Perceptions of an impending high speed, broadband network: Anticipation and anxiety among K-12 teachers, technical support personnel, and administrators

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Abstract

The purpose of this study was to solicit educators' perceptions of a high speed, broadband network being built in the Canadian province of Alberta, the *Alberta SuperNet*. We interviewed eight administrators, teachers, and technical support personnel in six Kindergarten-to-Grade 12 (K-12) schools that concentrate at teaching at a distance. They perceive the coming network with a mixture of anticipation and anxiety. They anticipate enhancing teaching and learning opportunities with multimedia learning objects and synchronous interaction on a faster, more reliable network. They are anxious about its associated costs, its compatibility with their existing systems, and its demands for sophisticated technical skills. This study is part of a larger, multidisciplinary SSHRC-funded project examining the affect of the Alberta SuperNet on several aspects of Alberta society.

In 2000, the federal government of Canada announced a four billion dollar plan to build a high speed, broadband Internet throughout Canada (National Broadband Taskforce, 2001). Amidst much criticism (and a key ministerial change), the plan was set aside. Convinced of the appropriateness of the plan, our provincial government took on the segment of the plan that applied to Alberta. As of this writing, the *Alberta SuperNet* is nearly complete. A central part of our government's justification for the network is its role in enhancing and extending educational opportunities. As the SuperNet was about to arrive at their doors, we talked to administrators, teachers, and technical support staff in several of Alberta's Kindergarten-to-Grade 12 (K – 12) *distance schools* to ascertain their perceptions of this coming network. (In this paper, *distance schools* refer to schools that undertake all of their programming at a distance through a variety of electronic and paper based technologies.) In the subsequent pages, we will report their anticipations of how it will enhance their current practice by allowing them to use bandwidth intensive applications (e.g., videoconferencing and multimedia learning objects), and their anxieties about increasing expenses, training requirements, and conflicts with existing social and technological systems.

Literature Review

The provincial government describes the Alberta SuperNet as "a high-speed, high-capacity, broadband network linking government offices, schools, health-care facilities and libraries" (*Alberta SuperNet Project, 2002*, ¶ 1). In addition to these sites, the government hopes that Internet service providers (ISPs) will take advantage of the network and make broadband access to the Internet available commercially to private residences.

One of the provincial government's hopes for the project is that it will end the disparity between rural and urban students in Alberta. Access to broadband, they argue, will help rural students collaborate, access better course content, and learn the technical skills required for successful futures (*Alberta SuperNet Benefits - Schools*, 2002, ¶ 1). Access to new technologies, however, is not always followed mechanistically by enthusiastic implementation.

The research-design-diffusion paradigm (Burkman, 1987) offers one way of thinking about the introduction of a new technology into a setting. Theories of adoption and diffusion arising from this paradigm can help explain and predict the factors that impede or facilitate the diffusion of innovations. Surrey (1997) has grouped these theories into two types, developer-based and adopter-based.

Developer-based theories

Developers assume that people are predisposed to adopt superior technologies. In educational settings, the specific assumption is that "the best way to bring about educational change is to create a system or product that is significantly superior to existing products or systems" (Surrey, 1997). This assumption is discernable in our government's conceptualization of the Alberta SuperNet.

Rogers (1995a, 1995b) developed some of the most prominent developer-based theories of adoption and diffusion. His theories address four issues, including 1) the innovation decision process, 2) individual innovativeness, 3) rates of adoption, and 4) the perceived attributes of an innovation. A brief description is all that is required of these influential theories. Innovation diffusion theory describes how diffusion occurs over time as potential adopters go through stages of knowledge, persuasion, decision, implementation, and finally, confirmation. Individual innovativeness theory explains why some individuals adopt a new technology earlier than others. The rate of adoption theory represents diffusion occurring over time in an s-shaped curve—adoption begins slowly, accelerates, then hits a plateau. Rogers' fifth theory, perceived attributes, states that potential adopters evaluate innovations based on five qualities: their relative advantage over existing technologies, their compatibility with existing social systems, their complexity, triability, and the observability of their impact. Rogers' theories are influential in understanding why individuals do or do not adopt a technology that is demonstrably better than the one they are using currently. In our study, we are concerned with an innovation that has not yet materialized; therefore, we focused on the perceptions of potential adopters. Thus, Rogers' theory of perceived attributes seemed most relevant, and we began with a look at empirical applications of this theory.

Surrey and Gustafson (1994) interviewed 29 potential adopters of three computer based learning modules to determine their perceptions. They concluded that compatibility, complexity, and relative advantage were important considerations when introducing an innovation into instructional settings. Hamilton and Thompson (1992) studied early adopters of Idaho's Electronic Educational Exchange (EEE), an electronic communication exchange for teachers. They found that the characteristics of early adopters' perceptions were compatible with the perceived attributes of the EEE. Lewis and Orton (2000) interviewed 63 IBM mangers after a 50 week innovative on-line course. They found that relative advantage, compatibility, complexity, trialability, and observability were more important predictors of the effectiveness of the e-learning innovation than students' learning preferences. Moore (2004) found that the theory of perceived attributes offered a satisfactory explanation of the implementation of a performance technology. In Brazil, researchers studying the adoption of the Internet in foreign language schools found observability and triability were predictive of adoption (Martins, Steil, & Todesco, 2004). Dozier (1985) studied the adoption of electronic text in higher education institutions in laboratory settings. He found a causal model of relationship between perceptions of relative advantages and risk, compatibility, complexity, trialability, and observability that affect the adoption or the rejection of electronic text as an innovation. Rogers' theory of perceived attributes is useful at explaining the diffusion and adoption of a variety of innovations in an array of settings.

However, as Surry's designation reveals, *developer-based theories* emphasize the perspective of an innovation's designers. If an objectively superior technology is not adopted, developers single out the adopters as the problem. In the context of educational innovation, teachers are often blamed for not adopting technology because they lack the access, knowledge, or skills to use technologies effectively (Cuban, 1996). Developer-based theorists believe the situation can be corrected by providing better equipment and training. *Adopter-based theories*, alternatively, emphasize the perspective of the potential users with a focus on the social and cultural aspects of diffusion.

Adopter-based theories

Cuban (2001) is dismissive of pejorative characterizations of potential users, teachers in particular, and offers the following argument that typifies adopter-based arguments: "Policy makers and administrators need to understand teachers' expertise and their perspectives on classroom work. They need to engage teachers fully in the deliberations, design, deployments and implementation of technological plans" (p. 183). Applied to educators in Alberta's distance schools, this perspective would position them as the ones who will ultimately accept or reject the SuperNet and its corresponding educational technologies. As Shuldman (2004) reminds us, the challenge of implementing any innovation involves many factors that are not related to technical superiority. Szabo and Sobon (2003) expected a slow, non-revolutionary adoption of technology in one university because faculty and administrators were not utilizing "methods from successful diffusion of past innovations (e.g., vision, leadership, empowerment) in a systematic way to guide the change process. They also point to a myriad of individual issues and challenges faced by the stakeholders in a research university with respect to the diffusion of the instructional communication technology innovation. G. E. Rogers and Mahler (1992) surveyed 80 teachers to learn about teachers' feelings, perceptions and attitudes as they consider the use of technology education innovations in their curriculum. Rogers et al. found that school size, teachers' feelings, and the lack of in-service training can contribute to the acceptance or lack of acceptance of education technology. P. Rogers (1999) studied 1000 art teachers to identify barriers to technology adoption used for learning in computer-based art classes. She found that the needs of the institution in terms of teaching and learning need to be determined before educational technologies are chosen. In opposition to developer-based theorists, Burkman (1987) argues that effectiveness and efficiency in performance are not the only attributes that potential adopters consider in judging new products. Successful developers he argues 1) identify potential adopters, 2) measure the relevant perceived needs of the adopters, 3) design and develop effective and efficient products, 4) inform potential adopters about their product, and 5) facilitate the implementation of the product with moral, tactical, training, and material support. Working from an adopter-based perspective, Jacobsen, Clifford and Friesen (2001) observed that technology is rarely integrated seamlessly into educational settings. They note that visions for technology often come from ICT specialists rather than educators, and they stress that teachers will take advantage of a technology only once they perceive a need.

Diffusion theories, both developer-based and adopter-based, provide a means of understanding what will happen in our K – 12 distance schools as the SuperNet spreads throughout the province. Developer-based theories are consistent with the provincial government's position: a fiber optic, high speed, high bandwidth network is better than the current twisted pair, dial-up network, and it is better than the unreliable and expensive satellite network. Therefore, the SuperNet and its associated educational technologies will be adopted quickly, widely, and seamlessly (given the proper training and support for users). Adopter-based theories, alternatively, should be consistent with the educators' perspectives: The SuperNet and its corollary technologies will be accepted only if the educators are currently experiencing problems, which the SuperNet has the potential to solve, and if they are consulted on its development and implementation.

The purpose of our study was to seek educators' perceptions of the approaching SuperNet, and to try and situate these in the discourse of the adoption and diffusion of innovations.

Method

To these ends, we conducted semi-structured interviews with four administrators, two teachers, and two technical support staff from six of the twenty K – 12 schools in Alberta that concentrate on teaching at a distance. These six schools were chosen from the respondents of a prior survey that gathered information about the distance course delivery, student and teacher support and technology utilization at Alberta's K-12 distance schools. The survey was sent to all twenty of Alberta's K-12 distance schools; there were only seven survey responses. Information from the survey provided background information about the participating schools.

Our participants were from schools that spanned the entire province. Student enrolment at these schools ranged from 100 to 20,000. Figure 1 illustrates the connectivity, student locations, delivery mode, student age, and enrolment at each of the six schools. At one school, students attend community learning centers; at another, students learn at

home. At the other four schools, there was a mix of home-based and school-based students. Five of the schools accommodate rural home students with dial-up. At one school, the First Nations learning centers have satellite broadband with on-site tutorial support.

School	Connectivity	Student Location	Delivery mode Online or correspondence	Rural/ Urban	Student Age	Population size	Exceptional Traits
A	Dial-up	home	Either	Both	K-12	325	
B	Satellite broadband	Learning center	On-line	rural	Grade 9-adult	300	Aboriginal learners
C	Dial-up	Home or school	Either	rural	K-12	350	
D	Dial-up and Broadband	Home or school	Either	Rural and urban	K-12	20,000+	
E	Dial-up	school	Correspondence	rural	Grade 9-12	100	
F	Dial-up	home	On-line	Rural and urban	K-12	1,800	

Figure 1: Characteristics of the schools at which our participants worked.

Each interview ranged from 30 minutes to 2 hours. During the interviews, we asked the participants to describe their situation (student characteristics, program scope, current technology), to describe how the Internet was being used, and to reflect on how the *SuperNet* might affect program quality, diversity, and cost effectiveness. Proximity permitted us to conduct three interviews face-to-face. The other five were conducted over the telephone. The face to face interviews consumed more time than the phone interviews. Each interview was recorded and transcribed. For analysis, we used the techniques described by Strauss and Corbin (1998) (though we were not attempting to create a grounded theory). We listened to the recordings of the interviews, read through the transcriptions, made marginal notes, and identified commonalities to gain an understanding of the participants' perceptions of the *SuperNet* on their day-to-day operation. We then presented the participants with our provisional analysis and asked them to comment on the accuracy, completeness, and appropriateness of our interpretations.

Results

The following section summarizes the key perceptions the administrators, teachers, and technical support staff have about the pending arrival of the *SuperNet* and the broadband technologies it will facilitate. Participants anticipate that the *SuperNet,* with faster and more reliable data transfer, will enable them to enhance their existing programs with synchronous interaction and multimedia learning objects. However, the participants expressed anxiety about the cost, compatibility, and complexity of the new system (See figure 2).
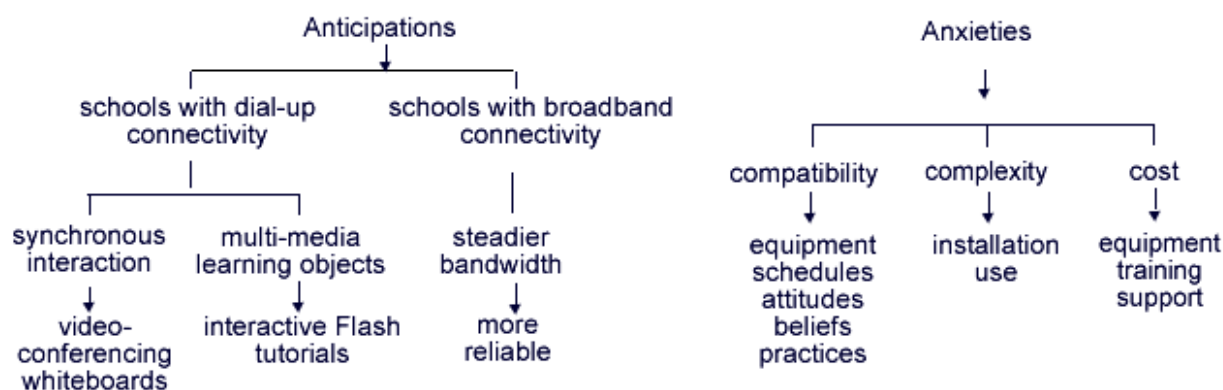
Figure 2: Administrators, teachers, and technical support personnel's perceptions of the Alberta SuperNet.

Anticipations

Teachers, technical support staff, and administrators anticipated the SuperNet would allow them to enhance their current systems with bandwidth intensive educational technologies. Technologies such as web-based video- and audio-conferencing, they felt, could be exploited to provide students and teachers with better opportunities for interaction. Streamed videos and interactive Flash lessons were also cited as possible enhancements to their programs.

Synchronous interaction: Some of the benefits that they attributed to these enhancements included connecting distant students to face-to-face classrooms and expert teachers. Our participants discussed the current challenge of not always having subject matter experts in rural schools. Video-conferencing is anticipated to deliver specialists into rural classrooms. One administrator said:

> My understanding of the *SuperNet* is that it's going to make videoconferencing work. To give you an example we have a math specialist here who does high-level pure mathematics. We can have our teacher here deliver a full-blown mathematics lecture by videoconferencing to a rural school that can't get their hands on a Math teacher.

Another important benefit that the participants associated with synchronous interaction was reduced attrition. Three of the administrators observed higher completion rates in courses with synchronous interaction when compared to their traditional paper-based correspondence courses. One administrator emphasized, "the most successful number of completions is synchronous online and the highest dropout rate occurs in paper-based courses."

Another synchronous interaction technology that would be enhanced by broadband was whiteboards. Web-based whiteboards are a form of graphic conferencing used in combination with audio communication, which emulate writing or drawing on a blackboard. Participants were eager to discuss the importance of whiteboards to their existing programs. An administrator at a school using whiteboards reported, "We really like our synchronous whiteboard. It is really simple, really easy, and very effective." A technical support person at a school with dial-up connectivity agreed: "We have been using whiteboards for math classes for the past couple of years. Kids can see the teacher solving problems right on the screen."

Importantly, these projections were dependent on the students also receiving high bandwidth access, which, it is important to note, is not a central part of the governments' SuperNet plan. Educators at five of the eight schools reported having rural student populations with dial-up. Data transmission rates for dial-up top out as 56.6 kbps. In comparison, the transmission rates for SuperNet broadband is between 6.5 Mbps and 26 Mbps, which is 100 to 4000 times faster (Project - technology, 2002). Participants spoke of how students' connection speeds limit their access to resources. In schools where the students use dial-up at home, download times restrict the types of resources that educators include in delivery.

Multimedia learning objects: Once all participants are connected to the SuperNet, teachers will be able to include high-bandwidth files in their delivery. As one technical support person told us, "Right now, we can't use things like video streaming because of bandwidth limitations. Hopefully, the SuperNet will change that, but at this point were pretty much stuck."

A home schooling teacher added:

We've kept our web content very basic because we have quite a few rural students. You have to consider working with low bandwidth and downloading stuff; they don't have high-speed in rural areas. It gets really tough to put interactive things on the site.

Alberta Learning, our provincial ministry of education, has developed on-line resources for teachers, including multimedia tutorials. However, teachers are reluctant to include these resources in their delivery because it difficult to download these interactive resources on dial-up. Inequities will continue for rural, home-study students until Internet service providers make high speed available to individual homes.

Reliability: Two of the eight schools were currently using satellite broadband. Educators at these schools did not anticipate the SuperNet making a difference in their bandwidth, but they expected it to provide more reliable service. Several factors can degrade the performance of a satellite broadband connection including, bad weather, local interference, or a misaligned dish (*Everything You Need to Know About Broadband*, 2001).

To summarize, there are several anticipated benefits to the arrival of the *SuperNet*. The *SuperNet* will increase video-conferencing opportunities, allow for multi-media content to be incorporated into courses, and provide more reliable bandwidth for schools already using satellite broadband. However, the integration of educational technologies that exploit broadband is reliant on the fact that all students studying at home need broadband access. While administrators, teachers and technical support personnel expect the *SuperNet* to enhance their existing programs, not all of their perceptions are optimistic.

Anxieties

The optimism for the SuperNet was balanced by the anxiety invoked by the limitations of high bandwidth technology. Perceptions of the implementation of any new technology, including SuperNet was constrained by concerns about compatibility, cost, and complexity. The following section will discuss each of the perceived constraints.

Compatibility: Conducting a synchronous session requires all users to have compatible hardware, software, and schedules. For a video conferencing session, each participating location requires a compatible computer, camera, microphone, video screen or monitor, and sound system. The computers must be relatively new, medium to high powered, and require compatible operating systems and video conferencing software. An administrator expressed his frustrating experience using matching systems:

It would be wonderful if everybody hooked up to some type of compatible system. It really has to be consistent all the way through the organization. That's the main concern—consistency… There's nothing more frustrating than having five groups together and having two sites get bounced out all the time. They just get angry and frustrated. They wonder why they are getting bounced out and not everybody else. All those things have to be taken into consideration.

Technology is just one element that needs to be consistent across settings. Connecting different schools in curriculum-specific synchronous sessions require synchronizing the schools' schedules. Each participating school would need to have, say, Math 30 on the same day at the same time. An administrator discussed the logistical issue of getting students in different school divisions on the same timetable:

It creates a whole bunch of logistical concerns because we need to build common timetables. It means getting every school in the division on board. It's going to be a heck of a challenge for the next few years for sure.

Teachers also talked about anxieties among parents toward new technologies. The religious and political attitudes of the parents may prevent students from accessing ICTs such as the Internet. One teacher taught to the children of Hutterites (a group with strong religious convictions and who live communally). This teacher said:

I don't know if people in the Hutterite colonies are going to embrace the technologies…. We teach to lots of different types. To a lot of home-schoolers the *SuperNet* might seem like government intervention. Although most of us in Alberta are pretty mainstream, some home-schoolers are paranoid about that kind of thing, and they may not be willing to let the government into their house.

At one school, a technical support person observed that parents were concerned with being able to supervise their child's progress. Some parents prefer paper-based courses because they allow them to monitor their child's work habits and progress. The technical support person observed, "Probably sixty percent of our enrolment is in print-based courses because the parents want to monitor their children. If you have a book laying there open and an assignment booklet that's not done, the parents can see that."

Another potential problem was the compatibility between the technology and stakeholders' attitudes. At one school, past mistakes with technologies have made people resentful. An administrator at a school that was getting ready to implement video conferencing said:

There is a barrier within our division toward technology because we have spent a fair bit on technology which has sometimes worked and sometimes not worked. In the past our focus has been on equipment rather than people and so that has left a sour taste and some people's mouths.

Costs: The cost of the equipment for e-learning technologies was another concern. Not all schools can afford the technologies. One of the schools received provincial grants to purchase expensive videoconferencing and whiteboard technologies. The schools administrator explained:

We have equipment because we got a massive grant. We would not have done this if we didn't. How are other schools doing this? Did they get grants? Are they having to dig into their own pockets to get the software and hardware?

Another administrator discussed how declining student populations correlated to less teaching positions. His school did not have provincial grants for purchasing desired video conferencing systems. He explained that the upfront cost of the videoconferencing technology would be acquired through staff cuts:

There is going to be an upfront cost but we're hoping that the upfront cost will be turned many times over in the fact that we won't have to have as much staff within the school division to meet the needs that we presently have.

The parents of home schooled children absorb the costs of technology in their homes. Costs are incurred because students need software and hardware that is consistent with their school's to participate in on-line courses. Four of the sampled schools use whiteboards for their home students. To participate in synchronous whiteboard sessions at home, students require a suitable computer and a graphic tablet that allows them to draw on the screen. At one school, the tuition for on-line synchronous courses is more expensive than the tuition for print-based distance courses. An administrator from this school said:

One of the problems is that we charge [90% more] for online course tuition than print course tuition. At this point in time the online kids get more of a Cadillac service. They pay more to start with so that's why they get those little extras …The kid also needs to have the same equipment set up as our teachers. Graphic tablets cost $150. If the kid is going to do a whole bunch of synchronous courses, their parents will just buy them one.

The cost of the educational technologies associated with broadband delivery caused anxieties for all involved in online schooling. Computers, peripheral hardware, software, multimedia, and bandwidth have costs that are compensated through possible grants, school budgets, and parents. Once technology is available to a school, installing it and learning to use it create additional anxieties.

Complexity: An administrator at another school is content with his technological system since every thing is working well. He is concerned that as the complexity of the enticing new technologies increases, there is more chance for the system to break down. This administrator said:

One thing we decided from the beginning was not to be seduced by new technology. We don't want all the bells and whistles. We'd rather keep it simple. We know that the more complex it gets, the more broke it's going to get. So we don't want to put in a bunch of fancy stuff. We want to deliver quality type material that doesn't have a lot of flash or videos.

Participants expressed anxiety about the lack of technological professional development and the expectations to learn new technologies on their own. An administrator lacking technical support staff lamented, "We have an $18,000 screen sitting in a warehouse because we have no one to hook it up." He continued, "My background is as a home-room teacher and counseling. I am very technologically inefficient."

Technically savvy teachers with full teaching workloads are often expected to help the other less technically savvy teachers. One teacher observed:

It is an objective within our school for professional development. But we do not have the funds right now to do this …We have some people that are really computer savvy in our program, and they can help people who are not.

At another school, teachers do have basic personal-computer skills. One teacher explained:

Our teachers tend to come in with little background in distance education, and they need a little more training. They are not on top of their computer skills. There is a lot of computer skill training we need to take them through. They don't appreciate the importance of keeping their virus software up-to-date and keeping their [operating system] updates current.

The lack of training for administrators and teachers is compounded by the lack of technical support. One administrator vocalized the disadvantage that staff in his office experience because they are responsible for their own training. The lack of skill puts them behind schools that learn the video conferencing technology with outside support. This administrator fears that his school will not be able to take full advantage of video conferencing without technical help. An administrator wanting technical training and support said:

We are all on our own for training. We are at a bit of a disadvantage. The other three offices have already been taught on the whole thing. Nobody has been going around to our office saying, "Press this button, and here's how you make your connections." We are self-taught here. That's where we are limited. There's no question in my mind if we ever expand here we need a techie. That is critical if were going to be really successful and really use this thing to its max.

The lack of technical support in the schools was also found to affect the students. In one school, students were not able to submit assignments electronically. Frustrated by their inability to get their work handed-in, students at his school simply gave up. One teacher said, "[Electronic assignment submission] was causing our students too much frustration, and we were starting to lose them." An administrator added:

> We haven't talked about on-site student support. We do believe that in certain courses that will be a necessity. And it depends on the motivation of the students. If you're dealing with the remedial math class, support is probably crucial. If you're dealing with a [calculus] class of one or two students, it may not be crucial. We'll find that out as ago.

Prevailing attitudes create anxieties as new technologies become available. Past mistakes, beliefs, and cultural practices make some administrators, teachers, and parents reluctant to embrace broadband technologies. Broadband technologies create anxieties in the potential adopters for whom they are developed. The participants were concerned with the compatibility of systems and schedules at different schools. The cost of purchasing and supporting the technologies associated with broadband also created anxiety. Once acquired, participants expressed concerns about learning how to install and use the technologies.

Discussion

Four years previous, the provincial government undertook an ambitious ICT infrastructure project. Current projections indicate that by Christmas of this year, the majority of the government offices, schools, health-care facilities, and libraries in Alberta will be connected to a fiber optic, high-speed, high-capacity broadband network. As part of a larger investigation of the influence of this project on several aspects of life in Alberta, we talked to K – 12 distance educators about their perceptions of how the SuperNet would affect their operations.

The infrastructure itself was not a salient element of their experience—nor is the network infrastructure that underlies their current activities. Instead, their perceptions focused on the educational technologies that the high speed, high bandwidth network would bring within their grasp. With broadband videoconferencing and whiteboards, they could provide synchronous interaction between remote students, on-site classrooms, and subject specific teachers. Their experiences suggest that this will improve achievement and completion rates. With multimedia learning objects, they could provide sophisticated tutorials on an expanding variety of topics. The participants believe that this would also improve achievement as well as student satisfaction and engagement.

The participants whose activities were already supported by a satellite broadband infrastructure anticipated less dramatic changes. Still, they were excited about the possibility of a more reliable and stable digital environment than their current one, which was prone to changing with the weather.

These anticipations were balanced by the pragmatic concerns of practioners who have seen technological innovations wither in the face of budgetary constraints, rigid curriculum objectives, standardized testing, parental concerns, and other everyday realities in the K-12 schools. Our participants were certain that the successful implementation of any new, state-of-the-art educational technology would require additional equipment, technical support, and professional development.

Even with these elements in place, there were concerns about the compatibility of new systems with existing ones, both technological and social. Will all the schools in a district be using the same videoconferencing codecs? Are their timetables for core subjects in synch? And, how will the religious and libertarian groups that we serve respond to the Internet?

A final concern that will affect a subset of our participants is one that challenges the *network* connotations of an Alberta Super*Net*: The SuperNet extends only to schools; it does not continue the *last mile* to the homes of all students. The government hopes that private enterprises will fill this gap, and there have been many expressions of interest. Nonetheless, our participants worried about implementing broadband-intensive educational technologies, particularly for core delivery, if their students continued to use dial-up connections.

Developer-based and adopter-based theories of diffusion of innovations prepared us for many of these perceptions. Rogers' theory of perceived attributes was particularly germane to this situation in which the target innovation had yet to materialize. Of the five factors that comprise the theory, three were prominent themes in the participants' interviews—relative advantage, complexity, and compatibility. The remaining two—observability and trialability—might be pronounced once the system is *lit up* (to use the language of the SuperNet technicians). In this section, we will draw connections between our participants' perceptions and the three germane elements of perceived attributes theory. We will also bring the voice of the developer, i.e., the provincial government, into this discussion. We will then do the same with elements of adopter-based theories. We begin with relative advantage.

Relative advantage

Objectively, there is little dispute that the SuperNet has a considerable advantage over plain-old-telephone system (POTS) networks and satellite networks in data transmission. This has been demonstrated at our government's test lab. But, it is not the network that these educators spoke to, but rather the educational technologies that the network would support. On this ground, relative advantage asks us to perform a media comparison analysis; in this case, we are directed to ask, is videoconferencing, the anticipated system, a better system for interaction and presentation than audiographics, the current system? Educational technologists asked variations of this question at each technological milestone of the last century. It accompanied the introduction of radio, television, video-and audioconferencing, computer assisted instruction, and now networked computers. The results are consistent: There is no significant difference in outcomes (e.g., achievement, satisfaction, efficiency) between one media and another (cf. Russell, 2004 for a summary of 76 years of studies). Instruction, it seems, is a thoroughly holistic phenomenon, which resists reductionist analyses.

Nonetheless, media comparison studies persist, perhaps based on intuitive perceptions like those of our participants who were convinced that multimedia tutorials would be better than paper-bound tutorials, and that videoconferencing, with its full presentation of synchronous, two-way, audio and video would be better than audiographics presentations, which contains only a subset of these capabilities.

Complexity

The SuperNet and the technologies that it enables, namely Internet protocol videoconferencing and multimedia learning objects, are complex innovations. Electrical engineers, computer scientists, and educational technologists in these areas are working at what has been familiarly described as the *bleeding edge*, "a term that refers to technology that is so new (and thus, presumably, somewhat buggy) that the user is required to risk reductions in stability and productivity in order to use it" (Bleeding Edge, 2004). It is a characterization that is meaningful to anyone forced to grapple with these technologies for practical rather than experimental uses. In this group, we can include teachers, administrators, and their technical support personnel. Predictably, their enthusiasm was tempered by their perceptions of the innovations' complexity.

Fortunately, the provincial government is proactive in this area. The learning ministry, in conjunction with a technical college, developed a set of courses for school technical support staff. Two-day courses are available at learning centres throughout the province, and they are complimented with online modules and online interaction. The courses are inexpensive, and the province is considering supplementing the technicians' tuition. Additionally, the government is developing a community of practice to support each of the three groups in our sample. This includes regular conferences (both face-to-face and online), professional development workshops, web portals, and collaborative research projects that include representatives from several stakeholder groups. Hopefully, these measures will address some of the training and support needs that developer-based studies identify as critical to successful and sustained adoption.

Compatibility

Our participants, as developer based theories predict, expressed some concerns about the compatibility of the new systems with existing technological and social systems. Their concerns about technological compatibility focused on videoconferencing equipment. Again, the government anticipated these concerns and is taking measures to alleviate

them. They selected H.323 as the standard protocol for data transmission, and they are conducting studies to determine the best equipment configurations with an eye to additional standard setting.

Other issues of compatibility are out of the province's hands. Currently, some parents have a system for monitoring the children's progress that is tied to traditional educational artifacts such as textbooks and assignments booklets. These parents have expressed concerns that their cultural practices are incompatible with intangible, digitized course materials and electronic assignments.

Alberta's Hutterite communities present at least two additional challenges. In regards to this project, these communities engender two qualities that may be incompatible with online learning. First, they are a conservative community that celebrates tradition and therefore they are judicious about the technologies that they assimilate into their way of life. They are not technophobic; they utilize many of the accoutrements of twenty-first century Western life. But, they are wary of the outside world and sensitive to the insidious nature of its technologies. Certainly, their orientation toward the Internet will be skeptical.

Second, the Hutterites have a fundamentalist Christian faith, a faith whose representation on the World Wide Web is overshadowed dramatically by content that clashes with this faith. It is not clear that the Hutterites are keen to adopt Internet educational technologies.

Rogers' theories, including his theory of perceived attributes, look at the world through the eyes of developers. To a limited extent, they recognize that the perceptions of potential adopters are instrumental in the success of their innovations. In support of their assertions, relative advantage, complexity, and compatibility were themes in our participants' perceptions of the SuperNet and its potential influence on their activities.

A fuller recognition of users' perceptions is provided by adopter-based theorists. They admit the utility of developer-based theories, but identify gaps in their models. Some adopter-based assertions were pronounced in our participants' perceptions.

One of the insights of adopter-based theories is that *problems* are not objective features of the environment; rather, they are socially constructed. An issue that has been problematized by a developer, therefore, may not be recognized as such by a potential adopter. This disjunction in views was evident among our participants. Though they could identify advantages of a broadband network, several of them stressed their satisfaction with their existing systems. Three of our eight participants—two administrators and one technical support person—provided enthusiastic descriptions of their use of electronic whiteboards on their existing networks. Others made a point of telling us, for instance, "What we're using right now works." One of the administrators made it clear that adopting the new network would be an evidential decision:

> We're comfortable with the technology and satellite broadband we're already using. We won't change from satellite broadband unless the *SuperNet* is cost-effective and more stable. If something comes along that is cost-effective and better in terms of stability and in terms of delivery we would be happy to go that."

As administrators go about the day-to-day business of meeting their responsibilities, they work with the resources that are available to them. With dial-up or satellite broadband networks, they develop teaching and learning activities that are functional on these network. They are not waiting motionless for the SuperNet to arrive. Administrators, teachers, and technical support personnel are looking to the arrival of the SuperNet with a mix of anticipation and anxiety. They are excited about any opportunity to enhance their teaching and learning activities, but they know there will be challenges. Where it can, the group that is building the network is working to intercept these challenges.

In the second year of our study, we will document the interplay of the participants' anticipations and anxieties with the reality of the SuperNet's arrival.

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