OECD/CERI ICT Programme

A Case Study of ICT and School Improvement in Mountview School

Overview

About half of Mr. J s grade eight class are seated at computer stations in an open area off a hallway 30 meters from his classroom. These students are working on one of two projects. Some are searching for content or quotations for a short speech (part of a language arts unit in which students present one of each of four types of speech to classmates spontaneous, extemporaneous, scripted, and memorized); others are choosing and researching a U.S. state to compare on a number of dimensions (location, interaction, movement, and regions) to a Canadian province they have been assigned. Most of the students are accessing the Web to search for relevant quotes or information, and use search engines like Google fluently. One girl has found an online map of the west coast of the U.S. and is comparing state features, one step in deciding what state to choose for her project. Another has gone to the Ask Jeeves Web site (used by several other students as well) to search for a quotation he needs for his speech, which he will be presenting as part of the school s upcoming Memorial Day services. A pair of boys are working together to enter data from a reference book into a Word file about the state they have chosen. One of the boys dictates facts about California to the other who types them into the file. A third boy, working alone, is starting to develop a PowerPoint presentation of his comparison. The state/province comparison projects are mostly at an early stage of development Ms. J s intention is to have students (who have the option of working individually or with a partner) develop Web pages based on their research which they will code using HTML and eventually post to the School s Web site. Over the course of 30 minutes, Mr. J. drops down to the work station area to monitor and consult with students a couple of times, but he spends about three quarters of his time working with students individually and in small groups back in the classroom, discussing the assignments and helping them choose and locate speeches to memorize. In his absence, his students are on task most of the time, but there are periodic bursts of socializing and goofing off . Mr. J. tells an observer that the Canada-U.S.

comparison project had been rushed due to prior off-site physical education activities that had eaten into his teaching time. Consequently, the project was student-centred rather than student-directed, something that concerned him; I feel bad when I assign topics like I did here. Then the magic isn t there. There s real magic when students can chose and pursue a topic totally on their own. He prefers to use Jamie McKenzie s framing process, having students iteratively develop a set of essential questions through readings on an issue under his guidance, questions which can then drive meaningful self-directed inquiry. He typically works collaboratively with students to develop a project marking rubric, something which he didn t have time for on this project.

This vignette captures just a few of the many ways in which ICT is being applied to teaching and learning across all grades and subject areas at Mountview School.

Mountview is a K-8 school with 437 students and 21 full-time equivalent (F.T.E.) staff. It is nested beside several acres of woodland in a rural area about 30 minutes from a major city in Canada, and the great majority of its students are from upper-middle and upper class families. Most classes have only one computer in them; students have access to ICT in two island areas that are directly joined to the hallways with no intervening walls, as well as a very large room adjacent one of the islands. Teachers from grades one through eight frequently bring some or all of their students to work in one of these areas. While teaching practice at the school varies considerably across the staff, the school s pedagogical orientation is towards student-directed and inquiry-based learning, a direction that is strongly promoted by the administration and is evidenced in the school s vision statements, handbook, and plans. A principle of risk-taking and experimentation in the furtherance of more autonomous, authentic, and engaged student learning has been the central tenet of the school s direction and culture since its inception. While this has met with some vocal resistance on the part of a very small minority of parents who favor a back-to-basics approach, it has received enthusiastic support from the majority, who see their children developing greater enthusiasm for learning.

Technology use has been an integral part of the process of shifting teaching in the school in the direction of greater learner autonomy and inquiry-based work. Students of all ages regularly use professional-level applications such as Microsoft Office and Astound, undertake HTML coding, make Web inquiries, and employ multimedia tools (e.g. scanners, digital cameras, and digital probes) to conduct research and develop presentations, reports, and Web pages to share their discoveries and reflections. With the exception of a few short-term optional courses offered to grade seven and eight students, teaching around ICT use is fully integrated within the curriculum and is driven by the instrumental demands of the work at hand, often arising from a student initiative for example, a pair of students who desire to make a Web page out of a report might generate a general class interest in learning about Web page creation, which is then taught in a just-in-time manner by the teacher, or students from another class who have the requisite competence.

While ICT infusion is viewed by the administration and most staff as a key element of the school s program, it is not seen as an end in itself, but rather as an enabling tool in the service of desired pedagogical practices and outcomes. The contexts and forms of use seen in the classrooms of Mountview are very dependent upon both the teacher s pedagogical orientation and the nature of the curriculum work or project being pursued. Teachers with a more traditional directed teaching style were observed having students answer factual questions provided on printed worksheets by researching the answers on the Web; others taking a more student-directed approach would start a new topic by asking students very general questions about their knowledge of an area and what they needed to know to understand it further, and then having students pursue answers on the Web to the questions deemed pertinent by the students themselves, all the first stage in an interactive process of moving towards deeper questions which would then serve as the basis for long-term, in-depth inquiry and project work.

Staff view teaching at the school as exciting, involving, and fulfilling, and see their students as

benefiting from their efforts, both in terms of the technical competencies they develop and (according to the more constructivist teachers) in their growing commitment and skill as independent learners who are able to engage deeply in self-directed, cooperative enquiry. Efforts are made by the administration to cultivate a reflective community of practice amongst staff; weekly best practice meetings are held to discuss pedagogical issues, just-in-time workshops are offered on ICT topics, and the school benefits greatly from its ongoing relationship with the Exploration Centre, a professional development centre for the enhancement of teaching and learning through the exploitation of ICT, which was initially located on site. A key factor in the success of the ICT infusion over the past several years has been the energy and commitment of both the administrative team and several teacher-leaders with both the technical expertise and the pedagogical skills to tutor and mentor other teachers in new, innovative practices.

The Past

The planning for Mountview began well before its construction, when the principal chosen for the new school, then the technology coordinator for the district and a former vice-principal in a nearby school, began a process of community consultation in the catchment area that continued on a regular basis for over two years. Participating parents decided that they wanted a school that was different from the status quo, one that was forward thinking and provided their children with all the tools and skills they needed to move forward into the future. A team of teachers experienced in ICT use was brought together with parents and business community leaders under the principal to create a vision for the school, develop the architectural requirements for the new building, and function as a hiring committee for choosing the new staff. Mountview was envisioned as a place for rethinking teaching, for action research, and for pursuing inquiry-based, authentic, and student-directed learning. ICT use was seen as integral to this process, and the school s intent was to fully realize the leverage of technology on education . It was decided that free and ready student and teacher access to ICT was to be a fundamental aspect of the school s operation; the idea of locked labs full of computers was rejected, and widened hall sections where island clusters of computers could be located on both sides of the building along with one very large open-access Career and Technology Studies (CTS) room were included in the school design.

When it came time to begin hiring new staff, the committee decided that they would not require candidates to have a background in ICT, since that was quite rare at the time. Instead they sought staff with a willingness to reflectively examine the types of practices in which they asked kids to work...and to be in an environment were we don t really know where we re going with this .

Decisions around software acquisition were also shaped by the constructivist stance of the those involved in the school s planning. One of the policies put in place that still exists to this day was not to buy any software if the software could determine the student s next step. Dumbed-down tool packages were avoided, even for younger children, as it was felt that putting adult-level tools in students hands would help raise the level of student thinking and problem solving. In spite of being a new school, Mountview received the same funding allocations for computer hardware (prorated for school size) as any other school in the province. It took several years to build up equipment levels to the point where staff felt students needs were being met.

Every staff member and parent interviewed who was involved in the planning process and/or present during the first few years of the school s life saw the principal as the holder of the vision for Mountview, a charismatic leader who inspired staff and parents alike about the potential for the new school. While others had significant input, his appeared to be the directing drive behind the school s

inception and planning, and his expertise and leadership were crucial to the direction the school was to take. Many parents initially expressed strong concerns about giving computer technology so central a place in the school s plan; he was able to convince most of them that his plans were worthy of support. He also played the major role in initial ICT professional development activities at the new school, conducting after-school workshops once a week and on-demand for staff that dealt not only with the technical aspects of software use but also focused on infusing the technology into a constructivist pedagogy. He also undertook extensive consulting and mentoring in classrooms during the day, helping teachers gain proficiency with unfamiliar tools and begin to explore their place in inquiry-based learning. He brought to the school development team the second key player in the staff development Marianne Klose, a teacher with extensive ICT expertise and knowledge in constructivist pedagogy. The efforts of these two leaders did a great deal to enhance initially minimal staff proficiency and confidence in the use of ICT, as well as their comfort in experimenting with more constructivist teaching approaches. Collectively this work went a considerable way to mollify critics and passive resistors on the staff, who had intially felt that the expectation that teachers would make regular use of ICT in teaching placed an undue burden on them when they were already trying to cope with adopting new teaching strategies.

During the planning process for the school, a local community member deeply concerned with improving the quality of public education offered substantial funding over three years to support an on-site research and professional development centre at the new school. This person had experience as a CEO of a major corporation in promoting long-term systemic change in organizations, and had a vision of professional development that went well beyond the one-shot workshop model: he thought that change would only occur with long-term classroom-based support, and he wanted to help make that possible. Plans for the centre were developed in conversations between teachers, academics, and parents. A large conference/work room with two adjunct offices was incorporated into the school plan for the centre s use, and it came into operation as the Exploration Centre for Educational Innovation in the first year of the new school. Its goal was the advancement of teaching practice by providing a working professional development school for research, innovation, and the effective use of ICT. Its pedagogical orientation paralleled that of the school; it was dedicated to fostering a reflective community of practice amongst teachers, encouraging the development of innovative, constructivist teaching practice, and exploiting the potential of technology for teaching and learning. While the full extent of its past and current activities are beyond the scope of this report, many of its projects had and continue to have a direct impact on Mountview's practices and outcomes. Several of its external partnerships with area businesses, instigated primarily by the principal, have brought resources or personnel to the school to set up the school network, train students to function as ICT mentors and problem-solvers for staff and other students, and provide an interactive whiteboard for the school. In conjunction with a local University, the Centre sponsored a one-year Doctoral Fellowship was awarded each year; successful candidates had three roles conducting on-site action research into teaching and technology in conjunction with school staff; serving as a professional development resource working individually or with groups of teachers in facilitating the integration of ICT into their teaching; and providing outreach and liaison support for the Centre. In addition, every year until 2000-2001 the Centre brought to Mountview 1-3 project teachers from other school boards who had been selected for their interest in integrating ICT into their practices. During their stay, these teachers assumed a .66 teaching load; the rest of their time was devoted to action research, collaborative ICT project work, and staff professional development activities. Their presence together with the part-time presence of the Exploration Fellow made a significant contribution towards building up the critical mass of practitioners necessary to create and sustain a culture of innovation in the school. In addition, Marianne Klose, who had left the school staff to become vice president of the Exploration Centre, spent two days per week in 1999-2000 and one day per week in 2000-2001 providing situated professional development support to Mountview teachers in their classrooms, helping them to infuse

technology into their practice by teaching alongside the teacher and modeling new teaching strategies. She also worked with teachers to help them address assessment issues as they wrestled with how to best assess and document new student proficiencies and accomplishments in ICT-based work. She provided leadership at the staff technology committee meeting every week, which she saw as giving her an important opportunity to promote continuity in the innovation at the school.

The new school plant opened in March of 1997. (The school itself operated for most of the 1996-1997 year in an existing school structure.) In its first full year at the new site it was a K-5 school, as construction was continuing in a modular fashion even after the building s opening. Each succeeding grade was added in turn in subsequent school years; the 1999-2000 year was the first with grade eight students in attendance.

The initial principal left the school at the end of the 1998-1999 school year; at that time Alice Archer assumed the principalship on a contract basis, and remains as principal this year. A large number of the staff left at the same time, requiring the hiring of 14 new teachers. Despite the fact that Brian and the vice-principal had hired the majority of the new teachers, there was considerable concern over the collective impact of this staffing transition on the continuity of the school s vision and practices, and in the view of one researcher who had been periodically on site since the 1997-1998 school year, there was some movement back to more traditional, teacher-directed pedagogy at the school. Alice spent a significant amount of time that year orienting new staff to the school s pedagogical approach, with which she was completely attuned. She saw her role as maintaining and extending what Brian had started in teacher professional development, ICT use, and the enhancement of student learning.

The Present

Mountview is situated in a rural commuter area on 40 acres of treed land. It primarily services families of affluent higher-level businessmen and professionals, according to school data. A disproportionately high number of the mothers are not employed outside the home. Observation suggests that less than 5% of students are of non-Caucasian origin. Of its annual $1.6 million (Canadian) budget, 1% is spent on hardware, 4% on software, and 7% on teacher professional development. Staffing allocations include a 1.5 F.T.E. administrative designation for the principal and assistant principal; a .6 F.T.E. music specialist; a .2 F.T.E. technical support staff person; a .6 F.T.E. position designated for teacher time under a Alberta Initiative for School Improvement (AISI) grant, giving release time to three AISI lead teachers in the school; and full time positions for 17 teachers, one at the kindergarten level and 2 each at the grade 1 to 8 levels.

The school operates on an integrated timetable at all grades which is arranged to give teachers large blocks of time with students to allow for cross-subject integration using a student-centred inquiry approach. The main exception to this is the scheduled periods for the short-run complimentary courses for grade seven and eight students in subjects like art, music, drama, and a few IT courses in graphics design and Web creation. These courses (but not their specific subjects) are mandated by Alberta Learning, and they are scheduled in three double blocks per week to allow for long work periods. Special needs instruction is largely integrated into regular classrooms, although some student withdrawals are made for short periods to work with specialists.

The school plant is an attractive and inviting facility with a large central atrium space leading to four wings laid out in an X formation. Between paired homerooms are smaller breakout rooms which teachers or students from either room can access directly without entering the halls. These rooms are used for small-group work and student-teacher conferencing. There is usually a soft, movable wall between these paired rooms, which is occasionally retracted, as several of the teacher pairs working at

the same grade level engage in team teaching to some extent.

Figure **1**: Island area

About half of the school s approximately 100 Pentium and Pentium II computers are located in two hallway island areas, grouped in clustered pods. While there is no designated school computer lab, the oversized CTS room containing 20 computers is available for on-demand use most of the day (see Figure 2). A further 10 machines are placed in the Mountview s resource room [library]. Originally two computers were assigned to each classroom; this has recently been reduced to one so as to expand the number available in the islands and CTS room. The school policy is for all students to have open and ready access to ICT as much as possible; while the island areas can be booked a week in advance, this is not always done, and teachers report that computer availability on demand is generally good.Despite its designation as a site for educational innovation using technology, the school receives no additional funds for hardware or software beyond that provided to other schools from either the School Division or the provincial Ministry of Education. The majority of hardware purchases are made by the school division, with a minimum of 30 new computers being provided to the school every three years.

All computers are connected via a 100BaseT Ethernet network to both a Novell and a Windows NT server. The network is connected to the Internet through two 56K modems. A Linux OS proxy server is used to cache frequently retrieved Web pages so as to speed up student page accesses. The school maintains both an extensive public Web site as well as an internal intranet with its own Web site. Each student has their own password-protected account for computer access and private and shared file server storage. Network administration is largely the responsibility of Ms. C, a grade five teacher with a graduate degree in computer applications in education, who had learned networking earlier in her teaching career through a trial-and-error process, and was also mentored on-site by Marianne Klose

from the Exploration Centre. Ms. C was given .2 F.T.E. release time for this duty. The Web sites themselves were maintained by Mr. J, a grade eight teacher who had taught a course on computer applications to teacher candidates while still completing his own B.Ed. Degree and was a proficient HTML coder. (He recieves one hour a week release time for his Web work.) Ten laptops are available for staff to check out of the resource centre, although most have computers at home.

Figure 2: Small wing of CTS room

By mutual agreement between the school s administration and the Technical Committee of teachers that oversees ICT at the school, virtually no money has been spent on traditional educational software tutorials and games (see discussion above). Instead, the school has obtained site licenses for several professional-level tool packages for graphics, data analysis, animation, presentation, and multimedia/Web development, including Microsoft Office, Microsoft Image Composer, Macromedia Flash, PhotoDeluxe, Adobe Illustrator and Photoshop, Studio DC 10 (for video editing) and Intuous (for drafting). One-user packages for some more specialized applications were also obtained, such as Ray Dream Studio (for 3D rendering) and AutoCad LT (for higher-end drafting). The Technology Committee had also decided to acquire an Inspiration license so students could work with concept mapping software. According to staff, the most commonly used tools are Word, Excel, and Web browsers.

The two school administrators work as a team. They see their role as one of building and sustaining the school s vision of teaching and learning, and of supporting teachers and students in bringing it to life. Both the principal and the assistant principal spend part of their time teaching. Budgeting, staffing and policymaking for the school are largely site-based, and are the responsibility of the administration team, with the Technology Committee providing guidance on ICT related decisions and parents providing strategic advice through weekly School Council meetings. The principal has a strong academic orientation; she conducts action research in conjunction with a professor at a nearby university, and attends academic conferences such as AERA and SITE, occasionally presenting a paper with her academic colleague. She is enrolled in a Ed.D. program but has yet to begin coursework. She noted that her graduate work done over three years when she was not working following ten years in the classroom had a tremendous impact on her thinking, leading her to reconstruct her educational philosophy and understand how research can be used to inform a radically different mode of student-directed, inquiry-based teaching. What attracted her to Mountview was the fact that it shared her vision of teaching, although she acknowledges that in their day to day activities, teachers at the school vary considerably in the degree to which they actualize it.

Professional Development. The staff is recurrently involved in reflective group discourse around realizing the school s goal of authentic and student-directed learning, and examining the role ICT should play in the process. Technology use is a given, an expectation of all staff, but the nature of its integration and how it could best support learning is often under review. Alice engages teachers in discussions about educational values and practices on a regular basis, especially with new staff, helping them sort out elements of their teaching, and bringing an academic and research perspective to their practice. In this ongoing role she sees herself as modeling a reflective, questioning orientation which she considers to be a fundamental building block of professional renewal. She also works to establish connections between different teachers and programs in the school; finding, for example, a class of students with experience in working in one topic area or with certain software that can then

mentor and work collaboratively with another class wishing to explore the same topic or tool. Age differences in the school are considered relatively insignificant younger students will serve as mentors for older students if they possess the necessary skills, and multiaged learning experiences are timetabled into the school s schedule.

Professional development in the broadest sense is considered by both staff and administrators to be critical to accomplishing the school s stated mission of promoting reflective, child-centred practice. Teachers are seen as needing opportunities to read, reflect, and work with mentors and collaborators over an extended period of time to reformulate and refine their teaching, and to effectively integrate ICT into new pedagogical practices. Every avenue is explored to provide release time for more experienced and expert staff to work with colleagues in their classrooms, and to bring in external expertise when it can make a difference. Several staff members with the requisite technical skills provide just-in-time after-school workshops on ICT topics when enough teachers express an interest in an area; around the time of the site visit, Mr. J. and Lynn were offering a short series of workshops on Web page creation. The level of skill amongst several of the more experienced staff is thought by others at the school to be considerable, and a valuable resource. Their expertise is evidenced in their leadership roles outside of the school: they have given talks and workshops at regional meetings and conferences and provided inservice in other jurisdictions. Ms. C., for example had taught a course in computer applications in education at a college of education the previous summer, and Mr. J. had given six board-level presentations and workshops the previous year.

The provision of ongoing, situated support in the classroom was considered the most effective and important means of professional development around ICT use. Although the practice of bringing Exploration Project teachers into the school had ended by the start of the 2000-2001 school year, both Mr. J. and Ms. C. had approximately .3 F.T.E. release time to work with other teachers, partly as a result of a successful grant application made to the Alberta Initiative for School Improvement for professional development support by a coalition of innovative schools organized by the Exploration Centre (now renamed the Exploration Network). Some release time funding was also coming from a $10,000 grant from the Network of Innovative Schools, funded by the federal government. Some of this time was spent mentoring teachers in technical skills on a need-to know basis, but these teachers also helped staff look at how technology could best be utilized to foster more constructivist learning in a very practical way, demonstrating strategies and providing feedback to staff on their trial runs . In his role as Web master, Mr. J. helps teachers determine how student projects can be brought to the Web. Marianne Klose of the Exploration network continues to spend one day per week working with staff, sometimes modeling new practices in the class while teachers observe and engaging in reflective discussions around practice. Currently she is collaborating with a first year teacher, a former accountant with a math degree, in the development of deeper ways to explore mathematical concepts in elementary teaching, and the ways is which ICT can contribute to this goal. Several staff are also active in professional development initiatives that go beyond the school s boundaries. For example, the teacher working with Susan recently attends monthly meetings of the Sum Talk group initiated by the Exploration network, which brings educators together with mathematicians (both in-person and online) to look at ways of enhancing math education.

A great deal of professional development occurs in very informal encounters questions asked in hallways and lunchrooms, drop-in visits to see what another teacher is doing, brief chats with the principal or talking to a student seen working on something interesting. Many teachers also have email and conference-based connections to off-site groups and individuals (faculty, other teachers) with whom they critically reflect on practice in ongoing conversations. One teacher summed up a pervasive staff view of professional development at the school: It's the dialogue that makes all the difference. It s not the presented things. The school culture is based on there being a number of places where there is on-going and sustained dialogue and discussion about what this means and what matters.

ICT Use. While virtually all staff use ICT in their teaching, the forms of use and the pedagogical practices this use is embedded in varied considerably. In our classroom observations we saw a range of pedagogical approaches being employed, from very traditional and controlled teacher-directed modes of instruction to totally student-directed, inquiry driven learning. Activities also varied in their levels of authenticity and connection to the world beyond the school, and the degree to which students collaborated and worked independently in building knowledge. The following exemplars are representative of the range witnessed (see also the opening vignette):

1. Ms. C. made a request of her grade five class: I d like you to go home tonight and find out what is happening in the Middle East, enough so we can have a conversation about it tomorrow. Extensive discussion ensued over the next few days abou the conflicts in the area and their causes, and connections were drawn to what had been studied earlier in the year about the Renaissance and the Crusades. Ms. C. then asked her students to develop questions they had at that point. Once their questions were formulated, she guided them in grouping and relating the questions and issues raised as the class engaged in the collective construction of a knowledge web (see Figure 3).

Ms. C. took an active part in this process, monitoring, coordinating, and offering suggestions, but her students developed the categories and relationships for the web. It was constructed as a long chart which was hung on the adjoining hall wall, with name tags marking the place of individual students questions in the concept space. This web is to be the basis for the project s WWW site structure. Students will research their questions, either individually or in small groups as they choose, and then develop Web pages with their findings that will be interlinked on the Web site. One student, for example, has decided to develop a page looking at what George W. Bush s policies on the Middle East are and what they might mean for the area. Students will read and respond to each others work as it evolves by accessing documents placed in shared storage space on the network, with the teacher helping them to integrate their understanding of the various elements on the concept map. Ms. C. will teach any Web skills needed on a just in time basis, training a small group of students who can then peer tutor others.
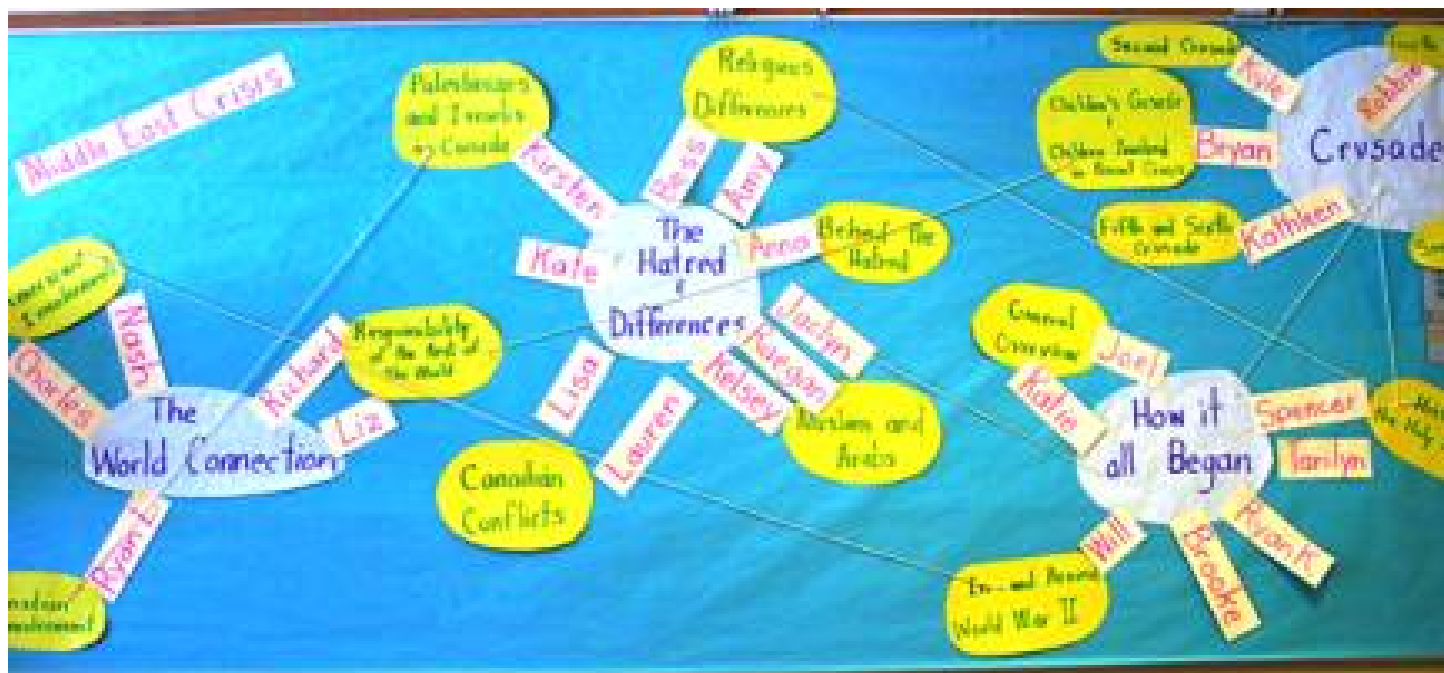

Figure 3: Class knowledge web

1. A grade four teacher reviews a new project students will be doing and then distributes an outline of it to her class. Each student has been assigned a region of Alberta to research. Their objective is to develop promotional material intended to encourage toursim or residency in their assigned region. The handout lists the facts that need to be researched, such as the climate, geography, vegetation, resources, and jobs. Students are given a number of choices in the way they can present their information: a poster, a TV advertisement, a pamphlet, a pictorial display, or a radio announcement or interview. The handout dictates a series of steps to be taken in developing their projects: reading about the region in classroom books, developing a concept map for the data, deciding on a presentation format, drafting the presentation and reviewing it with the teacher, and producing the final version for class presentation. An assessment rubric with 5 point ratings for several aspects of the research and presentation is included, and a due date assigned for different stages of the work. Earlier, the teacher had involved students in a discussion of what the dimensions for rating the project should be, and they were collectively agreed upon. Students are allowed to use any ICT tools they want for project presentation: digital video, still photos, PowerPoint, Astound, Word, PageMaker, etc. No Web sites for researching Alberta are suggested, but students know they can use the Web if they wish to. Students have the choice of working alone or with one or two others. An example concept map is given to show students how to organize their information.

2. Students in a grade eight science class are working in small groups. Each has drawn the name of a basic machine (such as a block and tackle or winch) from a hat. A project handout provides a series of questions on the definition, history and use of the machine that they must work together to answer using whatever resources they deem appropriate. Examples: Why was this machine invented? What was going on in history at the time? How might your life be different if this machine had not been invented? The resulting information is to be posted in a report on the school Web site. The second part of the project consists of a series of experiments that the groups are to design for their machine. They are to detail hypotheses, variables, and procedures, and record observations and conclusions. A draft of their procedures is to be submitted for approval before the experiment is demonstrated to the rest of the class and then written up in a final report. An extensive 3 page assessment rubric is distributed, with descriptions of what constitutes excellent, good, etc. work on a number of dimensions. Groups will use this to assess and grade their own work, before negotiating a final grade with their teacher.

3. Both grade two classes are working together, about to start a seven week Sky Science unit. They sit on the floor in front of one of the teachers, listening (for the most part) as she reads from a book about Galileo and his discoveries. She pauses at times to show pictures from the book to the group. Few questions are asked of the students. After several minutes, the teacher announces I want you to be thinking about how things have changed from Galileo s time, and where we are now   you ll be amazed at what s on the computer about what people thought 100 years ago   they didn t even know that the earth moved. The teacher groups students together in threes before telling them to start Web research. Each group is to go to the web site they have been assigned (from a list of four U.S. government and NASA sites). Students move over to a computer area and begin going to their assigned sites, which they explore seemingly at random, looking at text about planets and stars and viewing diagrams and photos. The children vary in their knowledge of keyboard shortcuts but can operate the browsers (albeit slowly). One child, for example, had a picture of Jupiter up, and wanting to know how many moons it had, had been able to click on a link labeled moons to see photos of Jupiter s moons; he was disappointed that no text was given indicating the number of moons.

Some students have problems getting to their sites, apparently due to the overloading of the school s two 56 K modems, and both teachers help students connect. The sites are listed on a handout they have which also outlines the activities taking place over the next several weeks. This handout is written in adult English, and is clearly meant to be read and explained to the students by their parents. Parents are to sign it to indicate they understand their child s responsibilities in the study unit. Students will be expected to conduct and record evening observations of the moon, planets, and stars with the aid of star charts; as their culminating project , they will each be researching and making a multimedia presentation of a planet.

Of the teachers observed and interviewed, Ms. C. and Mr. J., who together with Leona, a former Exploration Project teacher, were the lead teachers in the school in terms of ICT infusion and the ones with release time to consult with colleagues, exhibited the highest levels of student-directed inquiry in their classroom work. For some of the other staff it was clear that the school discourse around authentic, student-driven inquiry learning was (to a greater or lesser degree) not reflected in practice. Not all staff were in agreement with the constructivist approach; some thought students needed more direction, others were wary of the assessment problems it entailed. Negotiating around parental demands for comparative and quantitative reporting was a major problematic for many teachers at the school. While some parents appreciated qualitative, portfolio based reports and celebrations of learning in which student work was presented and explained at a school open house reporting strategies the administration was promoting others did not feel these approaches adequately informed them of their child s standing.

Two lunch time programs using ICT were open to students: Robotics and Stellar. In the Robotics program, held twice a week, grade one and two students are tutored in the construction and programming of Lego robots by grade three students who had undertaken a major robotics project developing data collection robots for a Mars landing in Ms. C. s class the previous year. Students worked in groups designing and building programmable vehicles, and developing and testing the code to accelerate, brake and steer them. About 15 children were observed participating in one session. In the Stellar program, students of all ages learn how to assist fellow students and teachers in the operation and basic troubleshooting of computers and the network. Here students have an opportunity to develop their skills in collaboration, problem solving and mentoring.

Teachers who had been at the school for two or more years unanimously felt that they had become much more competent and comfortable in using ICT, both from an operational standpoint and in terms of their skill in infusing it into their teaching. It was no longer seen as something special at the school, but simply as one of a number of tools and media to be used as appropriate for research, exploration, and expression in the service of better teaching and learning. Analysis of the teacher practice survey data (see Appendix B) indicated that staff were either comfortable or very comfortable with all of the listed applications with the exceptions of using a database and creating and maintaining a Web page (somewhat comfortable on average) and programming (not comfortable). They reported that their students used the Web, word processing, and presentation software several times a month, with Web page building, graphics, spreadsheets, and email being used less frequently. Game and instructional program use was rare, and no teacher reported using on-line forums or chat rooms. Teachers were divided on the practice of grading computer use. About half of them had created or modified a Web site in their classes. The amount of assigned computer use undertaken individually by students in their classes averaged between most and some ; virtually all use was directly related to course content. Computers were used at home to prepare for teaching several times a month on average, and half of the staff indicated that they involved their students in collaborative learning activities with off-site students over the Internet. Most teachers stated that they were collaborating online with colleagues, sent email several times daily had made various software and hardware changes, and had created a Web site and databases a few times, although individual variability on

these items was quite high.

Main Hypotheses

I. Technology as a catalyst

Con: The main force driving improvements in practice at this school was not the technology but the vision and direction that was set for the school at its inception, which set up a teaching culture and set of expectations reinforced by the leadership and the professional development activities at the school in the following five years: that the school be a place where teachers are encouraged to rethink standard teaching practice, and take risks in developing and applying more authentic, collaborative, and student-directed approaches to learning. ICT was seen as an integral part of this process, but teachers and administrators repeatedly stressed in interviews that it was subsidiary to and in service of the main goal of pedagogical innovation. Asked if the teaching innovations could be sustained without the technology being present, staff indicated that they could, although they conceded that it would make the task more difficult as the use of adult-level ICT tools that produced professional looking output was seen as highly motivating for students. Observations indicated that more traditional teachers made considerable use of ICT, but this did not appear to have impacted their practice in any significant way: students merely used the Web rather than books to find answers to preordained questions, or typed up assignments rather than writing them by hand.

Pro: Analysis of student interviews and observations indicated that students were usually very motivated and focused in their ICT based work, especially when more advanced applications (high-end graphics and presentation software, for example) were being used. Whether they would retain a similar level of enthusiasm and commitment in large-scale project work without being able to work with the many adult-level multimedia presentation options ICT opened up to them, or take advantage of opportunities ICT afforded to make contributions to the community that they considered meaningful and authentic (such as adding pages to the school s extensive Web site), is questionable. Without student access to technology, some of the desired pedagogical innovations (to the extent they were realized) might never have happened teachers might have found it too difficult to sustain meaningful student initiative.

II. Traditional diffusion pattern

Pro: The diffusion pattern at Mountview closely followed the traditional model, with a core leadership group spearheading dissemination in the school. The school s direction was initially set in large part by a small group of teachers who had already had a track record as innovators in pedagogy and technology; and its founder and principal in its first three years, Brian, was universally regarded by those who worked with him at the time as the key force behind the school s commitment to educational change and technology infusion. He worked tirelessly and with extraordinary effectiveness to overcome resistance from some members of the community to the school s innovative thrust. Together with two other experienced innovators on his staff, and in collaboration with the Exploration Centre, he implemented an extensive program of professional development incorporating sustained teacher mentoring and in-class modeling that gradually broke down what was initially high levels of resistance to ICT use on the part of many staff at the school. There can be little doubt that without his strong and inspired leadership which set and sustained a vision for pedagogical practice, together with the efforts of a core critical mass of like minded master teachers, the school would

have developed as a much more conventional institution.

Con: Because the school has a site-based hiring policy, the principal has been able to hire several new staff in the past two years that brought to the school high levels of ICT skill and constructivist teaching competence, such as Ms. C. and Mr. J.. These teachers have not had to have the innovation trickle down to them in the traditional way from the school s core group of innovators ; rather, their earlier exposure to pedagogical ICT use in their formal education and prior teaching practice allowed them to quickly begin to function as leaders themselves. (However, these teachers do report that their time in the school and contacts with other staff and the leadership has moved them further away from traditional forms of teaching practice, indicating that some diffusion did occur in the traditional manner.)

III. Staff competence

Con: The prevalent culture and pedagogical stance promoted at Mountview de-emphasizes the view of the teacher as the expert; rather, teachers are viewed as co-members of a collective learning community. Staff are generally comfortable with the fact that students will often know more about the technology than they do, and frequently have students teach other students how to use software that they themselves have not mastered. Nearly all staff interviewed remarked at how rapidly students learned how to operate new hardware and software with very little formal training; students are very motivated to quickly learn from each other the steps necessary to accomplish what they want to do. Because of the culture of collaboration at the school, which has been encouraged by the administration, teachers do not hesitate to ask one of the ICT leaders to come to their class and give mini-lessons on aspects of computer operation they had not mastered themselves. Students can be prepared to effectively use the tools they want to in spite of their teachers lack of skill, allowing them to make full use of the affordances provided by the schools extensive network of computers and strong software library.

Pro: Staff competence *was* critical, not in being technically adept in every software package and computer operation, but in knowing the capabilities of different ICT applications and having the pedagogical skill to see how ICT could be leveraged to promote new learning and communication possibilities within the context of their teaching. In teachers lacking the inclination or skill to engage in constructivist practice, ICT was relegated to less valuable roles that might have been just as easily served by the library or even a typewriter.

IV. Equity

Because of the socio-economically homogenous mix of students at Mountview, there was no evidence collected that could address this issue.

V. Academic standards and outcomes

Pro: Staff at the school made a conscious decision to limit software use to higher-quality tools and to avoid the use of traditional courseware and tutorial software altogether. Their high expectations that students as young as seven or eight would be able to make educationally meaningful use of tools designed primarily for adults were largely met. Students of all ages were seen successfully researching on the Web and easily working with advanced graphics, presentation, and design tools such as Astound and Photoshop, often having received little or no formal instruction in their operation. One grade 8 student remarked, the level of resources here is very high and it makes us want to work with it more. It encourages us to learn more. Teachers commented on the quality and depth of work that

they were seeing, which typically exceeded what they expected from students of their age level: What I thought perhaps 13 and 14 year olds could do, I m seeing 5 and 6 year olds do now. One teacher cited a tremendous value he saw in ICT: its capacity to present the spirit and competence in young children s work in a manner that is no longer obscured by poor motor skills (messy printing, etc.). The opportunity to create more adult looking work was thought by several teachers to motivate student learning. Staff also indicated that the communication and sharing of different ways of knowing that ICT made possible contributed to the students enthusiasm for learning. Students were seen to be developing a strong sense of confidence in and ownership of their learning. In the words of one teacher:

The majority of the students in the school really feel that they have a voice in what they ve learned, and they can talk about it and they can explain to somebody else what they ve learned and the process they worked through to learn that.

Parents were largely very impressed with what their children presented at the school s celebrations of learning and with the work posted on Mountview s web site. The students competencies were reflected in their performance on a standardized provincial achievement test in math and English administered in 2000 in all third grade classes; Mountview results greatly exceeded the provincial means, and a far higher percentage of the school s students were classified as high achievers.

Con: Some of the student work examined did not seem to indicate a level of achievement or functioning significantly different from what might be typically expected of students of equivalent age. Performance on the standardized achievement tests by grade six students did not differ from provincial norms. It would be expected given the high SES of Mountview s client families and the lack of ESL students in the school that Mountview students would exceed provincial norms even if the school offered a traditional program.

The Future

Sustainability. The innovations brought to teaching and learning at Mountview, while not implemented fully by all of its staff, have proved relatively resistant to erosion over the past few years despite major changes in staffing and leadership. Only four of the current staff were present at the school s inception, and of those, two are now part-time. The departure of the school s founder and first principal in June of 1998 was a major test of the sustainability of the school s vision and practice, and many staff were not sure at the time that these would endure, especially sincea large number of staff left at the same time (15 new teachers had to be hired for the following fall). It was also during this period that the two key teacher-leaders who had worked with the principal from the start left the school to join the Exploration Centre on a full time basis, although one of them continued to play a major support and consultancy role in the school and does so to this day. Careful attention to sustained support for professional development and the creation of a culture of reflection, collaboration, and change on the part of both the administration, the Exploration consultants, and remaining experienced staff have kept the innovations alive and enabled their transference into the teaching practices of many of the new teachers. Consultation and cooperation with parents and the community both through the School Council, business partnerships, and meetings with individuals has kept community resistance at a minimum and allowed the school to survive pressures to move the school in a more conventional direction from the school division superintendent and others in the regional system.

Despite this success, there are ongoing challenges that continue to put its innovations at risk. All of the teachers interviewed noted how demanding teaching at Mountview was personally in terms of time, risk, and energy relative to their experiences at other schools, and they indicated that what was

keeping them at the school was the professional and personal satisfaction they derived from being able to teach in what they found to be a more meaningful and effective manner, and from seeing the positive impact their work was having on students. The latter was clearly a critical factor in sustaining support for the innovations. Students themselves had high praise for the dedication of the staff and the quality of teaching at the school. Several teachers thought the potential for burnout was a real danger over the longer term, and suggested that some of the former staff had departed for just this reason. The record of this school suggests that sustaining constructivist pedagogy requires an ongoing process of support and development if it is to remain viable.

Transferability. Transfer of the innovation to existing staff is an ongoing process, one that takes years in some instances. The level of support at the school for change is substantial, but the teacher has to be willing to engage in it; it cannot be imposed. It was noted by a former Galileo Fellow still conducting research at the school that there is some resentment on the part of less innovative staff of the attention and praise given the leaders. It seems likely that a few staff will never choose to alter their conventional approaches; the best that can be hoped for is that with less staff turnover the innovations can spread more completely through the school given more time.

External transference of its pedagogical innovations and ICT infusion model to existing institutions is likely to be very challenging for two related reasons. First, finding existing leadership in other schools as exceptional in skill and dedication as the original core team at Mountview was will be difficult, and the Mountview experience shows that such leadership is crucial to success. And Mountview had the advantage of being able to carefully select staff amenable to risk-taking and constructivist practice, of great advantage in the promulgation of change.

Still, frequent visits by other teachers to the school is sparking interest in the reforms elsewhere in the district and the province. The transfer model being used by the Exploration Network having experienced teacher-leaders formerly at Mountview work in a situated, intensive, and ongoing basis with a few other schools which have been excited by what Mountview has achieved, using the same modes of professional development that have been successfully used there would appear to have the highest probability of success. Longer term, both sustainability and transferability will need to be addressed at a deep structural level if widespread reform is to occur. Policy and funding changes will be needed to deal with the lack of opportunity most teachers have for learning about, reflecting on, and trying out new approaches to their practice. They require a work environment and support structure that reduces perceived risk and lowers the levels of demand placed on them as they work towards a transformation of practice.

Appendix A

Methodology

There were four members of the research team. The team spent a week on-site. Two groups of three teachers each were interviewed; each interview was split into two parts, with the total interview time for each group being about 2 1/2 hours. Interviews of 90-120 minutes length were also conducted individually with a school system administrator (the supervisor of educational services), the teacher serving as the school s network administrator, an academic who had held the first Exploration Doctoral Fellowship at the school, and a former Mountview teacher who had been on the school development team and was now a consultant and vice-president with the Exploration Network. A two hour interview was undertaken with the school s administrative team (principal and assistant

principal). Two groups of three students each ranging in grade from grade 2 to grade 8 were given hour-long interviews. Finally, two parents were interviewed: one with what the principal deemed an average level of involvement with the school, and another more actively involved, who was President of the School Council.

Observations were made both in classrooms and in the areas where the computers were located. Classes were chosen for observation in consultation with the principal, with the goal of getting a representative sample of the range of teaching practice and use of ICT at the school. In an attempt to gather a maximum amount of observational data, different members of the team sometimes observed in different classes. Observational periods varied considerably in length depending on class activities and interview schedules. Some student project work was photcopied from several classes, and samples of student ICT work burned onto a CD-ROM. A great deal of student work was accessible on the school s web site. Digital photos were taken of the site, although due to school restrictions photos in which students can be identified could not be added to the report.

Appendix B

ICT Teacher Practices Survey results (N=8)

Question #	Coding explanation	Average	S.D.
1		1.00	0
2		1.38	0.52
3		2.88	1.25
4		3.00	0.82
5		1.13	0.35
6		3.88	0.35
7		2.25	1.04
8		1.88	0.99
9		1.57	0.53
10		3.14	1.21
11		2.71	1.11
12		1.86	0.69
13		3.57	1.13
14		3.29	0.49
15		3.00	0.82
16		4.00	0
17		2.29	0.76
18		3.57	0.79
19		2.00	0
20	good=1	1.67	0.52
21	yes=1	1.50	0.53
22	no restrict=1	1.75	0.89
23	yes=1	1.63	0.52
24	all=1	1.13	0.35
25	all=1	2.38	0.92
26	several times/week=1	2.00	1.07

27	yes=1	1.75	0.46
28	yes=1	1.50	0.53
29	yes=1	1.13	0.35
30	>12=1	2.75	0.71
31a	0=1	1.63	1.77
31b	0=1	2.38	2.26
31c	0=1	2.13	1.89
31d	0=1	3.38	1.92
31e	0=1	1.38	1.06