Educational Inquiry and Creativity: Developing Digital Resources in Ireland's Information Age Town

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Abstract

Despite cultural and social barriers to technology adoption, the teachers and administrators of schools in the Irish town of Ennis, with help from the Clare County Education Centre, integrated computers, networking, software, Internet, and digital imagery into the schools' curriculum. Success in technology integration has been achieved in primary education due to persistent and innovative efforts on the part of teachers; however, technology integration has not been as deep nor as broad in the secondary-level schools. Students have produced many new learning materials themselves using computer-based tools, the Internet, and other technologies. The barriers, challenges, and achievements of the community described in this case study may have implications for other small communities who wish to use technology for teaching, learning, and curriculum change.

Introduction

> As teachers move away from the lecture method to viewing students as active learners and providing for their learning needs in new ways, technology will become a natural and integral part of the classroom, just as it is in everyday life. (Matusevich, 1997, p. 147)

In 1997 when Ennis, Ireland, won the competition to become Ireland's "Information Age Town," there were virtually no computers in the schools, and very few teachers had ever personally used a computer. For the most part, educators were skeptical that technology would change traditional teaching and learning practices. This article documents the changes that have taken place since then, with emphasis on the integration of technology into the school curriculum, the efforts taken by teachers to make this happen, and examples of how students constructed their own digital learning materials.

LIBRARY TRENDS, Vol. 54, No. 2, Fall 2005 ("Children's Access and Use of Digital Resources," edited by Allison Druin), pp. 266–285

Background

Historical Context

Ennis, a town of 18,000 people located in the west of Ireland, was named Ireland's Information Age Town in 1997 after a spirited competition among forty-six Irish towns. Ennis had not experienced the technology and financial boom, usually referred to as the "Celtic Tiger,"[1] that other, more urban areas of Ireland had celebrated in the mid-1990s; thus, being named the Information Age Town (IAT) promised to move the town rapidly into the information society (Bangemann, 1994; Castells, 2000; Feather, 1994; Information Society Commission, 2002; Komito, 2001; O'Donnel, McQuillan, & Malina, 2003).

Eircom, the telecommunication firm that sponsored the Information Age Town contest, articulated two goals: "1. To saturate a town with 21st century communications technology and see how people come to terms with such technology. 2. To encourage the town to trial new technologies and applications" (Ennis Information Age Town, 2005b). Education was one of the sectors included in the attempt to infuse the community with computers, software, network technology, and training so that the entire town could become computer literate and benefit from the new tools available to virtually all town residents.

In 1997 Ennis was a busy county market center with a good school system, but there was little technology awareness and use. Even to supply homes with Internet access, the IAT staff first had to provide phone service to six hundred households (Behaviour & Attitudes Marketing Research, 2001, p. 10). Schools were not quite prepared for the loads of computers, monitors, and peripherals that were delivered to their doorsteps (McInerney, 2003). Space had to be found for the equipment, furniture had to be ordered for computer rooms, teachers needed computer training, and lessons needed to be revised if the technology were to be truly integrated into the curriculum. The price tag for the Information Age Town endeavor (1998–2003) was 19 million with 1.9 million of that amount devoted to education (McQuillan, 2000, p. 27; Ennis Information Age Town, 2005a). For a town in the mid-west of Ireland, this was a huge investment; the enormity of the possibilities was not lost on the town's teachers. The purpose of this article is to report on a study that investigated how educators incorporated new technology into the curriculum in the context of a networked community and to highlight projects where students created their own learning materials.

Networked Communities and Education

Rural and remote communities are often those most disadvantaged in the accessibility of information and communication technologies (Marshall, Taylor, & Yu, 2003). The Ennis schools did not have that problem

despite their rural surroundings and isolation from Ireland's major urban centers. Like other educators in networked communities, though, the Ennis educators confronted the challenge of how to best take advantage of the technologies for learning, a challenge more daunting than acquiring hardware and software. A similar situation faced the teachers in the Montgomery School System affiliated with the Blacksburg, Virginia, Electronic Village (BEV) project during the mid-1990s. The BEV educators found that, before using Information and Communication Technologies (ICTs) in the classroom, it was necessary to adopt learner-centered or constructivist models of education (Ehrich & Kavanaugh, 1997).

In considering models and methods to use in the continual adoption and integration of ICTs, the Ennis educators concentrated on active learning, social interaction, and inquiry-based cognitive learning and teaching, but they needed firsthand knowledge about technology before implementing any of these strategies. In a study of networked communities commissioned by the Rand Corporation, training was viewed by all interviewees as a critical first step to helping individuals go online (Anderson, Bikson, Law, & Mitchell, 1995). Training emerged as a key factor in implementing technology use in Ennis as well. Subsequent sections of this article will discuss educators' adoption of technologies and how they used new-found knowledge to enhance and, in some cases, change the curriculum.

Research Methodology

An investigation of the Ennis schools' integration of technology was a multimethod study where researchers spent extensive time in the Ennis community. It is part of a long-term community informatics study that focuses on various community sectors (Business, Education, Nongovernmental Organizations [NGOs], Public Service, etc.) as the units of analysis. "Community Informatics" (CI) is a relatively new field that studies

> the practice of enabling communities with Information and Communications Technologies (ICTs). CI seeks to work with communities towards the effective use of ICTs to improve their processes, achieve their objectives, overcome the "digital divides" that exist both within and between communities, and empower communities and citizens in the range of areas of ICT application including for health, cultural production, civic management, and e-governance among others. (Journal of Community Informatics, 2000)

The intention of the research is to create case studies of each sector of the community. The ongoing study began in 2001 and, although educators have been interviewed throughout the course of the research, the Ennis education sector was the primary focus of research during the fall of 2002 and winter and spring of 2003. A detailed timeline with a list of research methods and participant groups is given in Table 1.

Table 1. Summary of Research Methods with Sector Participants in the Ennis Study

Timeframe	Method	Sector	Number of Participants
May 2001	Interview	Ennis IAT Staff	7
	Interview	Entrepreneurs	2
	Interview	NGO—Regional Development Organization	1
	Interview	NGO—Chamber of Commerce	1
	Interview	Business	3
	Interview	Education	6
	Interview	Public Service—Library	2
March 2002	Interview	Ennis IAT Staff	1
	Interview	Business	2
	Interview	Education	1
	Interview	Public Service—Library	1
October–November 2002 (Three Visits to Ennis)			
	Interview	Ennis IAT Staff	3
	Interview	Education— Principals, Technology Teachers	21
	Interview	Residents—Parents	3
	Interview	Entrepreneur	1
	Group Interviews (2 sessions)	Education—Teachers	16
	Self-Administered Survey Distributed in Hard Copy to 360 Teachers	Education—Teachers (45% response rate)	162 respondents
January 2003	Interview	Education—Principal	1
	Group Interview	Education—Teachers	7
	Group Interview (2 Sessions)	Education—Students	8
	Interview	Residents—Parent	1
December 2003	Interview	Ennis IAT staff	3
	Interview	Entrepreneur	1
	Interview	Education	1
	Interview	Public Service—Library	1

Research Questions

The research questions that guided the study sought answers to the following:

- What was the level of ICT use in the schools?
- What processes were used to integrate ICT into the curriculum?
- What were the experiences of the teachers and principals in regard to learning and teaching with technology?
- What were the lessons learned from the Ennis schools' experience?

Research Methods

A literature review focusing on studies of networked communities and educational technology began the process. Issues of the *Irish Times* and the

local newspaper, the *Clare Champion,* were searched electronically for articles about the Information Age Town. Documents from the Irish Department of Education and Science were read, and the Web site for Ennis as well as those for each Ennis school were examined. In addition to individual and group interviews, self-administered surveys were distributed to 360 teachers in Ennis, with 45 percent of the town's teachers completing them. The results of the survey were entered into SPSS with subsequent reports generated from the software. The purpose of this article is to report on the qualitative aspects of the research. The quantitative results are reported in "Wired Ennis: Learning and Technology in an Information Age Town" (McInerney, 2003).

Participants

The principal investigator, an information scientist, visited Ennis seven times, spending weeks at a time in the community and a total of thirty-five hours observing in the Ennis schools. She conducted interviews with an array of key individuals and groups, including the principals of thirteen Ennis schools, eight school technology coordinators, parents, teachers, public library administrators, entrepreneurs, business people, public service individuals, and Information Age Town staff members. Another researcher, an educational psychologist, interviewed students, Information Age Town staff members, one parent, and one principal. The two researchers together conducted interviews with several individual principals and the director of the travelers' education center. The interviewers asked subjects for forty-minute interviews; however, most of the interview sessions lasted for an hour or more.

Researchers used prepared protocols in the semistructured interviews in order to be consistent in the questions asked within categories of informants. The questions covered standard demographic information; attitudes toward technology; technology diffusion, adoption, and use; impact of the Information Age Town project on teaching and learning; infrastructure; technology support; barriers to learning with technology; and general open-ended questions to allow for unique comments on the part of interviewees. Throughout the course of the overall project, ninety-four people were interviewed, with some key informants being interviewed multiple times. Key informants included the Ennis Information Age Town Director of Research, director of the Clare Education Centre, an Ennis entrepreneur, and a technology teacher. In the education sector, during the 2002–2003 period, 162 participants responded to the survey instrument, and 58 individuals participated in interviews.

Because interviewing was critical to learning about technology in the schools, great care was taken in analysis and coding of the interview transcripts. All individual and group interviews (with one exception) were tape recorded and transcribed verbatim, and the transcriptions were coded

Table 2. Interview Codes for the Ennis Information Age Town Schools Project

Code	Meaning
Apps	Key applications in the schools (Internet, Word, etc.)
Attitudes	Teacher, administrator attitudes
Barriers	Barriers encountered
Best	Best practice
Curric	ICT as cross-curricular tool
E-mail	E-mail use in schools
Factors +	Factors that encourage ICT use
Factors -	Factors that discourage ICT use
Future	Schools' future plans
Gaps	Gaps in existing technology solutions
Home	Home-school communication
Infra	ICT infrastructure (hardware, software, etc.)
Inter	Interschool projects, policies
Irish	How best to use technology to benefit Irish education
Learn	ICT used for learning, new learning
Lessons	Lessons learned
Level	Level of usage
Manage	Use of ICT to administer or manage Policy Schools ICT policy recommendations
Projects	ICT projects
S-skills	Student skills development
Space	Physical space for computers
Special	Special needs, assistive technology
T-skills	Teacher skills development
Tech	Technical issues (maintenance, support, networks, etc.)
Website	Role of school Web site

using Grounded Theory methods (Strauss & Corbin, 1998). Consistent with Grounded Theory, the researchers performed open coding, that is, reading each transcript and ascribing subject categories to each paragraph. After reading all transcripts and analyzing the categories, the keywords were synthesized into a list of categories related to the research questions. Axial coding produced the categories listed in Table 2. All interviews were reread and coded using these categories. Interviews were transcribed by the principal investigator and three graduate students. Graduate students also assisted in coding fifteen of the educator interviews.

Researchers entered open coding categories and keywords into Nvivo software, running reports to assist with the content analysis of the interview transcriptions. The revised coding using the keywords along with a review of the Nvivo reports allowed the researchers to perform an analysis in order to make sense of what informants said about technology and learning in the Ennis schools. During visits to the primary and secondary schools, researchers were able to observe students in classrooms and computer labs for a total of thirty-five hours. These visits helped verify what informants had said in interviews as well as allowed us to see students and teachers in the context of their educational environment.[2]

Research Findings

Change Necessitated Learning: Teachers

In late 1997 the reality of receiving truckloads of computers, monitors, keyboards, and cables took educators by surprise.[3] By 2002, however, most of the primary schools (prekindergarten through eighth grade) had integrated the technology into the curriculum. Most primary school teachers say that the changes in the school have been "transformative," and they are surprised that they are now conversant with computers and understand how to use them for teaching and learning. When interviewed, teachers said that in 1997 and 1998 most had never touched a computer. They were "terrified," "frightened," and "extremely apprehensive" of computers, to use their own words, and they knew nothing about how to turn the machines on and nothing about how to teach with them. By 2003 many were routinely communicating with the principal by e-mail, and most, especially on the primary level, were comfortable with software and technology tools as part of the curriculum.

The changes that took place were the result of a patchwork of professional development: formal workshops, self-education, experimentation, and teacher-helping-teacher learning efforts. Workshops were organized by the Clare Education Centre, a county in-service teaching center, where the director had a personal interest in the success of technology in the schools. The appointment of technology coordinators for each school through an Irish Department of Education and Science program[4] (Galvin, 2002) was timely. These coordinators were given one-year appointments all over Ireland, but in Ennis there was a gold mine of technology with which to work. In other places the technology coordinators had to struggle to supply schools with computers and networking.

Teachers who lived in Ennis were able to apply for one of the many multimedia computers that were offered to residents of the town for £260 ($333) with an estimated value of £1,800 ($2,286) (Spellissy, 2003, p. 78). Even teachers who did not live within the town boundaries, but who taught in Ennis schools, were allowed to take advantage of the special low-cost computers, which included software, modems, and printers. In interviews many teachers mentioned that having their own computer allowed them to work in a private space until they felt comfortable enough to introduce a program in the classroom.

In the interviews conducted by the author, teachers demonstrated that they were creative and persistent in their determination to "tame the computer beast," as one of them said. Another teacher responded that, at the beginning of the project, the teachers were "as green as cabbage" regarding computing. The biggest motivation for teachers to learn about technology themselves was the realization that something new and potentially life changing was happening to the town, and they wanted to participate. One

teacher said, "Some teachers really had this vision that it was going to be a big thing, and they needed to be part of it." It was this vision that encouraged the teachers to employ a variety of strategies to learn themselves.

One of the more adventurous learning strategies was a "field trip" organized by nine of the teachers to the Education Technology Centre and three schools in Omagh, County Tyrone, Northern Ireland, where schools had a reputation for effectively integrating technology (Walshe, 2001, 2002). The goal of the visit was to see how the schools in Omagh compared with those in Ennis, using Omagh schools as a benchmark for Ennis. The UK had been equipping schools with software and computers since the 1980s, so the Omagh teachers were much more experienced than those in Ennis, and they were required to integrate technology into every class. The result of the trip was a heightened sense of self-confidence for the Ennis teachers because they saw some practices in place in Omagh that the Ennis teachers were using, even though technology in Ennis was still at a nascent stage. Another unintended consequence of the trip to Omagh was a feeling of closeness and connectedness among the teachers and an understanding that they would support each other in the future, especially with the task of selecting and learning new educational software.

As interviews with teachers revealed, though, it was the personal, gritty will of the teachers to use the technology to the children's advantage that made change possible. The teachers admitted "We were all beginners" in the early stages, but they started from scratch to select software, discuss curriculum changes, and learn about computing in a peer-helping-peer model. Teacher-learning efforts included

- enrolling in classes offered by the Ennis Information Age Town (EIAT) staff; the Schools Integration Project (SIP), a nationally funded program; and the University of Limerick and other universities;
- taking the European Computer Drivers License (ECDL) course;
- learning from the school-based SIP coordinator;
- participating in training offered by the Clare Education Centre;
- experimenting on a home computer;
- learning from a colleague.

Figure 1 summarizes these learning methods quantitatively, with data gathered from questionnaires completed by Ennis teachers.

Challenges and Champions

Teachers in Ennis committed themselves to change teaching strategies in radical ways. As teachers indicated in interviews, traditional teaching in Irish schools is conducted under a didactic model where teachers are those who have the knowledge and inform the students through lecturing and designing learning activities. Unfortunately, the didactic model is simply

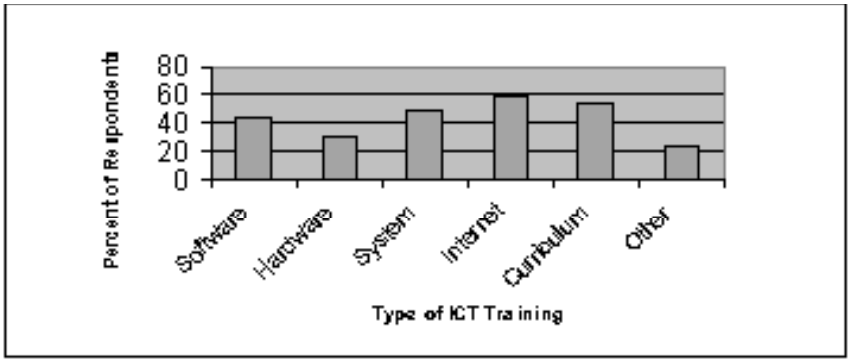

Figure 1. Types of Information and Communication Technology (ITC) Training in which Ennis Teachers Participated. Note: Numbers are derived from a survey distributed to all Ennis teachers.

not compatible with technology learning because, to use technology effectively, children must participate in inquiry, discovery, information seeking, and creative experimentation with various information resources (Berge & Collins, 1995; Ehrich & Kavanaugh, 1997). In confronting computing and networking, Ennis teachers were faced with a corpus of knowledge (how to use the technology) with which they were not only unfamiliar but actually feared. As Berge and Collins point out, in using technology "the roles of students and teachers will change. No longer perceived as the sole experts and information providers, teachers become facilitators and guides. Conversely, students are no longer passive learners, attempting to mimic what they see and hear from the expert teachers" (1995, p. 5). In Ennis, teachers would be called on to become technology coaches or guides with students who would take more responsibility for their own learning and constructing their own learning materials.

In observing similar challenges that faced teachers in Blacksburg, a small networked community in Virginia, Ehrich and Kavanaugh say:

> The need to transform pedagogy, to learn new technology, and to adjust to the challenges of teaching in a networked environment is but the beginning of the human problem for the teachers. Having taught with substantially the same style for many years, most teachers are not accustomed to an environment in which they must learn faster than their students and on their own time . . . After all, teachers want to focus on their educational agendas, and many view the need to deal with ASCII codes, broken cables, GIF files, and unusable freeware as an intrusion or a diversion of their energies (1997, p. 102).

How did most of the Ennis primary teachers overcome their technology reluctance and become motivated to take on the challenge of a new way of teaching? The answer points to several factors: technology champions, the culture of volunteerism, and pride in competition.

There were several "sparkplugs," or technology champions, who initiated change and were dedicated to seeing that technology change took place in the schools. In many ways these champions inspired the teachers to persist and learn. The Schools Integration Project director for the county organized and taught workshops; she helped organize the Ennis schools' technology coordinators, and took the lead in the teacher field trip to Omagh. The technology coordinators often embodied the spirit of excitement and doing something new, and, equally important, they were on hand in the schools to support teachers if they had problems with equipment or needed help with software. The director of the county education center was proficient with technology and supported training sessions by offering space and technical assistance. Other technology champions included several Ennis principals, one of whom was on the original town committee that presented the Information Age Town proposal to Eircom, and she continued to model technology learning, routinely sending out a daily email message to teachers. Two other principals were enthusiastic and encouraging, becoming computer literate themselves and working closely with the school's technology coordinator to ensure that progress was being made.

Having supportive principals and technology teachers certainly facilitated the availability of technology workshops for Ennis teachers during the school day. However, substitute teachers were scarce, so teachers had to learn about technology on their own after school and in the evening. One of the Information Age Town staff members, Sean (a pseudonym), explained why teachers were willing to put in extra time without explicit rewards, and his words were echoed by other town residents who were interviewed. He said that in the Irish culture volunteerism and competition are highly valued. Teachers volunteered to learn technology applications because they were accustomed to a culture of altruism. Sean indicated that much of the care of the elderly and other social services that would be institutionalized in the United States and other countries are carried out by volunteers in Ireland. In the United States teachers may have expected extra pay or time off to learn the new technology, but in Ennis many teachers learned and experimented on their own time. Some were able to take some time off during the day to attend training sessions at the education centre, and, while there was funding, substitutes were hired to take their place in the classroom.

Sean also said that "sport is taken very seriously here," pointing to the competition experienced in sports as a characteristic that pervades many aspects of Irish life. Both girls and boys are encouraged to join team sports and cooperate with the team and learn through competition. The Gaelic Athletic Association (GAA), as Sean pointed out, is the biggest organization in the country by far and hugely influential. Just as Ennis residents were proud of winning the IAT competition, the teachers would want to

Table 3. Summary of How Ennis Educators' Responses to Technological Change Paralleled Classic Change Strategies

Classic Change Strategy	Ennis Educators' Responses to Technology Opportunities
Provide awareness	Introductory workshops were held and newsletters distributed
Select those interested in change to pilot change	Information technology (IT) school coordinators were chosen
Train the trainers	IT coordinators attended regular meetings and took classes on software and hardware use, networking, and Internet applications. Coordinators then taught others in their own schools
Gradually add more people to the process as others see changes as successful	Teachers, principals, and the Clare Education Centre become partners
Use benchmarking to develop goals and objectives	A teacher group visited schools in Omagh, Northern Ireland, to learn about selecting educational software and teaching strategies
Ensure that there are well-trained champions who can sustain the change	At first the IT coordinators were the champions; when funding ended, volunteer IT champions were left to carry on

continue the pride by being a part of one of the biggest projects to come to the town, no matter how difficult that might be. Although many teachers said that they had worked in the Ennis schools twenty or thirty years or more and were well established in their teaching methods, they were still willing to change if it meant being a part of the new information society. Not all teachers signed on, of course, and at the time of the research in 2002, there were still a few in each school who refused to use computers in their classes. Unfortunately, those teachers were reluctant to be interviewed.

Ennis was a situation where change was thrust upon a social system, including the educational sector, and where educators responded by following a classic change process model. Table 3 spells out traditional change strategies and how Ennis educators responded using each strategy.

In the remarkable change process undertaken by the educators in Ennis, teachers adopted methods and a view of teaching that were closer to a constructivist paradigm and less didactic than before the influx of the technology tools. One educator told us, "Teachers need the three C's—a comfort zone, confidence, and commitment," and these three C's are somewhat dependent on each other. This sentiment is endorsed by O'Bannon and Judge, who remark that "Teachers must feel comfortable with technology before they can include it into instructional situations" (2004–2005, p. 198). Through a patchwork of technology training and self education, the teachers found themselves in a situation where fundamental change had taken place in most classrooms.

The following section of this article discusses examples of how, after being given access to digital materials, the children of Ennis created learning materials and began to create digital libraries for themselves and others.

Inquiry-Based Learning—Students

Merely investing in educational technology will not change education nor result in better learning programs. However, in the "largest community technology project in the world," as Ennis is reported to be (Ennis Information Age Town, 2005a), the opportunity to integrate technology tools in the schools became the impetus for allowing children to create and learn in new ways. As one veteran teacher said, "I think the Information Age Town has changed the face of the schools completely; it certainly has changed my life, and I think it has changed everyone's life who is involved in the schools." In Ennis, information technology champions (sometimes principals, sometimes teachers) devised new ways of teaching and learning.

Technology, Learning, and Young Children In Ennis, "infant" classes (four to six year olds) are introduced to keyboarding and using a mouse with age-appropriate software that relies on images, spoken words, and music. Children learn to follow the cursor and click to navigate through a program. As a pre-language exercise, children create their own picture books using image files and Microsoft PowerPoint. Although researchers saw no evidence of an archive of these works authored by children, one could be created on a school's Web site so that parents could access their own child's work and children themselves could track their progress as they move through the various levels.

In one school, as the six-year-old children learn the alphabet, become proficient on the keyboard, and acquire some language skills, they participate in an email exchange with their peers in Dublin. Mr. Seamus, a teddy bear, spends some time with the Ennis children[5] and then is sent for a stay with the class in Dublin. In this age-appropriate "Teddy on Tour" exercise, the children exchange messages to learn how Mr. Seamus is faring and what is happening around him, all of which encourages curiosity about another part of the country, teaches the usefulness of computer-mediated communication, and helps the children practice word recognition, spelling, and writing in general.

Technology Tools and Children with Special Needs Researchers found that children who have special needs (learning disabilities, autism, Down's syndrome, etc.) are among those in Ennis who use technology most frequently for learning. As one special education teacher stated, "We use it every day, all day. It is totally integrated in our curriculum for special needs children, especially those at a lower cognitive level." Children in the special needs schools and programs use talking word processing programs (Clicker-4, for example) and make extensive use of the digital cameras for creating stories and books.

An observer in one class in an Ennis school devoted to children with physical, learning, and other psychological disabilities was immediately struck with the ease and accessibility of technology tools, even for young

children. In an infant class, computers and monitors are scattered around the classroom on low tables, just the right height for four and five year olds. Headphones sit on the tables next to the computers. Digital cameras, resting in their cradles, are cabled in to the computers and ready for use. Children and teachers in this class take pictures of everyday activities, and teachers print out the color photographs. Each child has an activity book that goes home each evening and is returned in the morning, providing parents with daily communication from the school and a visual record of their children's progress in growth and learning. On its own, sending home photographs of the day's activities may not seem so unusual; however, the routine, personalized, daily use of the digital cameras in this way captures the immediacy of the learning and most certainly demonstrates an innovative means of school-home communication. In the long run, when Ennis educators seek to sustain their technology integration projects, the community will no doubt be called upon to support the purchase of software updates and new computers. The ongoing communication made possible by the technology tools may help in soliciting the support needed from parents, some of whom are influential community members.

The special needs children create stories, learning how to construct a narrative, just as the children in mainstream infant classes do. Images are embedded in the software, so even preliterate children can construct their own tales. Hyperstudio software and Storymaker assist the young story weavers, but it is the intellectual process of understanding the elements of a story, the development of a plot, creating characters, revelations and surprises, and then coming to a conclusion that helps the children become ready for reading on their own. One parent of a disabled child said that her daughter finds working on the computer more interesting, more fun, and more interactive than other ways of learning. Her daughter even tells her mother how to perform certain functions on the computer and encourages Mom when she succeeds by saying, "That's the way; now you've got it."

One educational challenge is teaching Irish to children with special needs.[6] One primary school uses a software package to teach Irish sign language to deaf children, and the children seem to enjoy the graphics and photographs on the CD. The problem is that Ireland is a small country, so there is no critical mass to buy software for children with special needs, thereby making it difficult for a software producer to make a profit. Teachers say that they would like to have the government subsidize the development of such educational materials so that the curriculum could be enriched with more interactive technology tools.

Curricular Innovations in Primary School Three projects stand out as particularly creative ways to use technology to encourage inquiry and fundamental research skills among children in primary school.

The West Clare Railway was at one time a narrow gauge railroad that

carried citizens of County Clare from Ennis to the coastal towns and back again. It was a critical transportation link from Ennis to outlying areas. Today, the legendary railroad exists in folk songs, plays, and personal accounts of a time when few had a car in County Clare. Although the railroad is no longer operational, children in schools where stations existed learned about their county's history (by researching original sources) in order to complete the explanatory text for the project. When a visitor clicks on the interactive Web site map, for example, on the town of Ennis or another town where the railroad stopped, information about the town and station are linked and made visible. The Web site presents a valuable historical record for anyone interested in the history of County Clare, whether in Ireland or the Irish diaspora, told in the words of the children who did the research and wrote the narratives.[7] The interactive Web site can be found at http://www.clare-education-centre.ie/projects/west-clare-railway/.

Traditional Irish music makes its home in County Clare, so it is not surprising that the music of Clare became a topic ripe for study and technology applications in Meet the Musician. The Clare Education Centre and the Traditional Music Archive (http://www.comhaltas.com/culturlann/ennis.htm) cooperated with the Ennis schools and others throughout the county to present biographies and music of local Irish musicians on the Web. The interactive Web site includes digital images, music, and stories about the musicians who call the county home. In order to populate the site with the narratives and sound clips, the students learn about the music and the musicians through an understanding of creating oral histories, learning interviewing and other research skills, writing up their results, and Web site development. This Web site is password protected, and, although available to students and educators, it is not publicly available.

Children from four to eleven years are also cooperating on a project called Birds in the School Yard, where children observe the species of birds that fly above and land in their school yard and keep track of the numbers of each species that they observe. They learn about the birds through literature and Web research and then write about them. Like the Clare Railway project, the work of all the children is being compiled and eventually will be posted on an interactive Web site that will link pictures of the birds to the children's descriptions of what they have observed and learned.

One can see a theme among these three projects of interschool learning in various disciplines, including history, zoology, music, etc. They all focus on local phenomena and primary and secondary research methods, with students analyzing and writing about the results of research, and the end result being learning products captured digitally on hyperlinked Web sites. The children not only learn, they create lasting learning products that can be archived and reused, forming the basis of ongoing digital libraries of locally researched material. Using the Web technology, all the students and, in fact, the community can benefit from the learning that has taken place.

Secondary School Curriculum Computing is not ubiquitous in Ennis' secondary schools; however, great strides have been made, and slowly technology is being incorporated into the learning activities. One coeducational secondary school of 960 pupils received 68 computers from the EIAT. However, this school has seen a 32 percent increase in enrollment over the past ten years and, even with this equipment largesse, it was hard-pressed to meet the needs of all students. In order to accommodate the demand, a new building was constructed in 1998 with two technology labs equipped with computers, video conferencing capability, and multimedia projectors for an optimum teaching environment. An extension is needed now and will be built in the near future.

Science teachers wanted to integrate ICT into course learning. Consequently, they worked with students to establish a collaborative project using "First Class" groupware. The EIAT provided a server so that students in a number of high schools in Ennis could work together via First Class. Three of the four secondary SIP coordinators had a science background, so the integration of IT and science was a natural venture. The four SIP coordinators met once a week at the Clare Education Centre to receive training from EIAT staff in First Class, to plan the project, and to monitor progress. Each student was given a password, so they were able to enter the Ennis network and talk with each other on the First Class platform.

Students were able to choose their own topics for the science study, for example, biology, energy, etc. A group of students chose ecology as a focus, and the coordinator arranged for details such as bus transportation necessary for field trips to the nearby Burren,[8] where students studied plants and animals that make their home in and among the megaliths, dolmans, and limestone outcroppings of the lunar-like landscape. The students used digital cameras and scanners to digitize images for the project.

Although they generally worked in groups, students completed individual work as well. The project results and reports were posted on First Class so that students and staff at other schools could read and view them and so that students could comment on each other's work. There was even an area on the First Class space for parents to comment as well. By the time images and PowerPoint presentations were added to the First Class platform, the projects were quite large, so eventually they were burned on CDs in order to preserve the work. During a dissemination day held at the Clare Education Centre, students were able to explain and demonstrate their research.

Funding for the First Class software was made possible through the EIAT office, but yearly fees for the software are unrealistically large and impossible for the schools to fund on their own. First Class is no longer used in the secondary schools, mainly due to the cost of the software updates and the loss of the EIAT project. The SIP coordinator for this secondary school indicated that one of the most valuable aspects of the Schools Integration

Project was the opportunity to collaborate with other teachers. Although it was sometimes difficult to make time for the meetings and to get away from the daily routine, the benefits far outweighed the inconvenience. Special projects were made possible by IT coordinator teachers giving up lunches and breaks, so there was a danger that IT teachers would suffer from "burnout." The SIP teacher who supervised the First Class project had one priority for future sustainability for secondary students' ICT skills: a program where students on the second level could be mentors to younger students in primary grades.

The Special Case of the Travelers The training center for travelers[9] in Ennis is thought to be the most advanced technological education program for a traveler community in Ireland. The equipment is up to date, the software is state of the art, and the computers are networked with students' ongoing work available on the schools' own server. The success of the technology program is due in large part to an energetic and savvy information technology coordinator and an innovative center director. Together they have sought and received grants to fund their evolving technology program. In 1997 the center had two computers, but no one on the staff knew how they worked. Now the school has a current and informative Web site, where students can make contributions, and a self-paced program that is motivational for the adult students. The foundation of the educational program is the Destinations software, which offers training in basic and lifelong skills. In addition, the traveler students use Microsoft Word, Excel, Access, PowerPoint, and the Internet. Through Equalskills.com students are able to test themselves on basic computer literacy; there is also a downloadable tutorial to help students in areas where they need guidance.

Researchers heard from the staff at the center that travelers' education is often marginalized in Ireland. However, through coursework and self-education the staff has learned about technology and has been persistent in advocating for themselves, their clients, and their technology needs. In recent years the teachers and administrative staff have gained the confidence to know what they want and need in technology to use the applications for appropriate educational purposes, and this has made all the difference.

What is the impact of the adult travelers' education program on children's learning? The center has had an ongoing process to include learning units that correspond with the units that the travelers' children would be learning in their own primary and secondary schools. Since quite a few travelers leave school early, often before primary school is finished, focusing on units that might be in the primary curriculum allows parents to be able to help their children with their homework in the evenings. The travelers' center has even sponsored evening homework help programs that parents and children attend together, although these programs are not necessarily ongoing.

The Role of the Library

Children in the Ennis schools are creating their own libraries of digital materials, and teachers encourage the inquiry-based learning that makes these projects possible. However, researchers found no evidence of traditional school libraries or media centers per se in the educational environment in Ennis and, even though some schools did have a library at one time that consisted primarily of a collection of books, in most cases those rooms were taken over to become computer labs. This is an unfortunate limitation for the schools. If the schools were able to have the services of formally educated school library/media teachers, they would be able to sustain a technology education program with the librarian/media specialist serving as a technology coordinator.

On the other hand, the Clare County Library is headquartered in Ennis, and the Ennis branch library is quite advanced in its provision of materials online. A large bank of computers is available for public use, and stand-up kiosks are configured for sending and receiving email. For several years the Clare library has been developing digital libraries of materials previously held in paper form in the Clare study center, an archive adjacent to the De Valera library in the heart of the town. The archive consists of historical materials about the town and county, census papers, travel memoirs, indigenous folk tales, and a history of the Great Famine in the county, among other local history papers and records. After school hours, it is common to see younger children and older students in the library studying; however, the use of the public library does not replace the guidance and teaching that professional school library specialists could give young learners if they were part of each school's staff.

Implications for the Future

Ennis educators have learned many lessons about integrating technology into the curriculum, and children have benefited from the infusion of technology that came to the town in the years of the Information Age Town project. Through primary research, secondary research, and interviewing, children are creating Web-based learning materials. No doubt the computer literate children have a good sense of how technology tools can function to enrich and enhance learning. The future will tell, however, if the Information Age Town can sustain its successes now that the funding flow has stopped.

Issues remain for educators in Ennis. Impressive gains have been made by Ennis teachers in transforming the curricula of primary schools to take advantage of computer and networking technology; however, other innovations are still waiting in the wings. With technology available in most homes, learning does not have to be confined to the classroom or during school hours. Pupils could continue their learning through advanced independent learning modules or through activities designed to reinforce in-school

learning. More student-designed materials could be made available to the community or could be shared among schools. Secondary school teachers could work together to tap student talent in working with historical materials, doing original research, and using network and communication technologies to learn about the world around them.

One of the questions remaining for the Ennis project is how the ongoing needs of a technology environment will be maintained. Information and communication technologies need to be nurtured and sustained with updates, new software, and hardware replacements. Banks talks about the sustainability issue in her essay related to lifelong learning in networked communities: "It is essential that all user groups in a community—the local adult population, young people, education users such as schools, business, industry and community and voluntary organisations—should be catered for in the provision of Internet technology in a form which is affordable and sustainable" (1999, p. 130).

The motivation and skills are now in place among many Ennis educators. Children, too, have become comfortable and enthusiastic about "learning on the screen." If the educators wish to continue to be leaders in information age technology and learning, however, school administrators, teachers, parents, and the community will need to use all their creativity and considerable resources to provide what is needed in training, maintenance, and technology upgrades. The potential is there, and the foundations have been laid. It is for the people of Ennis to decide if they have the will to continue to be the Information Age Town, and if the schools will forge ahead with Information Age teaching and learning.

Acknowledgments

The research reported here was supported by the Rutgers University School of Communication, Information and Library Studies, the Rutgers University Research Council, and Eircom and its Information Age Town office in Ennis, Ireland. The author would like to acknowledge the help given by the people of Ennis in this research. She is particularly grateful to Helen McQuillan, Information Age Town staff; Kyran Kennedy, Director of the Clare Education Centre; and the teachers and principals of the Ennis schools. She would also like to acknowledge the assistance of her colleagues at Rutgers University, Professor Angela O'Donnell, and graduate students Jackie Borys and Larisa Rishkovsky.

Notes

1. The "Celtic Tiger" generally refers to the economic boom and success experienced by Irish enterprise in the late 1990s and the generally "optimistic and affluent attitude of the young" in Ireland (Trauth, 2000, p. 346).
2. Prior to the schools study, the principal investigator had also completed interviews with the Information Age Town's research coordinator and numerous local business people, economic development representatives, and a representative from the Chamber of Commerce.

3. Principals reported that the technology was piled high in their hallways when the computers and peripherals arrived, and schools had to scramble to find rooms, furniture, and enough electrical outlets to provide for functional computer labs. The influx of the equipment was so fast and so plentiful that there was little time to plan for the practicalities.
4. The Irish Department of Education and Science made funding available in 1998 "to foster whole school development in relation to ICT integration by establishing pilot projects in a number of schools, working in partnership with education centres, the community, industry, businesses, and third level institutions" (Irish Department of Education and Science, n.d.).
5. On weekends children take turns bringing the teddy bear, Mr. Seamus, home, thereby involving their families in the school program.
6. Learning Irish was made compulsory in Ireland in 1923 when the Republic of Ireland became an independent nation. Since then, the requirements of written Irish have been modified, but Irish is still required in primary schools, and, in fact, schools that teach all the subjects in Irish have become something of a status symbol for families who wish their children to leave school with a facility in two languages (Power, 2001).
7. The West Clare Railway, Meet the Musician, and Birds in the School Yard projects involved students in Ennis schools as well as schools throughout County Clare. The collaborative projects were created and implemented with the support and consultation of the Clare Education Centre.
8. The Burren is an unusual stone-paved, limestone-encrusted landscape in the northwest of County Clare bordering the Atlantic Ocean. Although it is impossible to grow crops in the Burren, it is said that the grass that grows between the stone there is particularly nutritious for cows and sheep; hence, farmers have their animals graze in the Burren in the winter months when ordinary grassy pastures may not be as lush as in other seasons.
9. The travelers are a group of native Irish who are nomadic people, changing the location of their residency periodically. During the census in 1996, it was estimated that there were 24,000 travelers in Ireland. The travelers have existed on the fringe of Irish society, and they often do not receive the services or benefits that other more traditional elements of society receive (Clans of Ireland Ltd., 2000).

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