and flexible tool for learning (Hannafin & Land, 1997; Harasim, Hiltz, Teles & Turoff, 1995; Lou, Abrami & d'Apollonia, 2001; Scardamalia & Bereiter, 1996). Proponents of the application of electronic technologies to education have long argued that computers possess the potential to transform learning environments and to improve the quality of the learning that results (for example, Bransford, Brown & Cocking, 2000; Jonassen, Howland, Moor & Marra, 2003; WBEC, 2000; Kuh & Vesper, 2001; McCombs, 2000, 2001; Siemens, 2005). Possible means include: increasing access to information (Bransford et al. 2000); providing access to a richer learning environment (Bagui, 1998; Brown, 2002; Caplan, 2004; Craig, 2001); making learning more situated (Bransford et al. 2000); increasing opportunities for active learning and inter-connectivity (Laurillard, 2002; Shuell & Farber, 2001; Yazon, Mayer-Smith & Redfield, 2002); enhancing student motivation to learn (Abrami, 2001); and increasing opportunities for feedback (Jonassen et al. 2003; Laurillard, 2002). A recently completed study (Lowerison, Sclater, Schmid and Abrami, 2006) points to the role of technology as a *catalyst* for change, supporting the learning process through course design and motivation. Indeed, there is sufficient optimism for technology's positive impact that governments have established committees, formed task forces, and dedicated substantial funds to the delivery or enhancement of technology-based instruction (CMEC, 2001).

There has also been skepticism (Clark & Sugrue, 1995; Cuban, 2001; Healy, 1998; Noble, Sheiderman, Herman, Agre, & Denning, 1998; Russell, 1999) about the use of technology to improve learning, including suggestions that it represents a threat to formal education, from kindergarten through university. For example, technology use may create an imbalance between computer skills and essential academic and thinking skills; foster isolated and technology dependendent, rather than independent and interdependent learners; or erode the joy and motivation to learn, replacing it with frustration because of failed equipment. Some teachers hold beliefs concerning the usefulness of information and communication technologies (ICT) that parallel their attitudes towards any change to teaching and learning, be it through government mandated reform or societal pressure: "If the computer can accomplish the task better than other materials or experiences, we will use it. If it doesn't clearly do the job better, we will save the money and use methods that have already proven their worth" (Healy, 1998, p. 218). Even moderate commentators such as Clark and Sugrue (1995) point out that the most likely explanation for increased learning with computer technology is instructional method differences, content differences, or novelty effects, and not the technology itself.

Technology integration and student achievement

Narrative and quantitative reviews of primary research have addressed the question of technology integration and student achievement; the findings are mixed. While many have reported positive effects of technology integration, others reviews have found that such a conclusion is not supported.

Some reviews have reported positive "technology effects." Kulik and Kulik (1989) reported that several reviews found positive technology effects on learning ranging from 0.22 standard deviations to 0.57 standard deviations compared to control participants. Several studies reported by Schacter (1999) found higher achievement, motivation, and engagement for students in technology-enriched environments. In their meta-analysis, Waxman, Lin, and Michko (2003) found small but positive technology effects on student outcomes. Gains in language arts and reading, mathematics, science and medicine, social studies, foreign and second language acquisition, and programming languages such as LOGO were found in studies cited by Sivin-Kachala and Bialo (2000). Kulik (2003) cited studies reporting positive impacts of word processor use on student writing skills, as well as on teaching programs in math, and in the natural and social sciences. In a meta-analysis of studies from 1992 to 2002, Goldberg, Russell and Cook (2003) found a positive technology effect of 0.4 standard deviations for students who learned writing using computers.

Other reviews are less enthusiastic. Though Coley, Cradler and Engel (2000) report achievement gains for drill-and-practice computer-assisted instruction, they found studies of more pedagogically complex uses of technology have been less convincing, reporting only interesting anecdotes (Coley et al., 2000). More concerning, Fuchs and Woessmann (2004) initially found mathematics achievement gains for home computer use, adjusting for family background and school characteristics, they found "the mere availability of computers at home is negatively related to student performance in math and reading, and the availability of computers at school is unrelated to student performance" (p. 17). Reviewing mostly Canadian research, Ungerleider and Burns (2002) found few methodologically rigorous studies reporting positive technology effects on student achievement, motivation, and metacognitive learning and on instruction in content areas in elementary and secondary schools. They also emphasized that access to computers in the classroom will not improve student academic achievement without concurrent changes to instruction. Methodologically sound studies must be undertaken with proper experimental and statistical controls.

More recently, Abrami et al. (2007) conducted a review that provided a rough sketch of the evidence, gaps and promising directions in e-learning from 2000 onwards, with a particular focus on Canada. They searched a wide range of sources and document types to ensure that they represented, comprehensively, the arguments surrounding e-learning.

For K-12 education, they concluded:

- Teachers need to be aware of differences between instructional design for e-learning as compared to traditional face-to-face situations.
- Immediate, extensive, and sustained support should be offered to teachers in order to make the best out of e-learning.

In the final stage, the primary e-learning studies from the Canadian context that could be summarized quantitatively were identified. Abrami et al. (2007) examined 152 studies and found a total of 7 that were truly experimental (i.e., random assignment with treatment and control groups) and 10 that were quasi-experimental (i.e., not randomized but possessing a pretest and a posttest). For these studies they extracted 29 effect sizes or standardized mean differences, which were included in the composite measure.

The mean effect size was +0.117, a small positive effect. Approximately 54% of the e-learning participants performed at or above the mean of the control participants (50^{th} percentile), an advantage of 4%. However, the heterogeneity analysis was significant, indicating that the effect sizes were widely dispersed. It is clearly not the case that e-learning is always the superior condition for educational impact.

Overall, Abrami et al. (2007) concluded that research in e-learning has not been a Canadian priority; the culture of educational technology research, as distinct from development, has not taken on great import. In addition, there appears to have been a disproportionate emphasis on qualitative research in the Canadian e-learning research culture. They noted that there are gaps in areas of research related to early childhood education and adult education. Finally, they believe that more emphasis must be placed on implementing longitudinal research, whether qualitative or quantitative (preferably a mixture of the two), and that all development efforts be accompanied by strong evaluation components that focus on learning impact. It is a shame to attempt innovation and not be able to tell why it works or doesn't work. In this sense, the finest laboratories for e-learning research are the institutions in which it is being applied.

One-to-one computer implementations

Until recently, studies of technology integration in schools have reported limited student access to technology: they learn in dedicated computer labs for select periods during the week, or in classrooms where computers are available but at ratios of several students per computer, or even in classrooms using "laptop carts" where a cart with enough laptops for a one to one ratio is shared be several classrooms so that students can use their own computer in their own classroom for select periods during the week. Now, interest is shifting to more widespread and ubiquitous technology use, that is, when each student is provided with a computer for use throughout the day. Underpinning this interest is the belief that increased access to technology will lead to increased technology use, which will in turn lead to improvements in a variety of educational outcomes (Russell, Bebell & Higgins, 2004). It is unsurprising that particular interest is being given to laptop initiatives where students are allowed to take their laptops home.

One-to-one computer implementations that provide students with internet access and laptop computers for use at school and home are rapidly increasing in number. Decreasing costs, increased portability, and availability of wireless networking all contribute to making broad implementations feasible (Apple, 2005; Penuel, 2006). In two separate research syntheses, Penuel reports that not only does research lag behind such rapid expansion, but of the research studies that have been done, few analyze implementation outcomes in a rigorous manner (Penuel, 2006). For this report we have conducted our own synthesis of one-to-one computing research. Research databases and the Internet were searched for studies on one-to-one computing in elementary or secondary schools that report implementation outcomes. The research we report here is not an exhaustive summary of all the available evidence.

In total, ninety-four studies were retrieved for review. Not surprisingly, many these were interim report of longitudinal studies. Studies of the same implementation were only retained if they studied a unique aspect of that implementation, otherwise only the most recent study was included. Of the ninety-four, there were twenty-five that presented unique research of implementations and that analyzed implementation outcomes. In addition there were six research syntheses or reviews. These twenty-five primary studies are synthesized below. The reviews are synthesized separately.

Although the studies reported on widely different implementations, from small private schools to huge state-wide initiatives, the findings converged around common themes. Implementation goals included increasing technology use, increasing technology literacy, improving quality of teaching and learning, reducting dropout rates/improving attendance, improving motivation and behavior, and improving academic achievement. Of the stated goals, increased technology use was reported in almost all (22 of 25 or 88%) of the studies. Though this result is expected—the more access to technology, the more opportunities to use it—even this finding is not as straightforward as it first appears. In two of the longitudinal studies (Stevenson, 2004; Newhouse & Rennie, 2001), though initial increases in technology use were reported, over time technology use in one-to-one classrooms declined to use patterns in classrooms with shared computers, suggesting that novelty accounted for at least some of the increase in technology use. Moreover, both these studies stress the importance of pedagogy that utilizes the unique affordances provided by the new technology (Stevenson, 2004; Newhouse & Rennie, 2001). Students quickly become frustrated when new technologies are forced into the same old pedagogy.

In a similar vein, the thirteen studies (52%) with data on student motivation report increases over previous levels or over non one-to-one comparison groups. Though it is often difficult to identify the proximate cause of student motivation accurately, these findings are certainly encouraging. At the same time, as with technology use, motivational increases may be due to the novelty effect. Closely related to both technology use and motivation, fifteen studies (60%) reported increases in positive attitudes toward technology. Again, of the six longitudinal studies that report attitudes toward technology, three report that differences between the one-to-one and non one-to-one groups declined. Given all these qualifiers, though, one-to-one initiatives have consistently resulted in increased technology use, student motivation, and positive attitudes toward technology.

Eleven studies (44%) report findings on technological literacy. Of these, eight report measured increases in technological literacy, while three report perceived increases. Though the number of studies reporting these increases is smaller, given the numbers reporting increased use of technology, it is unsurprising to find corresponding increases in technological literacy. Though improved attendance and discipline were frequently mentioned goals of one-to-one initiatives these were not often reported in the studies. Only four studies reported attendance figures. Of these two report dramatic increases while the other two report no differences. Similarly, of the four studies reporting on student discipline, two report improvements while the other two report no difference. Interestingly, though not usually an explicit goal of one-to-one initiatives, improvements in the quality of teacher student interactions were reported in nine studies. Not only is this important for both motivation and discipline, but these interactions impact directly on pedagogy.

Justifiably or otherwise, the success of any educational innovation is more often than not evaluated in terms of student achievement gains, usually measured by standardized testing. As far as one-to-one initiatives are concerned, the results are not straightforward. Although in three studies, students or teachers report perceived achievement gains, the actual data paint a more complex picture. In fact, of all the studies only fourteen (56%) report actual achievement data. Of these, six report improvements of some sort. Of these, the relationship between technology cannot be reliably established in two of the studies: one provides no comparison group data and another provides no pretest data. In contrast to the four that report reliable data on improved achievement, eight studies report no significant difference either between one-to-one and non one-to-one groups or between achievement before and after one-to-one implementations.

This is not to say that one-to-one technology has no effect on student achievement. The studies reporting increases in student achievement all report these increases in particular areas. In their evaluation of the Laptop Immersion Program at Harvest Park Middle School in Pleasanton, CA, Gulek and Demirtas (2005) found that when achievement results were controlled for prior performance, only differences in Language Arts and Writing remained statistically significant. Similarly, Lowther, Ross, and Morrison (2003) report substantial increases in writing and critical thinking achievement in their evaluation of a one-to-one technology integration using the iNtegrating Technology for inQiry (NTeQ) model. Trimmel and Bachmann (2004), in their comparison of 27 laptop with 22 non laptop students, report that while significant differences in student achievement could be accounted for by differences found in achievement on one sub-category of the testing measure used – spatial intelligence. Particularly interesting is that in three studies, (Mitchell Institute, 2004; Stevenson, 1999; CRF & Assoc., 2003) even though none of them reported overall gains for the treatment group as a whole, the authors report that within the treatment groups, low-performing students gained disproportionately.

Russell and Higgins (2003) raise another issue. They question whether standardized paper and pencil tests accurately measure the particular learning that might take place in a one-to-one classroom. In particular, they report research where two groups of students, a one-to-one group and a control group, take two versions of the same writing test, a computerized version and paper and pencil version. Predictably, on the computerized version, the one-to-one group had higher scores than they did on the paper and pencil test, while the control group had lower scores than they did on the paper and pencil test. In other words the unfamiliar test format tended to underpredict the performance of both groups. Moreover, they repeat the oft-heard argument that standardized tests don't measure the kinds of skills that one-to-one learning may be developing, for example spatial reasoning and problem solving. Though care must be taken with arguments of this sort, the findings of Trimmel and Bachmann (2004) and Lowther et al. (2003) seem to support this line of reasoning.

The six research syntheses reviewed echo the findings described above: they report consistent findings of increases in technology use and technology literacy, while reporting little evidence of a "technology effect" on student achievement. The syntheses report several factors contributing to the success of any one-to-one implementation: teacher beliefs, teacher training, technical support, comprehensive curriculum review that meaningfully integrates technology rather than forces into existing pedagogy, change management strategies. Most importantly, though, the syntheses emphasize the need for more research into one-to-one implementations to tease out exactly how, when, and under what conditions they are the most effective.

Taken together, available evidence of ubiquitous technology integration is consistent – laptop initiatives have shown improvements in technology integration, use, and proficiency, in attitudes towards technology and the promise of technology for learning, and to some extent increased engagement and motivation. What seems clear, however, is that research does not support the premise that one-to-one initiatives automatically lead to increased student achievement. Of the twenty-five studies of one-to-one implementations reviewed, fourteen provide data on student achievement. Of these, six provide some evidence of achievement gains, four reliably, while eight cite data of no significant difference. Technology seems to be suited to affecting improvements in some areas and with some students more than with others. Moreover as the results reported in Lowther et. al. (2003) seem to suggest, the best results are obtained when one-to-one computing is one part of a well-planned technological integration strategy that includes specific guidelines and training in pedagogically sound uses of computers in the classroom.

Project Overview

Rationale

In the first year of the DMI-ELS implementation, data were collected from 403 elementary and 270 secondary students from the experimental school board (ETSB) and also from 330 students in the control school board (SWLSB) (Sclater, Sicoly, Abrami and Wade 2006). In addition, questionnaire data were collected from 60 elementary school teachers and 51 secondary school teachers. Finally, interviews were conducted with 72 students and 20 teachers. Potentially the most interesting finding was the difference in achievement scores between the experimental and control boards. Secondary students from the experimental board had higher scores on the CAT-3 reading test and indicated making six times more frequent use of computer technology in their English classes, suggesting a possible treatment effect. In contrast, math scores were higher at the control board where neither board indicated high levels of computer use. Nevertheless, these findings must be interpreted with some caution until the threats to validity of selection bias are more clearly overcome.

Following the withdrawal of Industry Canada due to a change in its mandate, the CSLP, SWLSB and the ETSB agreed to continue their collaboration on the study in Year Two. The partners agreed to continue the evaluation as a quasi-experimental nonequivalent pretest-posttest design focusing only on children who would be exposed to laptops the following year. This design compares observed changes in a group that receives an educational "treatment" (in this case DMI-EMS) with a group that does not receive the treatment. For this evaluation, the treatment group consisted of students and teachers from ETSB, while the non-treatment (control) group consisted of teachers and students from the Sir Wilfred Laurier School Board (SWLSB). The evaluation studied Cycle Two (Grade Three) classes because students are exposed to a one-to-one computing environment for the first time at the beginning of Cycle Two. This is important as it offers the best opportunity to identify a "technology effect" on teaching and learning.

Unfortunately, at the conclusion of Year Two, following the collection of pretest data in both Boards, the SWLSB (control board) withdrew from further participation. Since no other board agreed to participate as a control board and given the budgetary restriction now in place, it was decided to use the national norms available on the standardized achievement test as the basis for comparison. Although not as strong a comparison as the original control group, because of the increased likelihood of selection by treatment interaction effects, this design is still superior to the one group pretest posttest design that would have been the result if no comparison group at all had been identified.

In keeping with the objectives of the evaluation, and following consultations among the partners, two types of data were collected, achievement data to identify changes in student achievement and technology use data to determine whether, how, and to what extent the new technologies were being employed in ETSB classrooms.

Methodology

Measures

CAT-3 The Ministry of Education in Québec (MEQ) does not use a provincial achievement measure for elementary students. A common achievement measure was needed. The Canadian Achievement Test Third Edition (CAT-3) was selected for several reasons including, but not limited to:

- CAT-3 is a well-established, nationally-recognized achievement measure;
- ETSB had experience with the test, having previously used it;
- SWLSB had been considering implementing use of the test; and
- To ensure consistency with the Quebec Education Program elementary school curriculum, a test consultant from the Canadian Testing Centre (CTC) conducted a thorough analysis on the basic battery to insure its compatibility (CSLP, 2006).

For the purpose of this evaluation, only the Basic Battery was used for comparing achievement data. The test consisted of a series of multiple-choice questions in reading/language (comprehension, vocabulary and language) and math (defined by province and test level).

TIQ. The Technology Implementation Questionnaire (TIQ) was developed by Wozney, Venkatesh and Abrami (2006). They used the TIQ to investigate personal and setting characteristics, teacher attitudes, and current computer technology practices among 764 elementary and secondary teachers from both private and public school sectors in Quebec. The TIQ was developed using expectancy-value theory. It consists of 33 belief items grouped under three broad motivational categories: perceived *expectancy* of success, perceived *value* of technology use, and perceived *cost* of technology use. In addition, teacher demographics, teachers' current uses of technology, and availability of resources were also surveyed.

We also added two open-ended items that allowed teachers to provide anonymous comments on technology use in the ETSB. These open-ended items were added: 1) Suppose your school administration annually made additional resources available (example: release time for improving computer-based instruction). In your opinion, what kinds of resources should they provide? How would you like to see these resources used in order to improve your instructional use of computers? 2) Please describe the ideal use, if any, of computer technology in the classroom.

TIC. To gain insight into student technology use, students were also asked to complete the Survey on the use of Technology (TIC) (Appendix B). The TIC is an online survey that was to be administered in class four times to measure students' technology use from March to May 2006.

Data Collection

Initially, achievement and technology use data were collected from ETSB and SWLSB teachers and students. As SWLSB did not participate in the study in the third year, however, national and provincial CAT-3 norms were to be used for comparison instead.

Pretest data were collected from Cycle One (Grade Two) students from ETSB elementary schools in the second year of project implementation (2004-2005). In year three, posttest data were collected from these same students, now in Cycle Two (Grade Three). The board provided trained personnel to administer the tests.

- *Grade 2:* The pretest measure, administered in May 2005, was the CAT-3, level 12 (Basic Battery for Reading and Language).
- *Grade 3:* The posttest measure, administered in May 2006, was the CAT-3, level 13 (Basic Battery for Reading and Language).

Once the CAT3 tests were administered, they were sent to the Canadian Testing Centre (CTC) for scoring. CTC forwarded results directly to CSLP for data entry and analysis.

Along with the CAT-3 exams, consent forms were collected from Grades Two and Three students to comply with Canada's Tri-council Policy on the ethical treatment of research participants (Appendix A). Parents were asked to consent for their child's participation in the study, since all students were under the 18. All student participants were told that they had the right to both discontinue participation at any time, and to decide not to complete questionnaires if they did not feel comfortable in doing so. Principals and school board officials, in some cases, included a covering letter to parents further explaining the rationale for and the scope of the research (CSLP, 2006).

In the current investigation, we were especially concerned about the quality and quantity of teacher uses of technology so we focused on these TIQ item in our analyses. A slightly modified version was distributed to teachers in spring 2005 and 2006 (Appendix C). The cover page of the TIQ indicated to teachers that by completing the questionnaire they were in fact consenting to participate in the study.

All completed consent forms, TIC results, and TIQs were sent to the CSLP for data entry and analysis.

Analyses – CAT-3 data

Because student level data (CAT-3 and TIC) and class level data (TIQ) were being collected, collation of data presented a theoretical challenge —how should data from different units of analysis be aggregated. Two possibilities were available:

- Use students as the unit of analysis and assign the same TIQ values to every student in the class (each of them have the same teacher),
- Use classes (in other words teachers) as the unit of analysis and assign aggregate CAT-3 data for the class.

Classes were chosen as the more appropriate unit of analysis as the comparison because this method would focus on differences between degrees and types of technology integration rather than on individual differences between students.

In each class student CAT-3 data were aggregated into a mean class score that was then assigned as CAT-3 data for each teacher. Pretest results from Grade Two (2005) for the Basic Battery in Reading, Language, and Math were compared with posttest results from the same tests in Grade Three (2006), and both pretest results and posttest results were compared with national norms for Grades Two and Three respectively. All CAT-3 results were reported as overall means and standard deviations and decile means. Deciles report the means of each tenth (decile) of the group, in other words the mean of the first (or lowest) tenth (10^{th} decile), the second tenth (20^{th} decile) and so on. Tests of significance for pretest-posttest gains were conducted, as were analyses of test-retest reliability.

We examined individual item and item clusters for technology use. We related teacher technology use to student achievement. We also categorized teacher responses to the two open-ended questions.

Correlational Analyses (CAT-3 Subtests and the TIQ)

Relationships between the three CAT-3 subtests and the Categories of Technology Use were examined through correlational analysis.

Analyses – TIC data

We hoped to analyze the TIC data to get an idea of how students perceived technology use in their classrooms. There was insufficient data to conduct meaningful and interpretable analyses as noted below.

Results: Breakdown of the Sample

Cat 3-Data

Data collected for year three of the study included pretest and posttest data for the ETSB students (CAT-3 level 12 and level 13 respectively), completed TIC surveys from students, and completed TIQ surveys from teachers.

Of the 501 students on the registers of ETSB schools in May 2005, 458 students (224 girls and 234 boys) were still on the register in 2006 and had pretest and posttest data (Table 1).

Table 1: Numbers of students with pretest (CAT-3 level 12) and posttest (CAT-3 level 13) data

Gender	Grade 2 students	CAT-3 level 12 (2005)	Returning Grade 3 students	CAT-3 level 13 (2006)
Girls	N/A	243	227	224
Boys	N/A	250	238	234
Total	510	493	465	458

Of these, 382 gave consent in 2006 to participate in the study: 187 females, 195 males (Table 2).

Table 2: Rates of consent for students with pretest and posttest data

Gender	Students with CAT-3 data	Consents	Consent Rate
Girls	224	187	83%
Boys	234	195	83%
Total	458	382	83%

Given that a fairly large number (76) of students did not consent or did not return consent forms, it was necessary to confirm that the remaining dataset was representative of the ETSB student population. Consent rates were compared across schools (Table 3).

Table 3: Comparison of consent rates across ETSB schools.

School	Consents	Eligible	Percent
Asbestos-Danville-Shipton Elementary	11	12	92%
Ayer's Cliff Elementary School	7	14	50%
Butler Elementary School	19	20	95%
Cookshire Elementary School	11	13	85%
Drummondville Elementary School	21	21	100%
Farnham Elementary School	4	9	44%
Heroes' Memorial Elementary School	26	30	87%
Knowlton Academy	33	39	85%
Lennoxville Elementary School	39	44	89%

Mansonville Elementary School	1	1	100%
North Hatley Elementary School	5	7	71%
Parkview Elementary School	45	47	96%
Pope Memorial Elementary School	8	10	80%
Princess Elizabeth Elementary School	19	23	83%
Sawyerville Elementary School	6	7	86%
Sherbrooke Elementary School	58	78	74%
St.Francis Elementary School	34	39	87%
Sunnyside Elementary	12	19	63%
Sutton Elementary School	13	13	100%
Waterloo Elementary School	10	12	83%
TOTALS	382	458	83%

Table 4 shows that the majority of schools (15 of 20) had a consent rate of 80% or better, close to the mean return rate (83%). While noting that two schools, Ayer's Cliff (50%) and Farnham (44%) had rates that were substantially lower than the average, it was decided that the sample was representative as these schools were small (14 and 9 students respectively) and did not contribute heavily to the overall mean.

Table 4: Overall participation rates.

Gender	Students with CAT-3 data	Consents	Valid CAT-3 data 2005 (level 12)	Valid CAT-3 data 2006 (level 13)	Valid data for both	Participation Rate
Girls	224	187	175	170	164	73%
Boys	234	195	176	170	159	68%
Total	458	382	351	340	323	71%

Of these 382 participants, 323 of them (164 girls and 159 boys) had valid data for both the pretest and the posttest (Table 4). The final dataset, therefore, comprised 323 of the 458 students who were administered both the CAT-3 level 12 and level 13. This represents a participation rate of 71%.

TIQ data

Of thirty-five TIQs distributed to teachers in this study, thirty-two were completed and returned to the CSLP. Valid student CAT-3 data was received from thirty different classes. Of these, twenty-eight had matching TIQ forms. The two missing TIQ forms were for teachers of classes with students from more than one grade level. In each case, there was only one Grade Three student in the class (each of whom had valid CAT-3 data and consent forms). In terms of classes, 28 of 30 classes with valid student CAT-3 data had matched TIQ data; in terms of students, 321 students with valid data had matched TIQ data.

On the 28 matched TIQ forms, the incidence of missing data was negligible (< 0.5%).

TIC data

Given that all four TIC surveys were administered in May 2006, the TIC would not give an accurate picture of technology use over time. Moreover, of all Grade Three students, only 158 completed all four TICs. It was decided that for each student, only the first administration of the TIC would be considered for evaluation. Of the 323 students with valid CAT-3 data and consent, only two did not have complete TIC data. Of the 321 students with valid CAT-3 data, consent, and matched TIQ data, 319 had at least one complete TIC.

The TIC has its own problems however. Given the age of the students, it is not surprising that the TIC suffered considerably from missing data. In fact no item on the TIC had complete data. It would be risky to subject this data to rigorous analysis. The data was recorded for interest nonetheless.

Results: Analysis of the Data

A. CAT-3 2005 (Pretest) and 2006 (Posttest) Results

1. Pretest Results (2005) for CAT-3 (Grade 2) vs. National Norms (Deciles and Percentiles)

The three tables that follow all have the same structure. Tables 5 through 7 relate to the Spring 2005 (Grade 2) administration of the CAT-3 and contain descriptive data concerning each. Of particular interest are the deciles for the actual reading scale scores and the deciles based on the CAT-3 National Norms (Canadian Test Centre, 2002). Across all three sub-scales, the same pattern emerges. ETSB students in the lower deciles (4th and below) tend to be around (sometimes at or higher) the National Norms at the lower and higher deciles, with scores lower around the 5th decile (median).

Table 5. Statistics for CAT-3 Reading (2005)

Statistic	Reading Scale Scores (Grade 2)	National Norms (Grade 2)
Median*	446.00	455
Deciles (Percentiles)*		
1 (10)	394.00	389-391
2 (20)	412.00	412-413
3 (30)	427.00	428-429
4 (40)	434.20	442-443
5 (50)	446.00	455
6 (60)	460.00	468
7 (70)	477.00	481
8 (80)	498.00	497
9 (90)	524.00	518-520

* Based on 332 cases.

Table 6. Statistics for CAT-3 Language (2005)

Statistic	Language Scale Scores (Grade 2)	National Norms (Grade 2)
Median	432.00	455
Deciles (Percentiles)		
1 (10)	382.00	382-385
2 (20)	391.00	407-409
3 (30)	411.00	425-426
4 (40)	421.00	440-441
5 (50	432.00	455
6 (60)	446.00	469
7 (70)	461.00	484
8 (80)	499.00	501-502
9 (90)	523.00	525-526

Table 7. Statistics for CAT-3 Math (2005)

Statistic	Math Scale Scores (Grade 2)	National Norms (Grade 2)
Median	413.00	422
Deciles (Percentiles)		
1 (10)	346.10	344-346
2 (20)	370.00	369-370
3 (30)	386.10	390-391
4 (40)	394.00	407
5 (50	413.00	422
6 (60)	424.00	437
7 (70)	435.00	453
8 (80)	447.00	471-472
9 (90)	475.00	496-498

2. Posttest Results for CAT-3 (Grade 3) vs. National Norms (Deciles and Percentiles)

The pattern of descriptive statistics across deciles compared to the CAT-3 National Norms for CAT-3 Grade 3 (2006) reading, language and math is similar to that of results in 2005 (Tables 8 to 10). Students tend to perform around the National Norms in the lower and higher deciles but are behind the norming sample around the 5th decile. Only on the math sub-test did ETSB Grade 3 students at all deciles (even at the median) perform around the National Norms.

Table 8. Statistics for CAT-3 Reading (2006)

Statistic	Reading Scale Scores (Grade 3)	National Norms (Grade 3)
Median	468.00	487
Deciles (Percentiles)		
1 (10)	420.00	417-419
2 (20)	440.00	441-442
3 (30)	452.40	458-459
4 (40)	460.00	473
5 (50	468.00	487
6 (60)	486.00	501
7 (70)	508.00	516
8 (80)	522.00	533-534
9 (90)	554.00	557-559

Table 9. Statistics for CAT-3 Language (2006)

Statistic	Language Scale Scores (Grade 3)	National Norms (Grade 3)
Median	484.00	489-490
Deciles (Percentiles)		
1 (10)	415.00	403-406
2 (20)	437.00	433-435
3 (30)	448.00	454-456
4 (40)	471.00	472
5 (50	484.00	489-490
6 (60)	484.00	504
7 (70)	498.60	521
8 (80)	531.00	541-542
9 (90)	551.00	569-571

Table 10. Statistics for CAT-3 Math (2006)

Statistic	Math Scale Scores (Grade 3)	National Norms (Grade 3)
Median	447.00	439
Deciles (Percentiles)		
1 (10)	373.70	362-364
2 (20)	403.00	389-390
3 (30)	418.00	407-409
4 (40)	432.00	424-425
5 (50)	447.00	439
6 (60)	462.00	454
7 (70)	470.00	470
8 (80)	490.00	488-489
9 (90)	511.00	513-515

3. Significance Test for CAT-3 Change (Correlated t-tests)

In order to determine if a change occurred in reading, language and math between 2005 (Grade 2) and 2006 (Grade 3), we conducted a correlated *t*-test for each sub-test (Table 11). A significant change was found across all three subtests, the greatest in math and the least in reading.

Table 11. Correlated t-test of change from Grade 2 to Grade 3 for Reading, Language and Math

CAT-3 Sub-Scale	Change (G2 to G3)	Standard Error Mean	*t*-value	*df*	Sig.
Reading Scaled Scores	27.13	2.13	12.72	321	< 0.001
Language Scaled Scores	39.48	2.90	13.64	321	< 0.001
Math Scaled Scores	44.83	3.20	14.05	321	< 0.001

4. Test-Retest Reliabilities for CAT-3 (2005 and 2006)

Test-retest reliability is the characteristic of an instrument to perform in a similar fashion over repeated administration. Standardized instruments usually display the best test-retest reliability (compared to, for instance, teacher-made tests) because they are refined over repeated administrations so that items measure the same thing repeatedly. A good test-retest reliability for a standardized instrument is $r = 0.80$ and above. Since the CAT-3 in reading, for instance, given at different grade levels contain similar, but not identical items, the tests might be considered parallel forms. As a result the test-retest reliabilities might be expected to be somewhat lower than the desired standard. Table 12 shows the reliabilities of the three sub-tests, reading language and math, administered in 2005 (Grade 2) and 2006 (Grade 3). The reading and math scaled scores demonstrate acceptable reliability, but the language sub-test is somewhat low.

Table 12. Test-Retest Reliabilities (2005 and 2006; N =21).

CAT-3 Sub-Scale	Test-Retest Reliability
Reading Scaled Scores	0.692
Language Scaled Scores	0.533
Math Scaled Scores	0.685

5. Comparisons Between the CAT-3 School Data and National Norms (Means and Standard Deviations

In order to determine if the students changed in the levels of reading, language and mathematics between 2005 (Grade 2) and 2006 (Grade 3) compared to the CAT-3 National Norms. These norms are found in the CAT-3 *Technical Manual* (Canadian Test Centre, 2002). A one-sample *t*-test was use to compare the CAT-3 norms with the actual student data. The comparisons involved testing the difference between the scores and the norms for 2005 data and 2006 data, separately for each subtest—reading scaled scores, language scaled scores, and mathematics scaled scores.

The norms of the CAT-3 were developed in 2000 based on a sample of 44,000 students (CAT-3 Technical Manual, 2002) from across Canada (including 1,629 students from Anglophone schools in Quebec). The subscales are considered to be valid and reliable measures of achievement against which comparisons of particular individuals, schools, and school boards can be made. Thus, the design of this portion of the study looked like this:

Groups	Data Source (Grade 2)	Treatment	Data Source (Grade 3)
Experimental Group (ETSB)	$O_{Reading}$ $O_{Language}$ $O_{Mathematics}$	X	$O_{Reading}$ $O_{Language}$ $O_{Mathematics}$
Control Group (Canadian Norms)	$O_{Reading}$ $O_{Language}$ $O_{Mathematics}$		$O_{Reading}$ $O_{Language}$ $O_{Mathematics}$

O = CAT-3 observations; Dotted line indicates non-equivalent groups; X = laptop treatment.

A. Reading Scaled Scores (2005 and 2006) Compared with National Norms

Since there was not a way to include a no-laptop true control group in this study, student achievement on the CAT-3 were compared to the Canadian national norms in Reading, Language and Mathematics. Since it is likely that that there was no systematic application of technology and especially laptops in students who served in the norming sample, this is a reasonable approach. Table 13 shows the Reading statistics for 2005 and 2006.

Table 13. Descriptive statistics for Reading Scaled Scores for 2005 (Grade 2) and 2006 (Grade 3).

One-Sample Statistics	*N*	Mean	Std. Deviation	Std. Error Mean
Reading Scaled Scores 2005	322	452.53	47.76	2.66
Reading Scaled Scores 2006	322	479.66	49.57	2.76

Figure 1 suggests a slight divergence for reading scores from Grade 2 to Grade 3.

Figure 1. ETSB Reading Scaled Score and National Norm Means (Grade 2 and Grade 3).

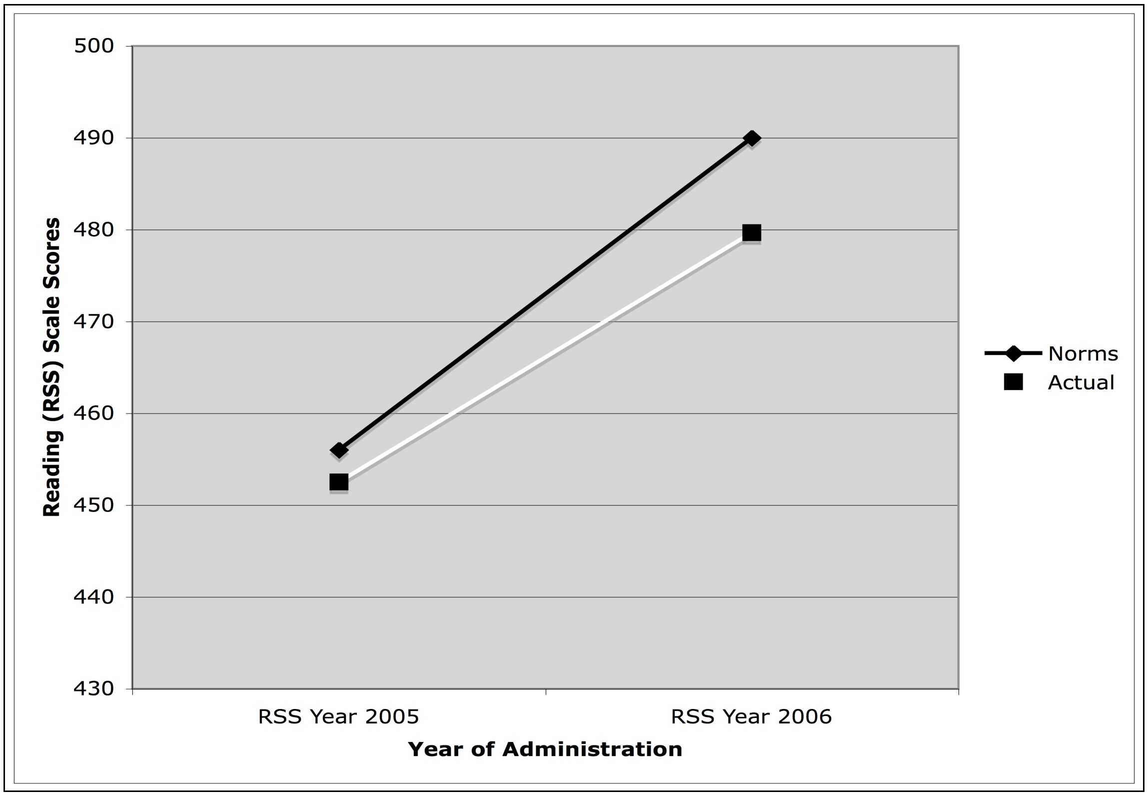


Table 14 indicates that mean of reading scores is not different than the norm in 2005 (Grade 2) but that it is significant in 2006 (Grade 3). This represents a net loss over the year of the project.

Table 14. Test of significance of RSS School Data (2005 and 2006) with National Norms.

One-Sample *t*-test	*t*	*df*	Sig. (2-tailed)	Mean Difference
Reading Scaled Scores 2005 Mean Sample Norm = 456	-1.30	321	0.19	-3.47
Reading Scaled Scores 2006 Mean Sample Norm = 490	-3.74	321	0.00	-10.34

B. Language Scaled Scores (2005 and 2006) Compared with National Norms

Table 15. Statistics for Language Scaled Scores for 2005 (Grade 2) and 2006 (Grade 3).

One-Sample Statistics	*N*	Mean	Std. Deviation	Std. Error Mean
Language Scaled Scores 2005	322	442.02	52.84	2.95
Language Scaled Scores 2006	322	481.50	54.63	3.05

Figure 2 suggests a change, or convergence, of ETSB language scores compared to the National Norms from Grade 2 to Grade 3.

Figure 2. ETSB Language Scaled Scores Means Compared to National Norms Means (Grade 2 and Grade 3)

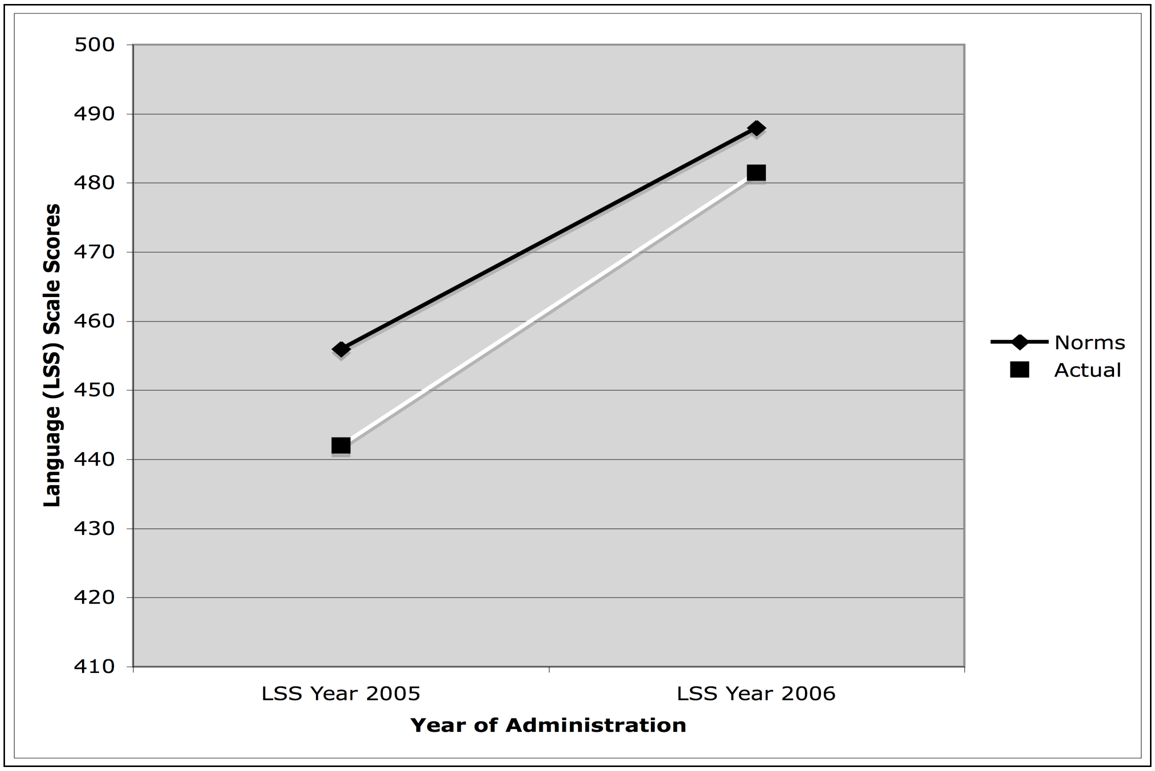


Table 16 indicates a slight change against the norm in language scores in 2005, but language scores are still significantly lower than the norm.

Table 16. Test of significance of LSS School Data (2005 and 2006) with National Norms.

One-Sample *t*-test	*t*	*df*	Sig. (2-tailed)	Mean Difference
Language Scaled Scores 2005 Mean Sample Norm = 456	-4.749	321	0.00	-13.98
Language Scaled Scores 2006 Mean Sample Norm = 488	-2.135	321	0.03	-6.50

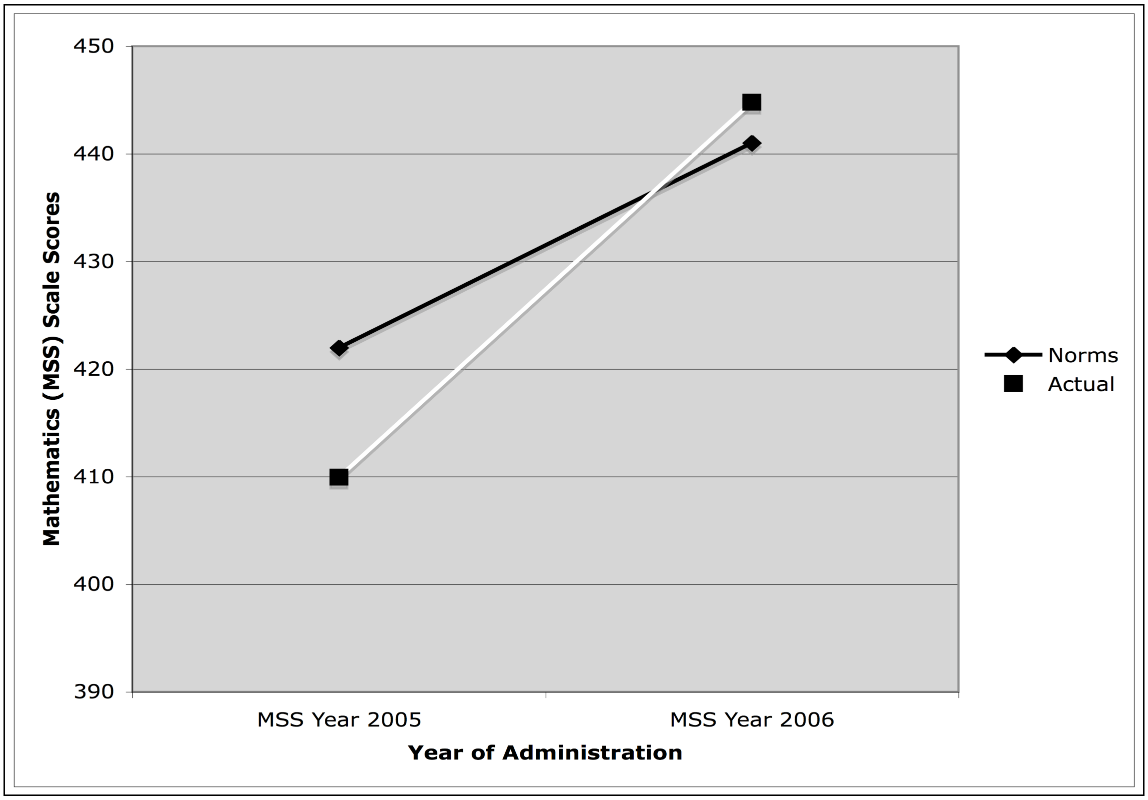
C. Mathematics Scaled Scores (2005 and 2006) Compared with National Norms

Table 17. Statistics for Mathematics Scaled Scores for 2005 (Grade 2) and 2006 (Grade 3).

One-Sample Statistics	*N*	Mean	Std. Deviation	Std. Error Mean
Math Scaled Scores 2005	322	409.95	49.52	2.76
Math Scaled Scores 2006	322	444.78	52.94	2.95

Figure 3 shows a crossover from Grade 2 to Grade 3, with ETSB math scaled scores lower than the National Norms in Grade 2 but higher by Grade 3.

Figure 3. ETSB Math Scaled Scores Means Compared to National Norms Means (Grade 2 and Grade 3)



B. Technology Integration Questionnaire (TIQ) Results

The first problem that we encountered in this portion of the analysis that involves the TIQ is the fact that there are 27 teachers, each with one TIQ, and that there are 323 students each with CAT-3 scores in reading, language and math. We solved this problem by using classes (i.e., teachers) as the unit of analysis rather than students. The problem with this approach is that it reduces the sensitivity of the analyses.

1. Item-by-Item Results for Technology Use (Means and Standard Deviations)

Section III of the TIQ asks teachers to rate their use of computer technology in categories of use. The instructions to the teachers and the six-point scale, from “Never” to “Almost Always,” are shown below. Some items were too low in variability to analyze (i.e., typically highly positively skewed), so we selected the 13 items that contained a reasonable spread of responses across the scale to analyze. These are shown below in the categories that were presented to the teachers.

Please indicate how frequently you use computer technologies for each of the activities listed below. Indicate the appropriate response on your answer sheet.

Never	Practically Never	Once in a While	Fairly Often	Very Often	Almost Always
A	B	C	D	E	F

Instructional

45. Use WebQuests in your lessons.
46. Use tutorials for self-training.
47. Have students use tutorials for remediation (in class).

Communicative

48. Use e-mail to communicate with other teachers.
49. Use e-mail to communicate with students.
51. Use LCD projector (a projector connected to a computer) in class.
52. Create PowerPoint presentations to use in class.

Organizational

53. Keep track of student grades or marks.
55. Create lesson plans.

Analytical/Programming

56. Create charts or graphs.
57. Create a class/school website or put student work on-line.

Creative

66. Use digital video, digital cameras.

Evaluative

69. Test or assess student learning.

Initially, we analyzed items on the TIQ within categories of use. Item responses were added across categories and then divided by the number of items to produce category means. Category means are shown in Table 18. Notice that the two highest category means are *Communicative Uses* and *Creative Uses*, while the three lowest categories are *Instructional Uses* and *Analytical* and *Evaluative Uses* (equal means). These means should be interpreted relative to the scale to which teachers were asked to respond. Means around 2.0 represent low use (i.e., practically never), while means of 3.0 or better are indicative of occasional (i.e., once in a while) use.

Table 18. Descriptive statistics for Categories of Technology Use

Categories of Technology Use	N	Mean	Std. Deviation
Instructional Uses	27	2.22	0.75
Communicative Uses	27	3.24	0.52
Organizational Uses	27	2.89	0.90
Analytical Uses	27	2.29	0.82
Creative Uses	27	3.40	0.96
Evaluative Uses	27	2.29	0.87

2. *Categories of Use Correlated with Each Other*

When we correlated these categories to find out how related they were we found that some use categories were positively correlated (See Table 19). A notable exception to this is *Instructional Uses*, which was significantly correlated only with *Evaluative Uses* and almost significantly with *Communication Uses*..

Table 19. Correlations between Categories of Use on the TIQ (*N* = 27).

Categories of Use	Comm. Uses	Organ. Uses	Anal. Uses	Creative Uses	Evaluative Uses
Instructional Uses	**0.42***	-0.08	0.26	-0.07	**0.44****
Communicative Uses		**0.54*****	**0.55*****	0.36	**0.66*****
Organizational Uses			**0.68*****	**0.69*****	**0.53*****
Analytical Uses				**0.44****	**0.45****
Creative Uses					**0.48****

*$p < 0.075$; **$p < 0.05$ level (2-tailed); ***$p < 0.01$ level (2-tailed).

3. Categories of Use Correlated with Change in Reading, Language and Mathematics

The next analysis involved correlating the Categories of Technology Use with change (2006 minus 2005) on the three subtests of the CAT-3 (Table 20). While all of the correlations were negative, only three were significant, and were all on the Reading Subtest. On this subtest, *Communicative, Creative,* and *Evaluative Uses* were significantly negatively related to change.

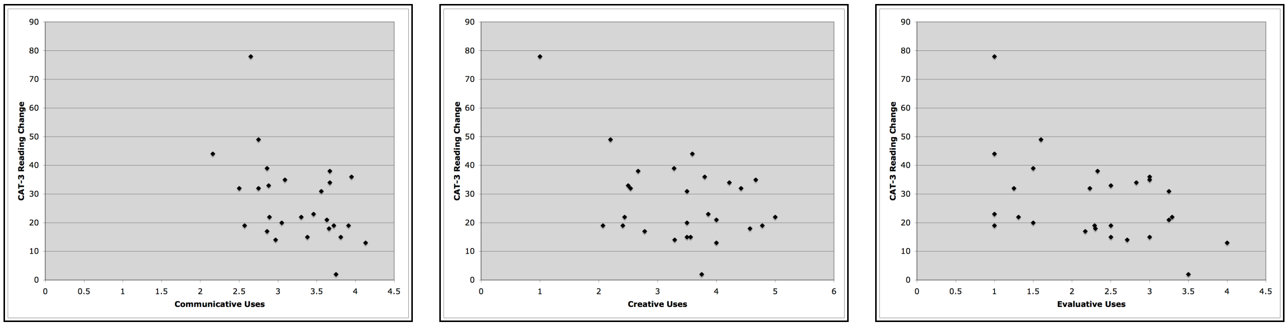
Table 20. Correlations of change on the CAT-3 subtest scores (2006 minus 2005) with Categories of Technology Use (*N* = 27).

Categories of Technology Use	2006 CAT-3 Subtests		
	Reading	Language	Math
Instructional Uses	-0.30	-0.24	-0.22
Communicative Uses	**-.455***	-0.24	-0.28
Organizational Uses	-0.26	-0.27	-0.03
Analytical Uses	-0.11	-0.14	-0.09
Creative Uses	**-.437***	-0.13	-0.01
Evaluative Uses	**-.450***	-0.28	-0.35

*$p < 0.05$ level (2-tailed); **$p < 0.01$ level (2-tailed)

Figure 4 shows the negative relationship (Table 20) that emerged between CAT-3 reading change and three categories of technology use.

Figure 4. Scatter plots of CAT-3 reading change and categories of technology use.



In Table 21, the relationship between specific TIQ items of technology use and CAT-3 Reading Subscale change scores is further explored. While the category Use of instructional category of instructional uses was not significantly related to CAT-3 Reading change scores, the item *Use of WebQuests* was significantly and negatively correlated with CAT-3 Reading achievement change.

Table 21. Correlations between specific technology use items and CAT-3 Reading Subscale Change Scores ($N = 27$).

Items of Technology Use	Category of Technology Use	Correlation with Reading Change
Q-46. Use of WebQuests	Instructional	-0.51**
Q-51. Use LCD projector	Communicative	-0.56**
Q-52. Create PowerPoint	Communicative	-0.44*
Q-66. Use digital cameras, etc.	Creative	-0.44*
Q-69. Test or assess student learning	Evaluative	-0.45*

*$p < 0.05$; **$p < 0.01$

4. Question 37 (Preferred Teaching Methodology) across Reading, Language Mathematics Change Scores

Question 37 on the TIQ asked teachers to indicate their preferred teaching style, five categories from primarily teacher-centred to primarily student-centred. The frequency of their response is shown in Table 22.

Table 22. Frequency of response to Question 37 (Preferred teaching methodology)

Code	Frequency	Percent
A. Primarily teacher-directed	0	0.0
B. More teacher-directed than student-centred	5	18.5
C. Even balance between teacher-directed and student-centred	11	40.7
D. More student-centred than teacher-directed	9	33.3
E. Primarily student-centred	2	7.4
Total	27	100

To investigate how the responses to Question 37 related to academic achievement in the areas of reading, language and mathematics, we grouped the responses into two categories, "More Teacher-Centered" and "More Student-Centred." The means and standard deviations of reading, language and mathematics change (2006 minus 2005) were then calculated for each category and an independent *t*-test was conducted over the categories. Table 23 indicates a significant difference for the two categories only on the reading change scores. Students taught by teachers who rated themselves as more teacher-centred or balanced between teacher-centred outperformed those who rated themselves as more student-centred. There were no significant differences for the other two measures.

Table 23. Means for Teaching Style (Question 37) for Reading, Language and Math change scores.

Measure	Teaching Style	N	Mean	Std. Deviation
Reading Change*	More Teacher-Centred	16	33.36	15.29
	More Student-Centred	11	18.48	8.94
Language Change	More Teacher-Centred	16	40.07	15.45
	More Student-Centred	11	38.09	11.01
Math Change	More Teacher-Centred	16	34.79	20.74
	More Student-Centred	11	28.99	16.68

*Mean difference = 14.88, t (25) = 2.90, p = 0.01.

5. Question 44 (Level of Technology proficiency) across Reading, Language and Mathematics Change (2006 minus 2005).

Similarly, we investigated responses to Question 44, Level of Technology Proficiency. Here, the levels ranged from "No experience" to "Expert User." The frequency of response to each of the six categories is shown in Table 24. Most teachers (92.5%) considered themselves as ranging from the proficiency level of basic user to an advanced user.

Table 24. Frequency of response to Question 44 (Level of Technology Proficiency)

Code	Frequency	Percent
No experience	0	0.0
Beginner	1	3.7
Basic User	7	25.9
Average User	9	33.3
Advanced User	9	33.3
Expert	1	3.7
Total	27	100

We then examined differences between two levels of proficiency, "Beginner" to "Average User" and "Advanced User" and "Expert." Table 25 shows that students taught by teachers reporting lower proficiency had results in reading change that were nearly larger (p = 0.054) than those teachers reporting higher proficiency in technology use.

Table 25. Means for Low and High technology proficiency (Question 44) for Reading, Language and Math change scores.

Measure	Technology Experience	*N*	Mean	Std. Deviation
Reading Change*	Lower	17	31.49	16.03
	Higher	10	20.16	9.57
Language Change	Lower	17	38.45	14.89
	Higher	10	40.64	11.75
Math Change	Lower	17	33.99	20.68
	Higher	10	29.77	16.66

*Mean Difference = 11.34; $t\ (25) = 2.02$, $p = 0.054$.

6. TIQ Open-ended responses

The response rate to the TIQ open-ended questions was high. Of the thirty-two responding teachers, thirty gave answers to one or both of the questions. In addition six teachers submitted additional comments. Both teachers who answered neither question submitted additional comments also. All free responses were coded using an emergent approach, each question separately. From these initial codes major themes were identified. The responses are presented verbatim in Appendix D, except that any identifying information has been deleted to preserve the anonymity of the respondents.

We identified several major themes. Chief amongst these was the need for increased professional development opportunities. In question A, twenty-one of thirty-two teachers (65%) mentioned the need for more training or workshops on both the hardware and software, particularly how both could be put to pedagogically sound uses. In addition, seven teachers (22%) agreed that release time would be an appropriate use of Board resources. One teacher asked for: “[h]ands-on workshops with a focus on pedagogically sound, age appropriate techniques, activities and approaches. (So far, our in-service has focused on writing responses to literature instead of more dynamic uses.)”

In question B, seventeen (53%) teachers describe the computers as useful motivational or learning tools. At the same time, fourteen teachers describe more specific ways that computers could be integrated, including as facilitators of independent, dynamic learning; work sharing; student research; inquiry-based, project-based, and problem-based learning. At the same time, three teachers were concerned that the implementation should compliment rather than replace existing pedagogies. A further five teachers were concerned that technology integration should not be implemented at the cost of instruction on basic literacy and numeracy skills.

Of the seven teachers who wrote additional comments, four used the comments to explain their answers to question B further, giving examples of how they have successfully implemented one-to-one technology. One teacher commented: “I had not expected to use a computer often with learning disabled children, but I am now a complete convert. I can find activities to suit all levels (elementary-aged), and to address all sorts of needs. In addition, even the most challenged child is able to understand how to use the computer (sometimes better than me!)” The other three teachers submitting free comments were less enthusiastic about the program, bemoaning the planning behind and the time and money spent on a program they feel does not address important issues.

Interpretation and Discussion

A. Major Conclusions

1. Improvement in CAT-3 Scores from Grade 2 to Grade 3

There was overall improvement (change) from Grade 2 to Grade 3 on all three sub-tests of the CAT-3. The greatest change was in math and the least was in reading.

Relative to the CAT-3 National Norms, scores at the mean on the reading subscale became more divergent from Grade 2 to Grade 3, while scores at the mean on the language subscales became more convergent from Grade 2 to Grade 3. Scores at the mean for math crossed the median on the National Norms from Grade 2 to Grade 3. Significance testing using a one-sample *t*-test (i.e., the sample mean compared to the mean national norms) confirmed this.

2. Teachers' Use of Technology Based on TIQ Results

The TIQ was used to measure teachers' use of technology in educational contexts. Overall, we found that use was low to moderate, especially in areas that might have an effect on student learning and achievement. As expected, we found that communicative uses (e.g., e-mail) were relatively high and that instructional uses were relatively low.

In addition, we analyzed responses to the TIQ open-ended responses. These data suggest that teachers want more professional development, especially in order to use technology for more student-centered purposes.

3. Relationship between Technology Use and CAT-3 Scores

What was the relationship between technology use and scores on the three sub-scales of the CAT-3? To answer this question we performed correlational analysis to determine the magnitude and the direction of the relationship between categories of technology use and change scores (i.e., Grade 3 – Grade 2) on the reading, language and math subscales. We found that the only significant relationship was between the reading subscale and three categories of use—communicative, creative and evaluative. This relationship was negative. It should be noted that the se correlations are particularly interpretable in light of the small sample size of teachers ($N = 27$). Relatively large correlations are required to reach significance in small samples. In addition, we caution against interpreting these correlations as suggesting a causal explanation between achievement change and technology use. When the correlations between reading change (Grade 2 to Grade 3) was examined relative to technology use on individual items, four items were significantly negative:

- Q46–Use WebQuests in your lessons
- Q51–Use of LCD projectors
- Q52–Create PowerPoint presentations to use in class
- Q66–Use digital video, digital cameras
- Q69–Test of assess students

Taken together, Q66 and Q52 suggest that presentations via technology may not be appropriate for students in this age range. WebQuest, an online scavenger hunt, also may not be an appropriate instructional activity when it comes to developing reading skills and comprehension. It is less obvious why using technology to test or assess students and reading achievement are negatively correlated.

The uses of technology by teachers varied. There was much greater use of technology for non-instructional purposes, such as communication with other teachers etc. The correlations between student learning and technology use were negative or neutral. We found no significant positive relationships between the TIQ and the CAT-3 subscales. In general, the more technology was used, especially for administrative and traditional purposes, the lower student learning. This is not to downplay the importance of non-instructional computer usage; it is just that if these uses predominate over instructional uses, there is little chance of a positive effect on student learning.

In sum, these are the major findings. There were expected improvements in achievement on the CAT-3 achievement test from Grade 2 to Grade 3. Much of the improvement in learning for the experimental group using laptops matched the gains by the Grade 2 and Grade 3 CAT-3 norms (i.e., the norming sample was used as the control group). Overall, there was a tendency for the ETSB students to close the gap in achievement over the years of the study (with the exception of reading). But we cannot attribute readily any learning gains to using technology given what we learned from the TIQ and by relating TIQ responses to CAT-3 scores.

Interestingly, we found a fairly large difference in reading change scores when we tested across levels of "preferred teaching style," Question 37 on the TIQ. Students in classes taught by teachers who expressed a preference for a teacher-directed classroom outperformed students in student-centered classrooms. Given the importance of reading in early elementary school, this result bears some consideration.

We found a nearly significant difference in reading change in teachers who indicated a lower level of technology proficiency (Question 44 on the TIQ) as compared to teachers who rated their proficiency higher.

Finally, teachers open-ended responses called for an increased amount of professional development, especially training focusing on more innovative pedagogical uses of technology.

B. Design Cautions

As with any research study, there are limitations of design that must be considered in light of the results. These are grouped here under the headings internal and external validity.

1. Threats to Internal Validity

Threats to the internal validity of a study relate to aspect of its design that limit causal interpretations and pose alternative explanations for the findings. They may or not be present in this study, but without proper control for them, it remains unknown whether they are operating or not. The core research design was a form of the nonequivalent pretest-posttest control group design with the national CAT-3 normative scores serving as the control group (but with different participants in the pretest and posttest).

The most likely threats to internal validity involve interaction effects with selection. For example, selection X maturation effects may operate here as a rival explanation of a technology treatment effect. That is, the growth of one group might be different than the other group because the participants in each group were not identical to begin with.

2. Threats to External Validity

Threats to external validity are conditions of the sample, materials or activities that limit the generalization of the results to the larger population.

2.a. Population Limitations

Because only Grade 3 students in one school board were included in the study, the results reported here may not extend to other grade levels or students attending school in other areas of the province or country.

2.b. Technology Exposure

Since this was the first year of technology exposure for these students, aspects of the type and/or amount of exposure limit generalizations to either non-exposed students or those who have received more exposure.

2.c. Measurement Limitations

The CAT-3 is a standardized instrument that is intended to measure reading, language and math skills and knowledge within different grade levels so that students and classes of students can be compared at that grade level. As such, it may not be as sensitive to achievement gains as true pretest to posttest measurement might reveal. In the absence of true pretest-posttest reliability estimates, we used the correlation between Grade 2 and Grade 3 scores in its place. The correlations we found were not as high as would be expected from a standardized measure.

Likewise, the TIQ was designed to assess teacher attitudes about the expectancy, value and cost of the use of technology integration in education and therefore may not adequately address the range of issues related to the frequency of use of technology.

Because of funding limits, we were not able to conduct as comprehensive measurement as we did at the outset of the longitudinal study. We did not collect data on student self-regulation or self-concept and did not interview teachers or observe them and their students using technology in the classroom.

All studies are limited in the extent to which they generalize across populations, settings, treatment variables, and measurement variables. This study is certainly no exception. The findings then, should be interpreted with these cautions in mind. While a more complete analysis probably would not reverse the current findings, a more complete analysis would serve to deepen our understanding of the findings and identify those conditions to which the results applied or did not apply.

C. Limitations and Recommendations

1. Overall Limitations

In the absence of a no-technology control condition (except for the CAT-3 national norms), we cannot conclude that technology was harmful to achievement, even in reading. These are correlational analyses that warrant the same considerations and cautions with respect to causation, that are attendant in all such designs and analyses. Therefore, the actual effect of technology use, particularly on the development of reading skills and comprehension, remains speculative, at best. More importantly, the data do provide some suggestions as to the type of technology use that may warrant further investigation.

Furthermore, the results are most appropriately restricted to early elementary students and their teachers in the initial phases of using technology for learning. It is inappropriate to conclude these findings would hold for older students and their teachers or when students are more familiar with technology as a tool for learning.

Major educational innovations are not easily achieved and may reveal disappointing results at the outset. Time, effort, and experience may be the basis on which solid developments are built. Sweeping changes may take time even while novelty and enthusiasm may make temporary change apparent. With time, does the novelty wear thin or does experience lead to better teaching and improved learning?

2. Recommendations

The limitations imposed by this design and instrumentation are rival hypotheses to strong recommendations for future use of technology. Two related and tentative suggestions may be made in light of these findings: 1) we suggest that the Board find ways to increase the quantity of instructional uses of technology, relative to other uses; and 2) we suggest that the Board find ways to improve the quality of the use of technology. This might be done through further support for teachers through consultants, workshops, etc., including the use of software tools that increase engagement in meaningful learning.

Computer technologies have long been known to increase administrative efficiencies and, in more recent years, have come to be a very reliable and useful means for people to communicate with each other. Where we still struggle, is in the use of technology for effective teaching and learning. As described above, the literature is still mixed as to whether it helps children learn in the areas of reading, language and math, or whether it is neutral, or whether it actually impedes learning in these areas. What does seem clear is that we cannot expect to see a generalized "technology effect" on student achievement simply by adding technology to a classroom. Not only must there be a plan for the physical and practical integration of technology, but also a plan for pedagogical integration that takes advantage of the unique affordances of the technology.

Perhaps the easiest way of integrating technology into teaching is to use it to replace overhead projectors, that is, for presentation of information. We suspect that this is one of the least effective uses for Grade 3 students. It is possible that technology applications that increase active engagement with reading, writing and math will provide efficiencies in these areas that are equivalent to the administrative efficiencies that are so well documented. Herein lies the challenge for every teacher who is intent on making technology work as a means of furthering the goals of schooling and learning in general.

Finally, continuing the longitudinal investigation and increasing both its breadth and depth may increase understanding of ways to maximize the impact of technology integration.

Next steps

Too often, critics have lamented that classrooms today look and sound no different than classrooms from decades ago. In contrast, advances in the health sciences and the natural sciences have been rapid, changing professional practice and everyday life.

The use of technology for learning is the greatest challenge to classroom tradition arguably since the popularization of the printed text. But educational innovation may not occur rapidly or easily. Vision, dedication, and perseverance may be its costs, especially among teachers and administrators.

These findings suggest that the breakthrough has not yet arrived but they most emphatically do not suggest that the breakthrough will not arrive. Instead, they offer as objective and complete an analysis that we could muster of where things stand and what lies ahead—more innovation, but different.

As the latest report from the Canadian Council on Learning (2007) so forcibly underlies, we have much to do to bring the essential skills of Canadians to the levels that will allow them to help make Canada a leader in the Information Age and Knowledge Society. What we have done before has not succeeded as it should; we need to do a better job of education. Let us, therefore, applaud, support, an encourage those who are brave enough to try and make a difference in the lives of our children.

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Appendix A – Consent Form

Dear Parent(s) and/or Guardian(s),

Researchers from Concordia University, in partnership with the Eastern Township School Board and the Sir Wilfrid Laurier School Board, have formed a Research Advisory Committee to evaluate the Enhanced Learning Strategy (the laptop program). This evaluation will help us understand how the laptop program is helping students learn and succeed in school as compared to those who are not participating in such a project.

Last year your school board decided that your child would complete a series of achievement tests (CAT-3). We ask for your permission to use the data from your child in the study. If you agree to have your child participate in the study, researchers at Concordia University will analyze your child's data to explore the impacts of computer use on learning.

Researchers at Concordia University will only have access to your child's scores if you give us permission to use them. All information will remain confidential. Only the Research Advisory Committee will have access to the individual results of the evaluation.

If you have any questions about the evaluation, please feel free to call Marie Claude Lavoie at (514) 848-2424 ext. 5923 or email her at marieclaude.lavoie@education.concordia.ca. If you have any questions about your child's or your **rights as a research participant**, please contact Adela Reid at (514) 848-2424 ext. 7481 or at adela.reid@concordia.ca.

Please complete the form below and return to your child's homeroom teacher, by ________.

Many thanks for helping us with this project.

The Research Advisory Committee

PLEASE CHECK **YOUR ANSWER** and FILL IN YOUR **CHILD'S NAME**.

☐ **I DO** give ________________________________ (child's name, please print) permission to participate in the evaluation of the Enhanced Learning Strategy conducted by the Research Advisory Committee. I understand that my child's responses will be kept confidential.

☐ **I DO NOT** give ________________________________permission (child's name, please print) to participate in the evaluation of the Enhanced Learning Strategy conducted by the Research Advisory Committee.

Parent or guardian's signature:______________________________

Date: _______________________

Appendix B – TIC Questionnaire

Grade 3
Survey On The Use Of Technology
April-May 2006

<u>The name of the school</u> (all schools will appear and students make the choice)
Name……………………………….
Homeroom…………………………
Date………………………………...

1. How much time did you spend on your computer in school today?

15 min. ☐ ½ hour ☐ 1 hour ☐ 2 hours ☐ more than 2 hours ☐

2. Did you use your computer today?

   - to look for information Yes ☐ No ☐
   - to talk to a friend, your teacher, or your parents Yes ☐ No ☐
   - to present a project to your classmates or to your teacher Yes ☐ No ☐
   - to write a story or a poem Yes ☐ No ☐
   - to write a good copy of your work to give to your teacher Yes ☐ No ☐
   - to play some games Yes ☐ No ☐
   - to do your Math Yes ☐ No ☐
   - to draw pictures Yes ☐ No ☐

3. Did you use your computer last night at home for homework? Yes ☐ No☐

4. What did you spend the most time on?
   - Searching for information
   - Email
   - Presentation to class
   - Writing
   - Games
   - Math
   - Drawing
   - Homework

5. Did you enjoy using your computer today to help you learn?
   Yes ☐ No ☐

Appendix C – Technology Implementation Questionnaire

Technology Implementation Questionnaire: Version II

This questionnaire is part of a project being conducted by the Centre for the Study of Learning and Performance (CSLP) at Concordia University in Montreal, Quebec in collaboration with the Eastern Townships School Board and the Sir Wilfrid Laurier School Board. One of the goals of the CSLP is to study classroom processes through an active association with teachers, students, and administrators. In that regard, we have developed a questionnaire to learn more about the reasons why teachers do or do not integrate computer technology in their classrooms. To gain an accurate understanding of these reasons, it is critical that we hear from both teachers who are using and those who are not using computer technology. Knowledge we gain from your responses will help in providing services to teachers where needed and requested.

By completing this questionnaire, you are consenting to participate in our study. You may choose to participate or not and are free to discontinue participation at any time. All information you provide will be kept strictly confidential and under no circumstances will your individual responses be released to the school or the school board administration. Overall results from your school will be compiled and presented to your school board.

You are requested by your school board to participate in this survey; your professional experiences and opinions are crucial to helping us understand teaching from an educator's point of view and, in particular, how resources should be organized to best help you accomplish your objectives. We would greatly appreciate your taking the time to complete our questionnaire.

If you have any questions about the study, please feel free to call Marie-Claude Lavoie at (514) 848-2424 ext 5923 or email her at m_lavoi@education.concordia.ca. If you have any questions about your child's or your **rights as a research participant**, please contact Adela Reid at (514) 848-2424 ext. 7481 or by email at adela.reid@concordia.ca.

Thank you for your participation.

Philip C. Abrami
Centre Director and Professor

Marie-Claude Lavoie
Research Assistant

Anne Wade
Information Specialist & Manager

CENTRE FOR THE STUDY OF LEARNING AND PERFORMANCE
McConnell Building, 1455 de Maisonneuve Blvd. W., LB-581
Montreal, Quebec, Canada H3G 1M8

INSTRUCTIONS

This questionnaire has five sections and consists of four printed pages. Please mark **ALL** your answers on the accompanying **Answer Sheet**. Fill in the circle that corresponds to the most appropriate response when answering the closed-ended questions. Please record your comments to the open-ended questions on a separate sheet of paper. After you have completed your responses, please return both the questionnaire and the answer sheet to your facilitator.

SECTION I- Your Professional Views on Computer Technology

Using the scale provided, please rate the extent to which you agree or disagree with the following statements regarding the use of computer technology in the classroom:

Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree
A	B	C	D	E	F

The use of computer technology in the classroom…

1. Increases academic achievement (e.g. grades).
2. Results in students neglecting important traditional learning resources (e.g., library books).
3. Is effective because I believe I can implement it successfully.
4. Promotes student collaboration.
5. Makes classroom management more difficult.
6. Promotes the development of communication skills (e.g., writing and presentation skills).
7. Is a valuable instructional tool.
8. Is too costly in terms of resources, time and effort.
9. Is successful only if teachers have access to a computer at home.
10. Makes teachers feel more competent as educators.
11. Is successful only if there is adequate teacher training in the uses of technology for learning.
12. Gives teachers the opportunity to be learning facilitators instead of information providers.
13. Is successful only if technical staff regularly maintains computers.
14. Demands that too much time be spent on technical problems.
15. Is successful only if there is the support of parents.
16. Is an effective tool for students of all abilities.
17. Is unnecessary because students will learn computer skills on their own, outside of school.
18. Enhances my professional development.
19. Eases the pressure on me as a teacher.
20. Is effective if teachers participate in the selection of computer technologies to be integrated.
21. Helps accommodate students' personal learning styles.
22. Motivates students to get more involved in learning activities.
23. Could reduce the number of teachers employed in the future.
24. Limits my choices of instructional materials.
25. Requires software-skills training that is too time consuming.

26. Promotes the development of students' interpersonal skills (e.g., ability to relate or work with others).
27. Will increase the amount of stress and anxiety students experience.
28. Is effective only when extensive computer resources are available.
29. Is difficult because some students know more about computers than many teachers do.
30. Is only successful if computer technology is part of the students' home environment.
31. Requires extra time to plan learning activities.
32. Improves student learning of critical concepts and ideas.
33. Becomes more important to me if the student does not have access to a computer at home.

SECTION II - Your Background, Your Teaching Style and Resources Available to You

34. Gender: A. Female B. Male

35. Years of teaching completed
    A. 0. This is my first year teaching
    B. 1-5 years
    C. 6-10 years
    D. 11-15 years
    E. 16-20 years
    F. 21-25 years
    G. 26-30 years
    H. 31-35 years
    I. Over 35 years

36. Current teaching position (If you teach in more than one subject area, choose the **one** that dominates your teaching schedule.)

Elementary:
A. Pre-K or Kindergarten
B. Cycle 1, grades 1 and 2
C. Cycle 2, grades 3 and 4
D. Cycle 3, grades 5 and 6
E. Other (e.g., Music, Phys. Ed., Science, Resource)

Secondary:
F. Mathematics, Science, or Computer technology
Language arts, Second language, MRE, Social Science
Special Education or Resource
Other (e.g., Creative arts, Phys. Ed., Vocational)

37. Preferred teaching methodology (**choose only one**)
    A. Largely teacher-directed (e.g., teacher-led discussion, lecture)
    B. More teacher-directed than student-centred
    C. Even balance between teacher-directed and student-centred activities
    D. More student-centred than teacher-directed
    E. Largely student-centred (e.g., cooperative learning, discovery learning)

38. Average class size that you teach

a. Less than 10 students
b. 10-15 students
c. 16-20 students
d. 21-25 students
e. 26-30 students
f. More than 30 students

39. What is the primary language that you teach in?

a. English
b. French
c. Other

<u>SECTION III –Your Experience with Computer Technologies</u>

For questions 40 and 41, use the following scale to rate your responses

40. How would you rate student access to computer technology at your school?

41. How would you rate teacher access to computer resource personnel in your school?

Extremely Poor	Poor	Acceptable	Good	Very Good	Excellent
A	**B**	**C**	**D**	**E**	**F**

42. Please indicate how often you integrate computer technologies in your teaching activities.

A. Not at all
B. Rarely
C. Occasionally
D. Frequently
E. Almost Always
F. All the Time

43. On average, how many hours per week do you spend using a computer for personal use outside of teaching activities?

1. None
2. Less than 2 hours
3. 2 hour or more, but less than 4 hours
4. 4 hours or more, but less than 6 hours
5. 6 hours or more, but less than 8 hours
6. 8 hours or more, but less than 10 hours
7. 10 hours or more

44. Please read the following descriptions of the proficiency levels a user has in relation to computer technologies. Determine the level that best describes you and circle the corresponding letter on your answer sheet.

A. Unfamiliar

I have no experience with computer technologies.

B. Newcomer

I have attempted to use computer technologies, but I still require help on a regular basis.

C. Beginner

I am able to perform basic functions in a limited number of computer applications.

D. Average

I demonstrate a general competency in a number of computer applications.

E. Advanced

I have acquired the ability to competently use a broad spectrum of computer technologies

F. Expert

I am extremely proficient in using a wide variety of computer technologies.

SECTION IV - Your Process of Integration

For Items 45 to 72:
Please indicate how frequently you use computer technologies for each of the activities listed below. Indicate the appropriate response on your answer sheet.

Never	Practically Never	Once in a While	Fairly Often	Very Often	Almost Always
A	B	C	D	E	F

Instructional

45. Use WebQuests in your lessons.
46. Use tutorials for self-training.
47. Have students use tutorials for remediation (in class).

Communicative

48. Use e-mail to communicate with other teachers.
49. Use e-mail to communicate with students.
50. Use e-mail to communicate with parents.
51. Use LCD projector (a projector connected to a computer) in class.
52. Create PowerPoint presentations to use in class.

Organizational

53. Keep track of student grades or marks.
54. Prepare handouts, tests/quizzes, and homework assignments for students.
55. Create lesson plans.

Analytical/Programming

56. Create charts or graphs.
57. Create a class/school website or put student work on-line.
58. Analyze data.
59. Statistics or data analysis.

Recreational

60. Have students play games (in class).
61. Use computer time as a reward for completing class work or good behaviour.

Expansive

62. Have students conduct experiments or laboratory exercises (in class/school lab).
63. Have students use 3-D modelling software or simulations (in class/school lab).

Creative

64. Use drawing or paint programs.
65. Scan pictures or images.
66. Use digital video, digital cameras.

Expressive

67. Use a word processor.
68. Maintain an on-line journal (diary) or discussion board.

Evaluative

69. Test or assess student learning.
70. Use digital portfolios.

Informative

71. Search the Internet for information for a lesson.
72. Access CD-ROM reference material.

73. Total amount of in-service training you have received to date on using computer technology in the classroom:
    (1) None
    (2) A full day or less
    (3) More than a full day and less than a one-semester course

(4) A one-semester course
(5) More than a one-semester course

- Please read the descriptions of each of the six stages related to the process of integrating computer technology in teaching activities. Choose the stage that best describes where you are in the process and circle the corresponding letter on your answer sheet.

- **Awareness**
  I am aware that technology exists, but have not used it – perhaps I'm even avoiding it. I am anxious about the prospect of using computers.
- **Learning**
  I am currently trying to learn the basics. I am sometimes frustrated using computers and I lack confidence when using them.
- **Understanding**
  I am beginning to understand the process of using technology and can think of specific tasks in which it might be useful.
- **Familiarity**
  I am gaining a sense of self -confidence in using the computer for specific tasks. I am starting to feel comfortable using the computer.
- **Adaptation**
  I think about the computer as an instructional tool to help me and I am no longer concerned about it as technology. I can use many different computer applications.
- **Creative Application**
  I can apply what I know about technology in the classroom. I am able to use it as an instructional aid and have integrated computers into the curriculum.

SECTION V – Additional Comments (Please answer on a separate sheet. We would appreciate if you would include your name on the separate answer sheet so we can combine all your comments together. Remember that under no circumstances will school officials be able to identify your individual responses.)

A. Suppose your school administration annually made additional resources available (example: release time for improving computer-based instruction. In your opinion, what kinds of resources should they provide? How would you like to see these resources used in order to improve your instructional use of computers?

B. Please describe the ideal use, if any, of computer technology in the classroom.

Thank you very much for your participation in our study.

Appendix D – Teachers' responses to Section V, Questions A. and B.

SECTION V – Additional Comments (Please answer on a separate sheet. We would appreciate if you would include your name on the separate answer sheet so we can combine all your comments together. Remember that under no circumstances will school officials be able to identify your individual responses.)

A. Suppose your school administration annually made additional resources available (example: release time for improving computer-based instruction). In your opinion, what kinds of resources should they provide? How would you like to see these resources used in order to improve your instructional use of computers?

B. Please describe the ideal use, if any, of computer technology in the classroom.

School 1
Teacher I
A. In the French department, we need a good built-in dictionnary and encyclopedia like there already is in English.
B. In FSL a student should be able to use illustrated vocabulary in his learning for one thing.

Teacher II
A. Training on using the server to store and communicate with students...
B. In F.S.L. teaching, a good tool is having illustrations from Internet or world book in order to clarify the meaning of certain words within a theme. Finally using the projector to share with the class. Ex.: mining, products, ...

School 2
Teacher I
A. I would like training in using programs that students find interesting and that can compliment a lesson. (ie: garage band)
B. Independent learning. I think it is a great tool that children can use to find answers to various questions.

School 3
Teacher I
A. Workshops where students who use computers in class share their experience/expertise to other teachers who teach same subjects at same level.
B. I see computer technology as being a complement (a tool that completes the teaching in terms of practice).

School 4
Teacher I
A. Basic training is a must. Often with staff changes and teachers changing levels, the basic training is missed and teachers are left to catch up Equipment training as well as specialized mini workshops re helpful. Release time should be allowed.
B. Computers are definitely useful in a classroom but should not replace basic writing, spelling, grammar skills. They should add to and compliment the basics thought.

Teacher II
A. A round table discussion involving parents-teachers-administrator as to the most beneficial way of integrating computers in school.
B. Computers would be used as a told by older students who had already mastered the basics in reading and writing. Word processing would be done on a daily basis by students who were submitting written work for interactive editing and correcting by the teacher. The internet would be used in addition to books for research, and power point presentations along with movie clips etc. would provide an alternative way to present work. Laptops would make great tools for high school students, however in my school they are being implemented in grade 3 up. These children are years away from being competent readers or writers and I've yet to be convinced that the computers are helping them get there. So much time is wasted by showing them how to do it, that IT never really gets done. What takes an 8 or 9 year old months to master (they can't read the directions, see) would be learned in a matter of days by a keen 13 year old. The money that has been spent providing individual children with a computer, not to mention the training of their teachers, could have paid salaries of extra teachers who in turn could have ensured that the younger children had the basics.
Additional Comments: Hmm... my school board [E.T.B.S.] implemented these laptops without consulting parents, teachers, or principals. They bullied the commissioners into agreeing to this project despite the fact that they had no money (the gov't made it clear they would not pay for it). They now owe over 14 million dollars and continue to be incredibly arrogant and defensive toward anyone who dares to question the wisdom of their actions. They still claim they are on the 'cutting edge' of education and tell the public that the project is going swimmingly well - they even have the doctored results to prove it!! As a parent and a teacher who has witnessed this mess I can only say that this use of technology has been terribly misdirected. Rather than be part of this - I asked for, and was granted, a different teaching position in the lower grades (gr. 2) where I would be spared having to deal with such nonsense. Our emperor (Ron Canuel, the director) has no clothes!! When will his subjects be brave enough to admit it?

School 5
Teacher I
A. In-service in how better to use the computers in the classroom. Programs made for schools.
B. As a tool for learning. Not to use it for everything, but when it is appropriate.

School 6
Teacher I
A. I would like to learn more about doing statistics and data on the computer. A workshop on this would be very helpful.
B. I feel the computer is a fantastic resource to help when doing inquiry-based projects. The computer is a useful educational tool to enhance a lesson plan, or organize a project.

Teacher II
A. Hands-on workshop with a focus on pedagogically sound, age appropriate techniques, activities, and approaches. (so far our inservice has focused on writing responses to literature using work instead of more dynamic uses) ; Purchase of software as Inspiration/Kidspiration
B. students and teacher use technology where it appropriately enhances a lesson or learning activity. Students simply go to their laptops and use them in the context which they require. Students should also have access to peripherals such as a digital camera, digital video, camera,

scanner... which they can use as necessity dictates. Students should work in small groups. Teachers should provide job-aids to support student autonomy.

Teacher III
A. I would like to know everything my computer does. I tend to only use what I know and explore from there. Although after talking with other teachers, I realize I don't know what every program can do.
B. In grade 3, I started the year working on Typing Pal so that the kids get to know their letters. We've been learning different fonctions. The projector really helped.

School 7
Teacher I
A. At present we are expected to do our own workshops on our own time after school. This is impractical and unrealistic- we are already too busy and schedules do not match. We should have release time for these workshops. The subjects of the workshops were good - researching sites, dot plan, writing tools...
B. I am learning more and more ways to use comp. tech. as a tool in the classroom - here are some I have found useful: webquests-using websites to increase understanding content knowledge-nutrition stories games, math manipulative site (excellent to (understanding), eco-stories games, learning how to research - what tools (search) - what sites - critical thinking develops as you evaluate websites, word processor to show progression of writing process (draft edited final copy) math fluency sites gives immediate feedback -, during art appreciation lessons can look up artist's work easily with search engines, responding to and writing about digital pictures, math imovies to explain concepts. Every day I think about more ways to use comp. tech. It is an excellent (if expensive!) tool for our classroom.
Additional comments. * When I say that students never play games I mean recreational games. My students play many educational games - for Math, Nutrition, Ecology - much of the content material is learned through these games.

School 8
Teacher I
A. I would like training using Document Manager to be able to make better use of the computer in recording and analyzing student's grades, as well as to make better use of the computer in planning and managing my files. The most effective way of doing this is bringing specialists to the school and providing the release time for the training. This should also include training in Excel and Power Point. As teachers, the more we are familiar with every aspect of the computer the better equipped we will be to teach technology to the students.
B. Obviously there are many possible ways in which the computer may be used in the classroom. It can be used to create Power Point projects in Science and Social Studies or used for typing Responses and Narratives in Language Arts. In Math there are many good Websites that reinforce skills and provide tools for graph making and probability. However we must keep in mind that the computer is just another tool that the students can use to enhance their learning.

School 9
Teacher I
Additional Comments. - This survey does not accommodate the teacher who is comfortable with technology and could use it in the classroom but disagrees with the amount of time expected of them to integrate computers in a Grade 3-4 class.

Teacher II
Additional Comments. Additional Information: My school board is so heavily focused on the use of technology that other major issues of importance to teachers are overlooked.

Teacher III
A. Providing information on how you can correct the students' works directly on the computer.
B. Problem-base learning, discovery learning. Giving the students a topic and allowing them to gather information and to create an understanding.

Teacher IV
A. More than enough time and money is available for computers in this school board. Just because a teacher uses technology it means he or she is a good teacher. The abuse of computes in our board is rampant. lazy teachers rewarding kids with computer time games.
B. As nothing more than a tool. Not used too often - children have more than enough screen time in their lives.

Teacher V
A. My training is adequate for the use I make of laptops with students - ie - word processing. The big problem with laptops is the glitches malfunctions that persistently crop up that I can't deal with.

School 10
Teacher I
A. I would like to have someone come into my class and do specific activities with the children so that I can learn at the same time as the students.
B. As a tool only. I do not agree with using a computer just for the sake of saying that I'm using it. It needs to be useful and meaningful.

School 11
Teacher I
A. Workshops - as we have been doing.
B. Occasionally for research. On a regular basis (1-2x/week) as a word processor.

School 12
Teacher I
A. I would like to see more workshops that actually give me the webpages for example that have worked. I find it very time consuming to search for age level appropriate webpages.
B. Ideally, I would be able to focus uniquely on typing & word processing skills rather than printing, cursive writing as well as typing. I feel that there is not enough time in a day to teach the curriculum as well as technology. I know about integration but let's face reality. I would like to use technology more & I do appreciate its benefits however grade 3 is too young.

Teacher II
A. I would like to see more workshops regarding the use of different computer programs, as well as specific lesson and project ideas (i.e. what has been successful in other classrooms) B. Computer technology is a great motivational tool, and can be used as a visual aid (ie.

powerpoint) for both student and teacher presentations, as a research tool to compliment books and encyclopedias, as well as for word processing.

Teacher III
A. From the beginning of our Laptop Initiative at the Eastern Township School board, we have been actively getting the support needed and have had extensive computer-training. B. Computers are an additional tool to research. Webquests are an excellent way to empower students with further computer skills. In both Language Arts and French, the word processor provides an excellent way for students to publish, share and celebrate their accomplishments. Computers are effective also for cooperative learning and student centered. All and all, I see the use of computers in the classroom as a definite asset. Learning becomes dynamic and children are very proud of their accomplishments. I have seen students share their skills with peers as well as with me.

School 13
Teacher I
A. I would love to have free access to instructional websites such as Reading- a to z... websites which could enhance my students' reading writing skills.
B. I would have a LCD projector, smartboard, laptops for each students, digital camera to each classrooms.

Teacher II
A. 1) Release time for improving computer-based instruction 2) Computer training on specific areas of learning
B. The computer in the classroom is an additional learning tool. It helps access and retain information and work. It is an effective tool to share work and information. It helps organize work and information.

Teacher III
A. I would appreciate specifique lessons on specifique applications.
B. The ideal use of the computer is when student work, learn and have fun or like doing it. When they push themselves while using the laptop and ending up with a nice project wich they are proud of.

Teacher IV
A. I would enjoy seeing how other resource teachers are using computers with their students.
B. In the resource classroom, children have access to levelled reading texts, word games, phonics activities and math exercises. All of these activities seem to be more engaging than printed materials.
Additional Comments. I had not expected to use a computer often with learning disabled children, but I am now a complete convert. I can find activities to suit all levels (elementary-aged), and to address all sorts of needs. In addition, even the most challenged child is able to understand how to use the computer (sometimes better than me!)

School 14

Teacher I

A. We applied for an innovation grant (PDIG) for 2006-2007 to have release time to use Interactive White Boards in our classrooms and create material to increase the reading and writing skills of our students.

B. You have to use it as a tool and try to use it for different purposes. Sometimes however, our teaching assignments is so big that it is hard to find the time to do everything we would like to.

Teacher II

A. I am a beginner right now and looking for more time to learn how to handle lap-top on my own with help (workshops) or even " one on one." If the school administration annually made additional resources available such as release time/teacher subsidized for non-working days for improving computer-based instruction, this would certainly benefit the children. Continuous training in the previously mentioned activities (ex.: digital video camera, digital portfolios, lesson plans, etc...)

B. How to integrate the new technology in a K-1 second language class? Ideally, I would like to use computer technology more in the classroom to develop exciting lesson plans involving the previously mentioned activities with the continued assistance of trained, computer and curriculum specialists. How great would that be.

Additional Comments. I welcome ideas on how to use computer technology in Physical Education and Health class.

School 15

Teacher I

A. I believe it would be beneficial to provide teachers with short, voluntary workshops that focus on a specific aspect or program on the laptops. These workshops would describe and explain the material and also offer several examples as to how to implement it into the classroom.

B. Ideally, computer technology should be used in the classroom as a tool to help students reach their potential. Laptops provide students with an abundance of different ability levels. Of course, a balance should be reached in order for student not to miss the essential writing and reading skills.

Teacher II

A. ?

B. As a complement tool, not as a main tool.

School 16

Teacher I

A. I would like more workshops to be offered for programs I am unfamiliar with.

B. It should be a teacher's right arm in all subject areas.

School 17

Teacher I

A. Release time should be given at the time when a teacher is read to try something new. Maybe just an hour at the time with the computer person at school. A full day is usually too long - too much information at once!