Wireless Videoconferencing and Distance learning for Rural Communities: A Case Study

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Abstract: - This case study reports the sociocultural effects of an e-learning infrastructure collaboratively developed by five semi-isolated communities in Newfoundland, Canada. A wireless wide area network provides inter-community videoconferencing and the delivery of online courses to the schools. In response to a changing learning environment, educators and students show they are able to overturn exclusionary power relations and find means for asserting their own authority and power over the technology and the situation.

Key-Words: - E-learning, Distance learning, Videoconferencing, Pedagogy, Education, Power relations

1 Introduction

Canada is the second largest country in the world in total area, which produces unique sociocultural and technological problems associated with a sparse and scattered population. Approximately 90% of Canada's estimated population of over 30 million people is located along its southern border and 33% of Canada's population lives in rural areas, defined as sparsely populated lands lying outside urban areas. Canada has one of the most extensive technological infrastructures for e-learning in the world. High-speed broadband connections are rapidly being extended from urban areas to include rural settlements. This paper addresses one case of how increasing connectivity, the provision of e-learning through wireless internet and videoconferencing to five rural settlements produces unanticipated sociocultural effects, creating new patterns of interaction and shifting power relations.

The fishing villages in this case study are located on the south coast of Canada's easternmost island of Newfoundland. A 500 year history of European ocean fishing along the mountainous Newfoundland coastline evolved over time to produce numerous scattered harbour villages nestled between the mountains and the sea. The south Newfoundland islands and coastline were first settled by fishers from France in the late 1700s and were followed soon after by English-speaking peoples. People from the various scattered locales gradually resettled into the five larger communities of our study, forming the traditional fishing outports

of Burgeo, Ramea, Grey River, Francois and Grand Bruit. Salt cod for the European market was the economic mainstay for these communities until the demand dropped off in the early 1920s. The local fishers turned to the inshore fishery and fresh fish processing plants. A government scheme for resettlement in the 1950s and 60s, increased the population of the five communities and commercial fishing trawlers flourished through the 1960s and 70s, until the rapid decline of fish stocks in the 1980s. By 1992, the commercial fishery had essentially become extinct and a moratorium on cod was enacted. A 500 year tradition of exploiting a single economic resource, the cod fishery, had come to an end [5].

The people of these outports who share a heritage, common locale and homogeneity of economic activity often develop a strong sense of community. Individuals express their attitudes about the future implications of e-learning as common community concerns. For example, one of the school principals discussed the possibility that e-learning might lead to a loss of teachers by stating "that's a real fear here in this community" and by referring to the School Board members as the decision-makers who are outside of the community. Not all of the people living in these places feel they belong to them. The schools have difficulty attracting qualified teachers who are willing to work in such semi-isolated conditions, and these teachers may stay only for short periods of time without developing a sense of belonging. For those who do feel they belong, there is a strong bond that continues to tie them to these communities even

after they have migrated to other parts of Canada. One teacher stated, "they say that Newfoundlanders are always longing for home. I don't know why because I have never had to leave, but if I did [leave] I would feel much the same way."

2 Problem Formulation

By 1992 when the cod fishery collapsed, the information and communications technology (ICT) industry was becoming well-established in Canada and world-wide. A knowledge economy was rapidly replacing resource-based economies and soon network construction in Canada was being accelerated to make broadband connectivity available to every family. In 2005, in Canada as a whole, 72% of households in larger communities and 41% in smaller communities have high-speed internet access, with the majority being through cable connections, followed closely by DSL (digital subscriber line) [6]. These cable and fixed-line DSL options are not, however, technologically feasible solutions for remote island and harbour-based communities. An alternative means for providing connectivity was created through the construction of a wireless wide area network (WWAN) shared among the five coastal communities of Burgeo, Ramea, Grey River, Francois and Grand Bruit. These communities have a combined population of approximately 3000 people, with a steadily decreasing number of students in K - 12 schools, 312, due to the out migration of young adults in search of employment. The WWAN is cooperatively managed by the Burgeo Broadcasting System (BBS) and provides high speed Internet access and videoconferencing capabilities to support the e-learning, health, business and entertainment needs of community members, known as the ICT project. It consists of fixed microwave radio antennas on a series of towers located on the mountaintops and powered by wind and solar energy. The radio antennas use frame relay and transmit the wireless signals through uninterrupted lines of sight across the water to the five communities.

The commonly shared local belief expressed by a teacher is that "if you recognize a community as being a community … there are certain basic rights and one of them is the right to an education." In this case, that right to an education is being addressed by a technological solution to isolation and a declining population - the broadcast of e-learning technologies across the mountaintops and into the schools and homes of these traditional fishing communities. This movement towards a borderless, virtual learning environment changes the social context and creates new patterns of interaction and power relations that in turn are changing how people make meaning of, and live in their communities.

2.1 Research Methods

Canada's Social Sciences and Humanities Research Council (SSHRC) funded a three-year project in participatory research to investigate the effects of the BBS ICT project on economic conditions, health and education in the five participating rural communities [2]. Ethnographic research techniques of observational field notes, interviews, and text analysis was used to learn about the community and organizational context and to explore the participants' meaning-making. 22 semiformal interviews of approximately one hour each were conducted with students, educators, parents, community health workers, nurses, the general public, and the technology coordinators. The research team as a whole made repeated trips to each of the five communities and conducted over 80 interviews. Each interview was audio taped, transcribed and returned to the participants for verification.

This paper focuses on the findings in the K-12 education system and the introduction of two separate e-learning initiatives, (a) the uses of interactive videoconferencing technology installed and managed locally through the School District and the BBS and (b) the uses of web-based distance learning technologies, provided throughout the province by the government of Newfoundland and Labrador (NL) and delivered through the BBS WWAN. I draw the data mainly from the public school students and educators and related locations, such as the health clinics and public libraries where students access the Internet and videoconferencing equipment. For analysis and interpretation, and for the purpose of developing descriptive themes, I used a process of data coding to identify common patterns and idiosyncrasies. Learning is a situated activity that takes place within a sociocultural context and the selected themes depict the effects of e-learning on the peoples of these rural communities.

2.2 E-learning infrastructure

E-learning that crosses the boundaries of rural communities by connecting schools with teachers

and students in neighbouring communities is provided through videoconferencing technology. Videoconferencing equipment is located in teachers' classrooms in the two larger schools of Burgeo and Ramea to enable them to instruct classes of senior-level courses, such as Biology, Mathematics, Physics, English, and Workplace Safety, and elementary-level French and Music to students in the smaller communities of Grey River and Francois. The courses are selected by the students in the smaller communities based on a combination of teacher availability, graduation requirements, and interest. The teachers instruct a class of students while the video camera is remotely controlled by students in the other community, who attempt to track the teachers' movements within the classroom. A microphone is located centrally in the instructional classroom to pick up the teacher's and students' voices, while the speakers are located on the trolley with the videoconferencing computer and monitor.

E-learning that crosses the boundaries of rural communities by connecting schools with teachers in urban centres is provided by the STEM NET Centre for Distance Learning and Innovation (CDLI), which was founded in December 2000 by the Newfoundland Department of Education. It is a centralized educational service provided in partnership with a number of other organizations. CDLI provides online professional development programs and resources for teachers and free email services for teachers and students. It also provides 23 of the Newfoundland and Labrador senior level courses as "e-courses" for students who wish to participate in online learning. The teachers for these courses are known as "e-teachers" who are trained in the pedagogy of distance learning and are centrally located in larger communities to communicate with students mainly through the Internet using interactive audio and text-based communication, in real-time and asynchronously. Student assignments are submitted as email attachments and by posting to the CDLI website. Each school where CDLI courses are provided designates one or more local teachers as "m-teachers" or technological mentors to help students who experience technical difficulties. The m-teachers are not expected to provide help with curriculum content.

2.3 Sociocultural effects of e-learning.

The introduction of virtual learning environments into rural communities through internet and videoconferencing technologies influences how community members make meaning of their situations and changes the organizational structures and practices of teachers and students, as well as the community-at-large. E-learning is not a simple solution to the problems of small, isolated schools and decreasing student demographics. There are multiple interpretations and responses as people continue to construct their understandings of what e-learning means for their lives and their communities.

2.3.1 Institutional support

The teachers who are assigned to teach in front of the lens of the videoconferencing camera are not volunteers; they are required to teach a larger class load of students, those who are physically present and a smaller group of virtual students through videoconferencing. There is no provision for increased salary or other rewards for instructing the virtual students. Other than a short technological training session to orient teachers to the use of the videoconferencing equipment, there is no additional support provided. The instructing teachers did not welcome the added workload or the stress associated with learning to use a new teaching tool.

In the receiving schools, presented with organizational changes introduced by others, there is evidence of feelings of resentment and concern about the introduction of this technological solution for the problem of a decreasing student population. Some teachers and school administrators expressed a belief that the government's intention is to reduce the teaching staff for public schools in small communities, as teachers were being shown to be replaceable through e-learning. As a precaution, these concerned educators are turning to their provincial teachers' association to elicit support and protection to preserve their jobs. These educators' sense of community is being eroded by strengthened alignments with external organizations and increased politicization.

At the same time, other teachers in the recipient schools welcome the interactive online and videoconference delivery of secondary school courses as the only feasible means for providing specialist instruction to a dwindling number of students. For these teachers, e-learning means a reduction in their workload as they no longer have

the responsibility of instructing courses for which they are not adequately trained.

2.3.2 Student responsiveness

The recipient students in the smaller schools do not have a teacher physically present in the room while they take e-learning courses. Virtual teachers instruct through the local community WWAN of interactive videoconferencing courses and the provincial network of CDLI online courses. Teachers, who previously had responsibility for all of the students in the school, now have a reduced sense of responsibility for the e-learning students. They do not see the students taking e-courses as belonging to the school community in the same way.

Students who previously had to leave their communities after Grade 10 to complete their final two years, can now continue to live at home with their parents and complete their Grade 12 education through e-learning. An increased amount of individual student responsibility is required for the students to succeed in these courses. The relationship between a student and a teacher is a significant factor in the academic achievement of a student. These relationships take on a different quality when they are virtual only. These students and virtual videoconference teachers live within 20 to 50 kilometres of each other, but there are inherent dangers in transporting students by ocean ferry to neighbouring communities, so it is rarely done. There are no organizational incentives for the e-learning teachers to travel to visit their virtual students. Students' sense of community is also shifting as they are learning to build virtual relationships outside the geographic boundaries of their local communities.

As noted by other researchers, not all of the students taking e-learning courses experience academic success [7]. One teacher predicted that only one of the nine students taking an e-course would receive a passing grade. The students who were experiencing difficulty attributed it to an inability to follow the teacher's instruction. They could not hear a teacher when his or her back was turned to the microphone and could not always read the instructions and diagrams on the blackboard as the students who controlled the camera tended to move it at their own learning pace. These same students chose to move their desks out of camera range and to not ask questions of the teacher, refusing to belong to a virtual learning community.

2.3.3 Instructional roles

While the technological skills required to operate the videoconferencing equipment are minimal, the changes required in pedagogical practices are considerable. The limited training provided for the broadcasting teachers was solely technical. They were not provided with any information about the pedagogical implications of integrating virtual students with an existing class of students. The professional development of teachers in Newfoundland is managed by the provincial Department of Education and the school districts. Individual teachers can express their needs in an annual school plan, but the decisions and coordination of professional development is done centrally.

The teaching perspectives of the videoconferencing teachers varies, some supervise students' progress through workbooks specifically designed for a course, others focus on the transmission of content knowledge, and still others use the technology more interactively for language acquisition, but are hampered by the challenge of poor audio and video signal quality. There is no evidence of teacher planning to support constructivist learning by addressing the four themes identified by research to improve K-12 teachers' skills for applying technology to teaching and learning (a) synchronous connections, (b) student questioning, (c) student learning presentations and (d) student interactions on authentic activities [3]. One teacher stood immediately in front of the video camera and monitor and spoke directly to the students located in the other community, referring to them by name and personally greeting each one, while seemingly ignoring those students who were present in the room. Another teacher placed the trolley of equipment at the back of the classroom and concentrated on teaching the full class of students who were physically present, while seemingly ignoring the camera that broadcasts instructional activities to a remote classroom of six students. The teachers and students also tend to treat the video equipment as a separate instructional technology for the specific purpose of transmitting video and audio signals and do not integrate it with other technologies, such as email and instant messaging. Because there are no other computers located in the instructing classrooms, the students produce their

written assignments on paper and deliver them to their teachers by ferry rather than email. Efforts to consciously build new learning communities that integrate virtual and non-virtual students into a coherent whole are not readily apparent.

2.3.4 Family and community

Some of the parents in the communities actively contribute to the learning of their children. In one of the smallest communities, only one videoconferencing station exists, located in the hallway of the community health building a few blocks down a steep hill from the school. The mother of one young student voluntarily opens the building, moving the trolley with the teleconferencing equipment into a side room, and arranging the room for the arrival of three elementary students to participate in a French lesson being conducted by a virtual teacher in a neighbouring community. The mother stays to help the students while also providing care for her pre-school child. The videoconferencing equipment in this community has yet to be used for medical treatment purposes, but its availability for health care is deemed to be a higher priority than education.

Attitudes toward the use of the videoconferencing vary greatly. One mother informed me that she and her husband had decided to move the family out of the community to a large neighbouring city so her daughter could take her Grade 12 education in a school that provided sufficient teachers for face-to-face instruction. She said she values quality education and does not want her daughter to have less than what she deserves. Another couple said that they are pleased that their children graduated before the videoconferencing and online learning came into the schools, as their children were sent to board with relatives in larger communities for their Grade 11 and 12 years. They believe this helped to ease their children through the transition from a rural to an urban setting. The two daughters of this couple also spoke positively about their experience of relocating and staying with relatives during their last two years of grade school. They said that the students who now complete their education in the community through e-learning technologies and go directly from their small fishing villages to attend university, or other post-secondary education, experience a greater sense of culture shock and are more likely to develop problems with alcohol abuse and depression.

3 Problem Solution

The educators and students demonstrated self-reliant and adaptive methods for either integrating the e-learning technologies into their practices, or isolating them. The larger decision to create the technological infrastructure had been made by School Board members who were perceived as outsiders, but the smaller decisions as to how they are used for teaching and learning are made by the people who use them. This case illustrates how issues of user power and control are central to the implementation of e-learning.

3.1 Changing Relationships

At first, there appeared to be few conscious efforts to integrate the videoconferencing capabilities into the teaching and learning processes. Soon, however, both teachers and students were regaining their sense of control by adapting the technologies to their purposes. These finding provide examples of teachers and students' purposeful adaptation through the control of the transmission of video and audio signals by both the senders and receivers.

3.1.1 Teachers

While there is no formal program of professional development to familiarize teachers with the pedagogy of teaching with e-learning technologies, the teachers demonstrated adaptive strategies for using the technology for their own purposes: "There is training, but most of the training is done through informal methods. People show one another. Actually, I have a caveat that you really can't train people, people have to learn themselves. I think that this community is proof of that. No one was really trained but they have all learned rather well from one another. There are people here that can do amazing things with computers. So they have embraced them as part of their lives." Examples of this adaptability are the school teachers in one of the larger communities who have applied for and received funding for 28 different GrassRoots projects (a source of government grants ranging in value from $300 to $10,000 that are awarded to educators who want to develop their ability to use ICT to facilitate learning). While teacher training is advocated by researchers as essential for successful implementation of distance learning [1], in the absence of formal training, these teachers found ways to maintain their positions as experts within their communities through informal learning by

creating school websites and producing interactive videoconferencing projects.

Even the teachers who resent the intrusion of the new technologies showed evidence of being able to re-establish their sense of control. One of the teachers, who the students described as never having previously moved the remotely controlled camera, changed the camera angle so it included the researchers sitting at the side of the room. Another teacher who had provided students with instructional tasks they could complete independently, did not bother to connect with the virtual students, or to reconnect when the signal was interrupted. These teachers maintained their sense of power and authority by allocating the new technologies to the back corners of their teaching and learning practices.

3.1.2 Students

The e-students who do not have a teacher physically present also developed strategies for becoming self-reliant learners by organising their classroom activity. Specific students took on various roles, such as rearranging the desks, dialing the connection to the transmitting classroom, and using the wireless keyboard to track the teachers' movements. This was done without discussion or confusion and were obviously well-established routines that demonstrate student responsiveness. The actively engaged e-students would turn their microphone on and off so they could not be accidentally overheard while talking among themselves, but could ask questions when they wished. They also turned off the speaker when the teacher was not instructing, to eliminate the background noise. They monitored the video signals being transmitted to the teacher by watching the movement of the camera when using a full screen, and by using the picture-within-a-picture feature. Some e-students consistently took the lead and sought opportunities for virtual interactions while others chose not to directly engage with the technology, moving outside of the camera range.

The students in an instructing classroom who sat close to the speaker on the trolley helped the e-students by alerting the teacher when they were trying to ask a question. Some of the e-students who were reluctant to ask questions for fear of being teased by the classroom students were able to gain control of the situation by quietly getting the attention of a cousin who sat next to the speaker and was willing to ask the questions on their behalf. When disconnected, the e-students would repeatedly

dial the teacher's videoconferencing station, but if the computer's power had been turned off, it would not respond. The e-students would then telephone the school to ask one of the classroom students to turn the computer on so they could re-establish a connection with the teacher. These student-teacher interactions took place in the seeming absence of any of the recommended "culturally-embedded scaffolding that invites and supports them to enter into an e-learning environment," [4]. This case illustrates how some e-students, like their teachers, are able to overturn exclusionary power relations and find means for asserting their own authority and power over the technology and the situation.

4 Conclusion

E-learning affects the sociocultural context. People who welcome these technologies as a means of maintaining their communities need to be aware that moving from locale-based to virtual communities has consequences for organizational roles and shifting power relations that reach far beyond the classrooms and schools.

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