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A REVIEW OF NEW BRUNSWICK'S DEDICATED NOTEBOOK RESEARCH PROJECT ONE-TO-ONE COMPUTING – A COMPELLING CLASSROOM-CHANGE INTERVENTION



*A Review of New Brunswick's Dedicated Notebook Research Project
One-to-one computing – a compelling school-change intervention*

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New Brunswick's Dedicated Notebook Research Project was undertaken in English and French schools. This report is based exclusively on the project in the English sector.

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de fonctionnement en classe*




INTRODUCTION

The Canadian Education Association (CEA) was commissioned by Hewlett-Packard Canada to create a case study describing the development, implementation and outcomes of New Brunswick's Dedicated Notebook Research Project. The New Brunswick Department of Education designed its research project to assess impacts on teaching and learning of dedicated access to notebook computers by students in the specific context of New Brunswick's schools. Similar initiatives are usually referred to as one-to-one (1:1) laptop programs. An external research team of faculty members from Mount Allison and St. Francis Xavier Universities was contracted by the Department of Education to evaluate the initiative.

The project began in 2005 with the provision of notebook computers to each Grade 7 student in selected schools. The students continued with laptop access in Grade 8 and all teachers in the province were provided with their own laptops in 2006.

This review is based on the available research reports, documents provided by the New Brunswick Department of Education and interviews with provincial staff, participating school district staff, as well as principals and teachers in New Brunswick's Anglophone Sector.

This review aligns with CEA's overall research priorities that aim to inspire new perspectives, nurture innovative thinking, and facilitate knowledge exchange among others who share a vision for educational and social transformation in Canada. Findings from this and a growing number of studies of similar initiatives have demonstrated positive impacts of specific uses of technology on student engagement and motivation, and in creating more inclusive learning environments. The added value of unlimited computer access by students lies in the quality of learning activities designed by teachers to engage students in meaningful work. Implementation of dedicated notebook or one-to-one laptop programs are best considered as a pedagogical strategy rather than a technology initiative.



ONE-TO-ONE COMPUTING – A COMPELLING CLASSROOM-CHANGE INTERVENTION

The dedicated notebook initiative has been highly successful with a wide range of evidence to support the conclusion that student learning and improved teaching and pedagogy have been the direct result of this new technology in participating classes.¹

Several themes dominate conversations among educators who strive to improve learning in Canada's K-12 school systems – the need to educate all students well, personalization of learning for a diverse student body, and learning experiences that engage students deeply. The so-called 21st century skills of problem-solving, critical thinking, collaboration and innovation are not new in themselves. But the need to develop these competencies in *all* students is the new challenge. The agenda is not simply about what children should learn. How they learn matters too. Students who are deeply engaged in the process of learning will tend to learn more and be more inclined to pursue further knowledge.

The goal of the New Brunswick Department of Education is to have the best education system in Canada.² Currently, New Brunswick ranks tenth in science, ninth in reading, and eighth in mathematics among ten Canadian provinces participating in the Organization for Economic Cooperation and Development's (OECD's) Programme for International Student Assessment (PISA), while in 2005/06 New Brunswick had Canada's second highest graduation rate, 85.7%. Among the initiatives in pursuit of these goals is the Department of

Education's *Notebook Research Project* designed to find out how dedicated computer access impacts learning and teaching practices in its schools.

SETTING DIRECTIONS

Interest in the potential of dedicated computer access (commonly known as one-to-one laptop programs) to enhance student learning has been growing rapidly since the early 2000s resulting in school, district and jurisdictional level initiatives. Most well-known of these is the state-wide 1:1 laptop program for middle schoolers in Maine, New Brunswick's neighbouring state. Relying on its review of the research literature and the experience of people implementing dedicated computer access programs in Canada, the United States and Europe, New Brunswick established four key objectives:

- To enrich teaching and learning practices to support the skills required to succeed in the global knowledge economy;
- To improve both teacher and student ICT competencies;
- To impact positively on student motivation and achievement; and
- To increase parental and community involvement in education and lifelong learning.³

Seemingly good ideas in education can fail if conditions for success are either unknown or ignored. Learning from the experience of others, the implementation of the dedicated computer access research project was designed to address key success indicators – teacher knowledge and experience in using technology in the classroom; a stable, reliable and supported technology platform; and the role of instructional leadership in the school. The research project was organized to leverage contributions to the project by private sector partners. Hewlett-Packard Canada supplied notebook computers for students and teachers; Microsoft Canada supplied core software and other resources; Aliant provided Internet access and other resources; and other partners provided various contributions as well. Researchers from Mount Allison and St. Francis Xavier Universities were contracted by the New Brunswick Department of Education to undertake the project evaluation. By involving all partners, including school districts, ownership of the initiative was shared and commitment to success assured. Selected partners were involved at all stages of technical design, implementation planning and research design.

THE PROJECT DESIGN

a) Project Scope

The research project was designed to assess impacts of dedicated notebook computers in classrooms on teaching and learning in the specific context of New Brunswick's schools. New Brunswick is the only officially bilingual province in Canada and its K-12 system is organized into five Francophone and nine Anglophone school districts. Phase I involved three schools in each sector with a total of 237 Grade 7 students provided with laptops in January 2005. In September 2005 Phase II involved the original students taking their notebooks into Grade 8 and the provision of new notebooks to the 262 incoming Grade 7 students. With early positive indications of impact from the first year-end research report, the project was expanded to include one school in each district resulting in a further 1000 participating students. At the same time, all Grade 7 and 8 teachers in New Brunswick were given a laptop for their own professional use in finding and developing learning resources and to increase their ICT skills on its use. In 2006, this expanded to offering a laptop to every teacher in the province; not surprisingly, almost all of them accepted the offer.

The public investment of \$1.1 million in Phase 1 ensured adequate human resource deployment to support the use of technology as envisioned to impact teaching practices and learning. A provincial coordinator was appointed in both English and French sectors to facilitate the project implementation and technology mentors and technicians were funded for each school.

b) School Selection

The call for participation was made to all schools in New Brunswick with Grade 7 and Grade 8 students. Three Anglophone and three Francophone schools were selected as the sites for implementation of the dedicated access notebook program following an assessment of each school's improvement plan including its technology plan; school and project leadership; professional development and learning opportunities provided for its teachers; demonstrated partnership, networking, communication and promotion efforts; and its experience, innovations and achievements in using information and communications technologies for teaching and learning. The final selection included rural and urban schools and a variety of school sizes, small to large.

Within the broad goals for the initiative established by the Department, schools and teachers were free to develop specific curricular priorities based on the prior experience of participating teachers and the improvement plan of the school.

c) Professional Development

The challenge for teachers in exploiting the potential of dedicated access to networked computers is multifaceted. First, the pedagogical implications are profound. New Brunswick's approach explicitly focused on a constructivist pedagogy, sometimes referred to as an inquiry process that builds on students' existing knowledge and interests in developing conceptual understanding. Many teachers have limited prior knowledge or experience in problem-solving or knowledge-building classroom practices. Second, teachers are likely to have experience in using computers for administrative purposes such as preparation of report cards, designing lesson plans or in teaching specific technology skills to students, but they are much less likely to have either a theoretical grounding or actual practice in managing the curriculum and the classroom when students are given autonomous control of Internet connected notebooks at school. And third, teachers need to become adept in using technology for learning.

The Department of Education provided extensive support for professional development among participating teachers prior to the delivery of computers to the students in January 2005 and as an ongoing feature of the initiative. Professional learning opportunities were developed from teacher needs' surveys and delivery models included workshops, online learning, peer-to-peer exchanges and in-class help in lesson planning and classroom management in the 1:1 context. Teachers were encouraged to share the resources they developed and successful achievements with others involved in the research project.

ROLE OF TECHNOLOGY MENTORS

Guide educators in integration of technology coupled with instructional strategies for effective teaching, learning and professional growth. Provide timely school-based professional development opportunities by:

Modeling effective practices through leadership, assistance with lesson-planning, demonstrations and inclusion of district curricular and pedagogical experts.

Providing varied professional development through teachers' needs assessments, professional learning activities in school and online, identification and support to teacher leaders and development of digital resources.

Assisting in planning processes by setting long and short term goals and determining actions, assist teachers, administrators, schools and districts in formulating professional development plans.

Creating collaborative opportunities by using listservs to identify and develop collaborative projects, involving local school's teachers in existing collaborations and organizing a collaborative project within the district.

Promoting communication through progress reporting in the district, developing in-school communications among professionals and among students and teachers.

Reflecting and sharing through personal writing, documenting instructional strategies, collecting samples of student and teacher work that demonstrates effective use of technology in learning and posting resources to the mentor team website.

Responsibility for professional development rested largely with dedicated Technology Mentors funded by the provincial government and selected by the participating districts so that each project school had an experienced and full time instructional support throughout the project. Charged with supporting teachers in their use of technology to promote effective teaching, learning and professional growth, the Technology Mentors provided one-on-one guidance in direct response to teachers' needs and comfort level with technology.

d) The Technology Platform

The Department of Education provides a province-wide enterprise computing platform used by all school districts. It claims a history of technological innovation including becoming the first province in Canada to provide broadband Internet access for all of its schools. The dedicated access notebook research project was built on this platform with few problems. HP Canada was awarded the contract to supply the hardware based on an open competition, and provided notebooks to a total of just over 500 students and their teachers in 2005. Upgrading to switches and routers was required before consistent wireless network access was achieved. This was the only significant technical challenge encountered because schools needed 15-20 access points to enable teachers and students to work anywhere in the school building and good connections for up to 30 students in a classroom were required. Computers ran on Windows XP, and were installed with Microsoft Office 2003, McAfee Antivirus, Adobe Acrobat, Encarta, World Book Encyclopedia and SMART Board software. Teachers were given discretion in adding other applications. All project classrooms in the initial six schools were equipped with SMART Boards, a scanner, printers, and digital still and video cameras.

Frustration in the early days of implementation of new technology is a common experience not only in schools but also in most workplaces. New Brunswick mitigated any negative impact from start-up difficulties by providing each school with its own technical support staff person able to provide proactive assistance and immediate response to technical problems whether such problems were due to unfamiliarity or malfunction. As time passed and educators became more technically adept at troubleshooting, the need for technical support declined. This, combined with the fact that technology setup and deployment solutions developed for the early phase of the project continue to be reused, reduces the amount of resources necessary to expand and maintain the initiative.

RESEARCH DESIGN AND FINDINGS

The evaluation of the Dedicated Notebook Research Project in the three Anglophone schools was conducted by an external research team from Mount Allison and St. Francis Xavier Universities. The research activities were intended to generate advice to the Department of Education during the two-year project and to understand the impact of providing every student with a wireless-enabled computer on teachers' instructional practices and students learning experiences. The investigators focused on the project's goals of "enriching teaching and learning practices, supporting the mastery of skills required to succeed in the global knowledge economy, improving teacher student ICT competencies, impacting positively on student motivation and achievement and increasing parental and community involvement in education."⁴ The research methodology was primarily qualitative, drawing on data collected through online surveys of students and teachers, site visits and monthly meetings at the schools, classroom observations, literature review and document analysis including school websites and blogs, lesson plans and professional development plans.

The researchers report that "By any measure, the changes and improvements to the learning environment... have been dramatic and overwhelmingly positive for all involved with the project."⁵

- Students consistently demonstrated effective research, analytical and evaluative skills in the digital environment enabled by dedicated computer access both when engaged in individual or group-based projects.
- Students wrote more, producing work of greater length and higher quality than they had previously.
- Student engagement with the learning process across various subject areas was consistently high, with students, parents and teachers reporting that school became more enjoyable for students and individual motivation levels were raised.
- Improvement in the work of all students was reported by teachers. Of particular note was the increased confidence and quality of work by students with special needs.
- In most subject areas, students emphasized improvement in their grades, a greater awareness of how to improve the quality of their work and researchers observed an increase in student's meta-cognitive understanding.
- Increased student involvement in their French second language studies because of enhanced opportunities to communicate and use French in multimedia presentations was noteworthy.
- Students' work became more meaningful to them as they composed music, simulated the human heart and wrote for class newspapers.

CRITICAL SUCCESS FACTORS

The level of satisfaction among key informants with both the experience and the outcomes of the New Brunswick Dedicated Notebook Research Project was uniformly high. The key contributing factors were:

- Supportive, collaborative and committed leadership by the New Brunswick Department of Education.
- The Departmental Advisory Committee that included the project partners – suppliers, districts, teacher representatives.
- Extensive background research including site visits that informed the design of the project.
- Dedicated human resources for pedagogical and technical support.
- Selection of schools according to prior school and teacher experience.
- Effective communication strategies that engaged teachers, parents and students.

LESSONS LEARNED

- Professional learning opportunities should be provided before deployment of the computers and become a consistent feature of programs until teachers' confidence in new practices are secured.
- The computer installation and networks need to be robust and technical support is best provided on an as- and when-needed basis.
- Technical support requirements drop after the early implementation phase as teachers and students gain experience in troubleshooting many technical issues as they arise.
- Initial fears about loss of or damage to computers did not materialize. Generally students' computers needed no more repair or replacement than those used by adults.

SELECTED RESEARCH FINDINGS

Of students beginning with notebooks in Grade 7, 97% use them in class and 75% use notebooks 4-7 hours per week for Language Arts.

By Grade 8, 100% of students use notebooks in class at least 1-3 hours per week, and 75% use them 4-7 hours.

Notebooks help students:

Be better organized – 92% in Grade 7; 94% in Grade 8.*

Be more involved in class – 84% in Grade 7; 94% in Grade 8.*

Be more likely to revise or edit work – 90% in Grade 7; 95% in Grade 8.*

Work more quickly – 95% in Grade 7; 97% in Grade 8.*

Do more work – 92.5% in Grade 7; 93% in Grade 8.*

Understand work better – 83.5% Grade 7; 92% Grade 8.*

Be more interested in school – 84% in Grade 7; 93% in Grade 8.*

Choose, if allowed, to take notebooks home – 96% in Grade 7; 100% in Grade 8.

*Reflects combined percentages of somewhat agree, agree, strongly agree.

- Students and teachers generally desire that students be allowed to take their laptops home. (Considerations of insurance, the potential for damage, and the reality of unequal access to the Internet at home resulted in the decision to limit use of the laptops at the level of the school.)
- Communication with teachers and parents facilitates acceptance and commitment. Class and teacher blogs, wikis etc. enable parents to know what is expected and what their children are doing in school.
- Demonstration of effectiveness through evaluation research stimulates demand for expansion to all schools.

FURTHER CONSIDERATIONS

a) Towards a Fully Inclusive School System

New Brunswick plays a leadership role in Canada in its commitment to inclusive education.⁶ Fully inclusive schools are those where all children are welcomed and where learning environments are created in which all children can thrive. The evaluation of the Dedicated Notebook Research Project identified a positive impact on the learning experience of students with special needs working on Individual Educational Plans. Through their notebooks, these students had a much greater range of learning materials and an individualized delivery system. Teachers reported that students who had trouble writing in the traditional classroom were writing better and were more engaged in research with the notebooks.

The correlation between socio-economic background and academic achievement has been well documented in Canada. Students from low-income families are more likely to do more poorly in school than their peers. They are also likely to have fewer educational resources in their homes including Internet connected computers and therefore have less access to the vast knowledge resources of the World Wide Web. In a world of ubiquitous technology, students without technologies at home are further disadvantaged by their reduced access to knowledge.

Access to a dedicated computer at school, especially in settings where students can take their computers home, reduces this new “digital divide”. However, it may be necessary to develop strategies for out-of-school Internet access for students in homes that are not connected. In some communities, lack of access has been at least partially mitigated through discounted access programs or community access sites. Nevertheless, together with their role in increasing student motivation and engagement in learning, and improving quality of work, one-to-one laptop programs create inclusive learning environments.

b) The Challenge of Assessment

The education agenda in Canada can be summed up in the widely adopted goal of “raising the bar and closing the gap” that requires an overall improvement in educational outcomes with a faster rate of improvement for students from lower socio-economic backgrounds. In many provinces this goal is measured by results on standard achievement tests. Standardized testing as a measure of impact of dedicated computer initiatives is challenged on several grounds. These tests usually require students that have been using computers to return to pencil and paper. Better measures of achievement are required to confirm teachers’ observations of improved learning. (For example, “my class’ math results are now 6% above the district average”; “Writing scores went from 31% to 64.3% meeting the standard”; “Writing and math scores are going up – internal data are showing a lot of improvement”; “Last year 54% of students said they liked school work. At the end of the first project year 96% said they did.”)

c) The Significance of Engagement

For students not doing well in school, disengagement begins early and becomes more obvious in the middle years. Disengagement leads to reduced effort, a focus on marks over learning and for the fully disengaged, to disruptive behaviour or dropping out. Engagement and academic achievement usually go hand in hand but perhaps surprisingly an analysis of data collected by PISA revealed that although Canada ranked high on achievement by 15 year-olds, it ranked 15th in students' sense of belonging and 29th in student participation in school.⁷ Drs. Michael Fox, Jim Greenlaw and M. A. MacPherson, the research team for the Dedicated Notebook initiative write, "...we find that the introduction of the notebook computers in a 1:1 learning environment has had an impact... especially (in) individual student motivation, engagement with the material, the community environment created in the classroom, and personal responsibility and attitudes toward school" (p.119). This finding is consistent across many studies of 1:1 laptop programs. The computer provides a means for students to exercise greater control over their own work thereby increasing agency in their learning.

d) The Potential to Scale

Early in-school models of computer deployment generally consisted of a dedicated computer laboratory that was typically complemented by a small number of desktop computers assigned to individual classrooms and libraries. Enterprising teachers could be found 'borrowing' machines from colleagues not using them, leading to high levels of use by some classes and virtually none by others. The educational focus was on the acquisition of ICT skills by students.

One-to-one computing is an entirely different model. The machine is provided for the exclusive use of individual students. It is to be learned *with* rather than learned *about*. The educational value of this model is realized only when teachers' practices and students' learning processes and performance are enabled by the technology. The challenge in expanding the model from small-scale initiatives to system-wide deployment is twofold. First, the preparation of most teachers to successfully integrate technologies requires a significant shift in their models of educational practice, a resource intensive process of professional development.

The second challenge, and indeed an oft-cited reason for not moving to ubiquitous computing, is cost. School districts across Canada increasingly recognize the benefits of broadening and deepening the use of technology in the classroom, and are exploring a variety of deployment models based on the success of initiatives like that of New Brunswick. These include the provision of class sets of laptops that can be moved from class to class. The cost of hardware continues to decline while free and open source software proliferates; this, combined with a growing body of research on implementation best practices, is steadily lowering the risk and financial barriers associated with ubiquitous computing. The One Laptop Per Child (OLPC) organization is shipping machines to developing nations at a unit cost of \$188 with the aim of creating educational opportunities for the world's poorest children by providing each child with "a rugged, low-cost, low-power, connected laptop with content and software designed for collaborative, joyful, self-empowered learning." Other manufacturers have followed suit with intentions to market machines for student use in the \$300-400 price range. With an average cost of \$10,000 to educate an individual student, it may not be cost that determines whether or not students are provided with the essential tools of learning in the 21st century. But it may depend on whether our vision for academic achievement encompasses the evidence that social, academic and intellectual engagement in the work of learning is the foundation on which children and youth become experts at learning for the whole of their lives.

KEY REFERENCE SOURCES

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