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Reconstructing knowledge, negotiating cultural difference:
Using web-based media to build inclusive learning spaces for math and science

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ABSTRACT

Reconstructing knowledge, negotiating cultural difference:
Using web-based media to build inclusive learning spaces for math and science

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This thesis-project is an examination of how new media, specifically the graphical user interface of the World Wide Web, can be used to deliver effective informal, science learning opportunities for Aboriginal children in mid- to late elementary school. A review of current issues relating to education in Aboriginal communities located within Canada is presented. A model web site, Explore!, and pilot content, developed in collaboration with parents, educators and Elders from Aboriginal communities, then forms the basis for a formative and summative evaluation of both product and process. Because the content of Explore! is only pilot material, summative evaluation by members of the target audience is summative within the framework of the thesis-project, but formative with respect to further development of Explore!

This project is dedicated to my mother,
Barbara Lipski Wiseman,
who always wanted me to be a teacher,
and to my father,
Gordon Wiseman,
who always seems amazed that I'm his kid.

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List of Acronyms

APTN: Aboriginal Peoples Television Network
CASEA: Canadian Aboriginal Science and Engineering Association
CASTS: Canadian Aboriginal Science and Technology Society
CMEC   Council of Ministers of Education Canada
ICT: Information Communications Technology
INAC: Indian and Northern Affairs Canada
NAEP: Native Access to Engineering Programme, Concordia University
NSF: National Science Foundation (US)
PBS: Public Broadcasting Service
RCAP: Royal Commission on Aboriginal Peoples

The worlds of the shaman and scientists *sic* as two parallel modes of acquiring knowledge about the universe have managed to give birth independently to two distinct though equally positive sciences. (Smith, 2001, p. 84)

Educators need ... to teach students that Western science is one way, not the way, to perceive the world. (MacIvor, 1995, p. 87)

1. Introduction

This media project, *Reconstructing knowledge, negotiating cultural difference: Using web-based media to build inclusive learning spaces for math and science*, was undertaken as a means of examining how new media, particularly the graphical user interface of the World Wide Web, could be used to deliver effective informal, science learning opportunities for Aboriginal children.

The project was undertaken as a collaborative process with Aboriginal[1] Elders, parents, community teachers and children. It had three foci:

1. The development of a technological structure for an online, informal, science learning space aimed at Aboriginal children in mid- to late elementary school;

2. The production of the pilot content for the space;

3. The examination of a collaborative development process as a means of developing effective learning spaces for Aboriginal children.

While it may seem to some that what I have undertaken is an educational technology and not a media project, it is my belief that education is one of the most important communications processes in which we become actively involved over the course of our lifetimes.[2] From the moment we are born, to the moment we return to the Earth, each and every one of us spends a significant portion of our life as teacher and student. In both roles it is vitally important that we are able to clearly and effectively exchange messages in a variety of contexts. Unfortunately, people outside the dominant culture (which

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[1] In this paper, and throughout the project, the term Aboriginal will be used inclusively to denote people who identify as North American Indian (status and non-status), Inuit and Métis. It is standard practice at the Native Access to Engineering Programme to capitalize the term Aboriginal, as such I have used this practice throughout this paper.

[2] It is also the belief of many educators (Cajete, 1999, p. 75; Canadian Teachers' Federation; Dijkstra, 2000, pp. 223-224; O'Sullivan, 2000, p. 50).

defines the means of communication) often have difficulty in the exchange because the context is foreign to their experience. In these cases, it is necessary to look beyond accepted ways and methods of exchanging messages and find some common ground through which communication can take place in a manner that honours and respects the experience of both sender and receiver. Medium and message, delivery vehicle and programming, teacher and lesson; these are all reflections of the same process.

That being said, the question I examine through a formative and summative evaluation of the project is how to use the World Wide Web to deliver effective informal science learning opportunities to Aboriginal children in mid- to late elementary school. There is potential to consider the question as two separate theses: the first examining how to use new media for delivery of effective informal science learning; and the second examining how to make the resulting delivery and material work for an audience of Aboriginal youngsters. This approach, however, only reinforces the status quo of retrofitting the methods and solutions of the dominant culture for an Aboriginal audience. It does nothing to challenge "the core assumptions, values and logic" (Royal Commission on Aboriginal Peoples [RCAP], 1996b, p. 456) of learning resources themselves. It is my contention that effective solutions require more imagination than the status quo, as such I have attempted to examine the question as a whole and consider the intended audience as paramount in the development of the solution.

Why is it necessary to develop web spaces for Aboriginal children? At the present time, very little online content in any subject specifically addresses these children, so it is difficult for them to find any site which portrays their faces, their communities or their points of view. There is also an expressed desire at the community level for high quality, culturally relevant, online resources (Davies, 2002; Wakeham, Silva & Bracewell, 1998).

Unfortunately, this desire is not yet supported by sufficient local expertise or resources. Finally, there is a broader reason to develop online space for Aboriginal children.

I have been promoting post-secondary education and the pure and applied sciences to children since 1989. In 1994, at the invitation of Corinne Mount Pleasant-Jetté, an Aboriginal professor in the Faculty of Engineering and Computer Science at Concordia University, I started work with the Native Access to Engineering Programme (NAEP). I began taking what I knew about engaging children in science through non-threatening, fun, hands-on environments and trying to figure out how to replicate and expand the experience for Aboriginal youngsters. The specific (and long-term) goal is to encourage more Aboriginal children to pursue engineering as both an academic and career choice. Over the years, upon being introduced to this work, people have asked: "How many Aboriginal engineers do you think you will have in 5 years?" The answer: "A few ... maybe, certainly less than 10," usually takes them aback. In the corporate world, and even in academia, five years is a significant amount of time in which most people reasonably expect some kind of measurable result.

What I have come to appreciate since 1994, is that developing learning resources designed for Aboriginal children and working towards the broader inclusion of Aboriginal people and their perspectives within the sciences and engineering, is only a small part of a much larger and long-term project to redefine the relationship between Aboriginal and non-Aboriginal peoples in Canada. Redefining relationships is not easy, nor is it a one-sided affair. It requires that people be willing to change and reevaluate their sense of both themselves and "the other," whoever the other may be. It requires that all sides be willing to accept change. Redefining relationships can be a long and arduous process, especially when the relationships have been mired in extremely lopsided power structures. Yet, if Aboriginal and non-Aboriginal peoples are to continue to share this

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land in any way that is just, we must begin to reconstruct our relationship based on mutual trust and respect; this begins with apologizing for injustices, acknowledging our differences and examining what we can learn from each other. Given the sheer size of this country, media and associated communications technologies have always played a significant role in establishing a shared sense of "experience and identity" (RCAP, 1996a, p. 621). Any reconstruction of the relationship between Aboriginal and non-Aboriginal peoples must, therefore, also begin by ensuring that Aboriginal people, communities and perspectives are portrayed accurately and equitably within the media. Developing web spaces specifically for Aboriginal children, is a small but necessary step in this process.

This thesis-project is intended as a summary of the rationale, methods and results for the media project, *Reconstructing knowledge, negotiating cultural difference: Using web-based media to build inclusive learning spaces for math and science.* Chapter 2 presents the rationale and supporting literature review for the project. Chapter 3 provides both an analysis of how the media project proceeded, and summarizes means used for development and the gathering of evidence. Chapter 4 focuses on results from the summative evaluations conducted with both project collaborators and members of the target audiences. Chapter 5 presents conclusions and recommendations and proposes the next steps to be followed in the further development of Explore!

The development of Explore! was an exercise in building a model for the development and delivery of effective content through a specific medium, not in measuring the effectiveness of the medium for delivering content. The technological structure, pilot content and collaborative process developed in this media project should be considered as models which may be expanded and built upon at a later date or within the context of other projects. As such, certain elements which would likely extend through the body of a completed web site, are only integrated into sections of the pilot content. In addition,

some technical problems which arose during development have not been resolved, because they would have been time consuming to fix and their impact on evaluation was judged to be minimal. Finally, because I have developed only pilot content and not a complete web site, certain stated goals for the fully developed Explore! web site could not be measured or evaluated within the scope of this media project.

The Explore! project is a concrete manifestation of how multiple worldviews and perspectives can intersect within a medium to provide Aboriginal children with a learning opportunity that values both the teachings of the Shaman and the rhetoric of Western applied science.

2. Rationale and Literature Review

2.01 General demographics[3]

According to Indian and Northern Affairs Canada (INAC), the Aboriginal population is 1,333,700 people, or 4.4% of the total population in Canada (Indian and Northern Affairs Canada [INAC], 1997; INAC, 2000). This population is spread across the country, with the largest concentrations in the north and west. Figure 1 shows the Aboriginal population distribution as a percentage of the provincial or territorial population and (in brackets) as a percentage of the total Aboriginal population in Canada at the time of the 1991 census.

Figure 1. Aboriginal population distribution as a percentage of the provincial or territorial population and (in brackets) as a percentage of the total Aboriginal population in Canada.

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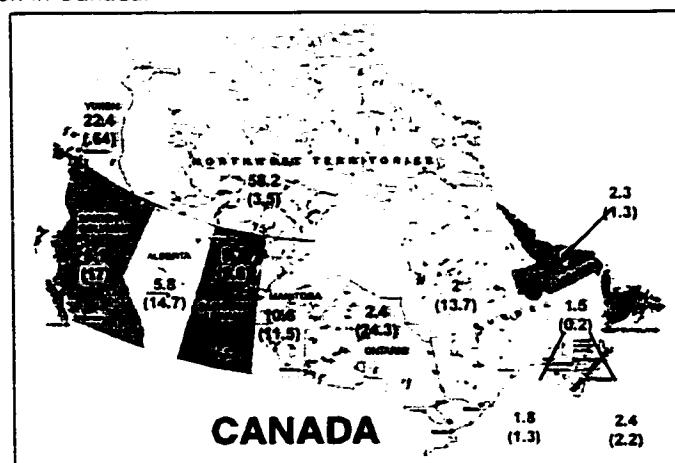
[3] The statistics presented in this paper are based primarily on the data collected during the 1991 Census and Aboriginal Peoples Survey conducted by Statistics Canada. They are supplemented with more recent education figures available from Indian and Northern Affairs Canada. While data from the 1996 Census regarding Aboriginal people is available, it has not been used here because for two reasons. First, the 1996 data cannot be compared with previous censuses. The question used to determine who was and was not counted as an Aboriginal person was changed from the question used in previous censuses resulting in significantly lower numbers (Statistics Canada, 1998). Second, undercoverage – the number of people not counted in the census – "was considerably higher among Aboriginal people than among other segments of the population due to the fact that enumeration was not permitted or was interrupted before it could be completed on 77 Indian reserves and settlements. ... While the impact of missing data tends to be small for national-level and most provincial-level statistics, it can be significant for some smaller areas" (Ibid.). Data from the 2001 Census is not used here because comprehensive results regarding Aboriginal peoples will not be available until after the submission deadline.

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The Aboriginal population is growing at an unprecedented rate: the on-reserve birth rate is more than double that of the Canadian population as a whole. The 1991 Census/Aboriginal Peoples Survey conducted by Statistics Canada found that about 54% of Registered Indians living on reserves are under 25 years of age (Statistics Canada, 1993, p. 9). In some communities, this percentage rises to in excess of 50% under the age of 18, and there is clear evidence that the explosion in birth rates is ongoing and consistent across all regions of Canada (McCallum, 1997, p. 4):

> Between 1991 and 2016, the population with Aboriginal identity is projected to rise by 52% (compared to 22% for non-Aboriginal Canadians). More striking, because of differences in demographic structure, the working age Aboriginal population (aged 15-64) is expected to grow by 72% over the same period, as compared with only 23% for non-Aboriginal Canadians. (Ibid.)

So, unlike the general Canadian population which is dominated by the concerns of aging post-World War II baby boomers, many concerns within Aboriginal communities focus on youth and the young, education, learning and training.

2.02 Educational demographics

> Education is our survival. It is our dignity, our pride. (Chief Misel Joe, Conn River First Nation, Labrador, personal communication. April 16, 2002)

In 1979, less than 100 Aboriginal people were enrolled in post-secondary institutions across Canada. That number grew exponentially to 27,000 in 1994-95 (INAC, 1997) and has remained relatively stable ever since (Mullens, 2001, p. 10). The reality is that in 1991 only 2.6% of the Aboriginal population over the age of 15 held university degrees (compared with 11.6% of the non-Aboriginal population) (RCAP, 1996b, p. 440). In addition, there is still a tremendous dropout rate at the secondary level; the 1991 census indicated that less than half of Aboriginal people were completing high school (Ibid.).

And yet, the long-term goal of self-government requires that the pool of young Aboriginal people with the skills to fill leadership positions in all sectors must grow dramatically within the short- and medium-terms.

A recent article in *Maclean's Magazine* outlines the efforts by certain, mostly western, Canadian universities to address the need for Aboriginal people with university-level and professional degrees. While it applauds the attempts being made to open doors to First Nations, Métis and Inuit students, it also notes:

> For most aboriginal people, getting into university – any university – remains a titanic struggle. The most obvious hurdle is academic. ... But native educators say that only tells part of the story. The quality of education that aboriginal youths receive – especially those from remote communities – is frequently substandard. Even those who finish high school often lack the necessary English, math and science skills to proceed to university. (Bergman, 2002, p. 40)

The fact of the matter is that many Aboriginal students do not receive the same quality of education of that children in the rest of Canada receive. They do not have the same access to resources, equipment and qualified teachers.

2.03 The pool of educators

> I have to be a better teacher – more creative – to reach my aboriginal students, and in doing so I am a better teacher for all my students. (Ed Doolittle, Professor of Mathematics, Saskatchewan Indian Federated College, in Mullens, 2001, p. 11)

According to *The Pan-Canadian Education Indicators Program Report 1999* (PCEIP), there are 268,000 elementary and secondary educators in Canada (Statistics Canada & Council of Ministers of Education Canada [CMEC], 2000, p. 28). These educators are largely baby boomers over the age of 45, many of whom will retire in the next 10 to 15

years. In fact, the Canadian Teacher's Federation estimates that 130,000 teachers (nearly half of the current cohort) will retire by 2010 (Seidman, 2001, p. A3).

Teacher retirements are already having an impact on Aboriginal communities. For the first time in close to a generation there is an abundance of urban job openings for teacher candidates graduating from education faculties. School boards in Vancouver, Montreal and Toronto (and more and more frequently large US urban centers) are competing for the pool of new, inexperienced teachers who have, until recently, been the primary source of educators for semi-urban, rural and remote schools. This shrinking pool has been documented by at least one remote school board: for the 2000-2001 academic year, the Kativik School Board, which serves 14 Inuit communities in northern Quebec, received 260 applications from prospective teachers compared with 1603 applications in 1996-1997 (Lampert, 2000, p. A6).

Neither is the loss to Aboriginal schools limited to their pool of potential teachers. Semi-urban, remote and rural schools have been a great proving ground for young teachers who have chosen to remain in a community or region over several academic years. Now, one of the few places urban school boards can find relatively young candidates with both teaching and school administration experience is in rural and remote communities. As such, baby boom retirements are disproportionately impacting schools in First Nations communities, and this is only the beginning of the curve. In the fall of 2000, the Northern Quebec Teacher Association, the union serving the areas covered by the Cree and Kativik school boards, noted that these boards were still "missing more than a dozen teachers" (Ibid.) more than 2 months into the school year.

Adding to these disturbing trends, is anecdotal evidence from reputable sources[4] which indicates:

- schools in many rural and remote schools (not just Aboriginal) are having difficulties in staffing certain subject areas, particularly math and the sciences, with qualified teachers. As such, *any* available and on-site teachers are being used to teach subjects in which there are openings;

- the number of qualified math and science teachers graduating from teacher colleges is on the decline;

- some remote First Nations communities have been completely unable to staff teaching positions, despite the existence of school infrastructure and supplies, as well as, and more importantly, students who *want* to attend school;

- teachers who do remain in place are under heavy pressure to fill existing gaps and are suffering from stress and burn-out.

In a country where all levels of government espouse lifelong learning and emphasize the importance of formal education to national competitiveness in an era of globalization and information-based economies, we cannot afford to exclude any community or group of people from the labour market talent pool. Emerging trends observable in the science and math education of First Nations students, support neither the national goal of continued economic viability in high technology sectors, nor the long-term development of self-government and self-sustaining economies in Aboriginal communities.

At the same time, cloning the "mainstream" Canadian experience of elementary and secondary formal education is not the answer for many Aboriginal communities or children. While Aboriginal people share with other Canadians the ultimate goal of

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[4] Where information is attributed to "reputable sources" it has been obtained either from numerous work or from people who, for reasons of professional reputation, wish to remain anonymous.

developing contributing members of society and attaining specific learning outcomes.

their preferred path(s) to these goals may not be the same (Hampton, 1995; MacIvor,

1995). According to the Royal Commission on Aboriginal Peoples (1996b):

> [Aboriginal people] want education to prepare them to participate fully in
> the economic life of their communities and in Canadian society. But this is
> only part of their vision. ... education must develop children and youth as
> Aboriginal citizens, linguistically and culturally competent to assume the
> responsibilities of their nations. (pp. 433-434)

The reality is that today's Aboriginal children must be prepared to walk in two worlds in

which they will be required to balance and, to a certain extent, reconcile two very

different worldviews. The question remains how to create education and learning spaces

which allow them to develop this ability along with the concrete skills, knowledge and

capacities they will need as fully functioning adult members of society.

2.04 Defining Education

> We are convinced that you mean to do us Good by your Proposal [to
> educate our young men]; and we thank you heartily. But you, who are
> wise, must know that different Nations have different Conceptions of
> things and you will therefore not take it amiss if our ideas of this kind of
> Education happen not to be the same as yours ... We are ... not the less
> oblig'd by your kind Offer, tho' we decline accepting it; and to show our
> grateful Sense of it, if the Gentlemen of Virginia will send us a Dozen of
> their Sons, we will take Care of their Education, instruct them in all we
> know, and make Men of them. (Drake 1834, 27). (Chief Red Jacket,
> Iroquois Confederacy at a treaty signing in 1744, in Brant Castellano,
> Davis & Lahache, 20000, p. xii)

What is education? In Canada, and other Western countries, the conception of education

is almost always linked with formal schooling. While children 'learn' from family

members, peers and experience throughout life, this learning is often separated from the

sense of 'education' which we use to make value judgements about a person's (or

people's) worth: "She's really well-educated," or "He hasn't had much education," or "They never do well in school."

Education is not an easy term to define. And in fact, in writing about education and related issues, many authors neglect to offer a framework within which the term can be discussed. There appears to be an assumption that 'everyone' knows what education is, yet different people (and peoples) have a distinct sense of what the word means. For Aboriginal peoples, the struggle over defining education has been further problematized by their status as colonized peoples, as evidenced by Sheila Watt-Cloutier's (2000) summary of the introduction of Western education in the Arctic:

> For thousands of years Aboriginal peoples had a very effective education. We knew how to prepare our children to handle the challenges they would face when living on the land. The harshness of our environment imposed a discipline that produced resilient, proud, and self-reliant people. Then things changed. Contact with southern culture brought a flood of new things and new ways of life. People and decisions from far away places began to have more impact on our lives than the people around us and the disciplines of the land that we knew and understood. It was no longer clear what our own time and place was, or what we now had to learn in order to control our own lives. The path of education we had successfully followed for countless generations did not prepare us for these new things.
>
> Southern culture traditionally used schooling as the principal means of education. Traditions seem right and natural to those who follow them, and seeing that we did not have schools, people from the south concluded that we needed them. The idea of institutional learning was new to us, and it was difficult for many of our people to understand and appreciate. However, if schools would help prepare our children for the changes they were facing, then most parents were willing to let their children be educated in the southern way. For those not willing to go this route, the government held back family allowance cheques, making it difficult for parents to feel like they had a choice in the matter. ...
>
> [School] programs had nothing to do with our language, culture, or the adaptive challenges faced by our people ... they did little to bridge the gap between our own culture and situation. Rather than making us stronger, they tended to undermine our confidence and identity. (pp. 114-115)

Is education really different things to different people? My research indicates that it is not so much the definition of education which varies, but the overriding goals, approaches and methods used in the process of education. That being said, the definition offered must be broad enough to accommodate difference because, as many writers on Aboriginal education (Aikenhead, 1998; Cajete, 1999; Ermine, 1995; Gillani, 2000; Gilliland, 1988; Hampton, 1995; Hankes & Fast, 2002; Hodgson-Smith, 2000; LaFrance, 2000; Pepin, 1998; Tobin; 1998) maintain, in order for education to more effectively work for Aboriginal children, it must be seen as a socially and culturally constructed process. Viewed from such a framework, it becomes clearer (although not necessarily easier to address) where - and some of the reasons why - Western education has failed Aboriginal students for so long.

As such, I offer the following definition for education. It is not my own, but an idea built by the co-Chair of the Working Group on First Nations Education (INAC), Corinne Mount Pleasant-Jetté, based in part on her reading of the work of Japanese educational theorist Tsunesaburo Makiguchi.[5]

> Education is the creating of human beings; people who are responsible, good citizens, capable of benefiting their communities,[6] and capable of fitting within their communities as individuals. Ideally, education is imbued with a sense of progress, in that it provides individuals with the capacity, through the knowledge they have gained, to contribute more to their communities than members of the previous generation. In order to achieve these goals, the process of education allows individuals to construct knowledge and develop the capacity to think. It also charges the individual with a moral and civic responsibility for the future. Education is a function of the philosophy of education adopted by a society. For instance, if you want a just society, you frame the education system to produce people who are just; if you want an economically competitive

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[5] Makiguchi was a Nichiren Buddhist and the founder of the Soka Gakkai (Value Creation Education System) movement. The reference for the book mentioned above has been included in Research Paper References.

[6] In this context the definition of community is broad, it begins at the local level and expands to include the global.

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society, you frame the education system to produce people who are capable of contributing to economic growth. (Personal communication, July 15, 2002)

2.05 Approaches to teaching and learning: Reconciling worldviews

If I walk back through my life and reflect on my education, I find I have always been in school. My family and the land from which I was born were my first teachers. Then walls were built that kept my family and the land away. Within these structures, I came to be schooled in a 'formal' way, and, twenty-two years later, I have returned to my mother's kitchen and my father's armchair to learn again as a child. (Hodgson-Smith, 2000, p. 156)

There is a growing body of evidence that mainstream approaches to teaching, or at least exclusive reliance on mainstream approaches to teaching, are not particularly effective means of cultivating learning for Aboriginal learners (Gilliland, 1988; Goulet, 2001; Hampton, 1995; Miller Cleary and Peacock, 1998; Smith, 2001). Unfortunately, as these authors point out, the lack of effectiveness is not caused by one or two elements of current pedagogy which can be easily identified and fixed to address the needs of Aboriginal children. Rather, the problem is based in a system of education designed by Westerners to reproduce existing power structures and a Western worldview. The root problem is, therefore, inherent in the structures and methods of the system.

Pedagogy is often referred to as the science of teaching, the definition of means and methods for educating students. Kathy Hodgson-Smith (2000) says that pedagogy is much more:

Pedagogy is not merely styles, methods, and strategies [for teaching]. It is also the epistemological/philosophical framework from which one approaches instruction. If I were to speak of Aboriginal pedagogy, it would be imperative that I speak to the philosophical and epistemological beliefs that inform and guide cultural practice. (p. 158).

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Because education is both socially and culturally constructed, effective education for any child is that which is most closely connected to the child's cultural and social reality:

> The farther the [teaching and learning] events are from the inner perceptions of the students, the less effect they have on the learning process. The closer the events are to the inner perceptions of the students, the more likely they will change behaviour, learning, and retention (Gillani, 2000, p. 163).

The approaches to learning, presentation of material and knowledge designated as appropriate in mainstream Western schools, is often very far removed from the "inner perceptions" and established understandings of Aboriginal children.

2.05.1 Fragmentation of knowledge

Mainstream teaching, despite ongoing reforms, is still largely based on "industrial Taylorism" (Hankes & Fast, 2002, p. 45), a system which breaks the curriculum into distinct subject areas, and each subject area into discrete informational quanta. For most (but by no means all) Western students this approach to teaching and learning reasonably mirrors the expectations and understandings they have learned in the home. Hap Gilliland (1988) writes:

> When main-stream *sic* children enter school, the ways, the ideals, and values they are taught reinforce and build on teaching they have received since birth. The same ideas and behaviors *sic* are rewarded. However, entering school for the Native American can be a shocking experience. Many of the behaviors and expressed values are in direct opposition to what the child has been taught at home (p. 21).

The "fragmentation" (Ermine, 1995) of knowledge and understanding can be particularly difficult for Aboriginal children, who tend to be "whole concept learners [who] prefer to start with the whole then move to the details" (Gilliland, 1988, p. 53). Watt Cloutier (2000) adds:

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In our Native heritage, learning and living were the same thing, and knowledge, judgement, and skill could never be separated. The Native way of teaching is holistic. ... In the institutional way of learning ... things are often pulled apart and never reassembled. (p. 118)

While there are many Aboriginal nations in Canada and the United States, each with its own culture and worldview, there is a shared sense of the interrelatedness of all life and so a holistic approach to understanding how the world works. This understanding was articulated by the authors of the Royal Commission on Aboriginal Peoples (1996b) who managed, through extensive consultation, to pull together submissions from individuals and communities and develop a sense of education from the perspective of Aboriginal epistemology:

In Aboriginal education the individual is viewed as a whole person with intellectual, spiritual, emotional and physical dimensions. Each of these aspects must be addressed in the learning process. Holistic education is the term used to describe the kind of education traditionally used by Aboriginal peoples. Such education is organized to develop all aspects of the individual. (p. 445)

This approach to education is echoed by Liliane McGregor, an Ojibway Elder from Birch Island, Ontario:

Everything is interrelated and has a purpose. In trying to teach a child, you must take a holistic approach. Put the subject [to be taught] in the middle and ask: How does the physical part help this child to understand? How does the emotional part help this child to understand? How does the spiritual part help this child to understand? How does the intellectual part help this child to understand? This approach is hard for people to understand because they have not been rooted in our ways. (Personal communication, April 4, 2002)

It has been theorized that one of the main factors contributing to the difficulties Aboriginal students face in schools is the break between the Aboriginal world view presented to them at home, and the western world view they are usually presented with at

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school (Aikenhead, 1998; Hodgson-Smith, 2000; LaFrance, 2000; Miller Cleary & Peacock, 1998; Pepin, 1998; RCAP, 1996b;). Brenda Tsioniaon LaFrance has articulated the Mohawk experience of Western education as one that "separates 'education' from living: so the experience alienates us from our surroundings and, therefore our culture" (LaFrance, 2000, p. 101). Holistic education, with its echo of home life and focus on relationships and interactions, provides a space in which students can more safely and easily negotiate meaning and the differences between the two world views and cultures to which they are exposed and in which, to a greater or lesser degree, they are immersed.

There have been some attempts in North American schools, particularly in US charter schools, to nurture the whole child, and develop methods of teaching and evaluation which reflect holistic development. However, by and large, these attempts remain experimental and well-outside the accepted mainstream, "eclipsed by models of education that place primary emphasis on intellectual development, with this focus intensifying as the individual moves into higher levels of education" (RCAP, 1996b, p. 445).

2.05.3 Whose knowledge?

Lynn Jacobs, an environmental specialist from the Mohawk Nation of Kahnawake, told this story to a group of history teachers from across Canada. When she was in high school, her history teacher started telling the class about the Iroquois Indians who lived near Montreal. Jacobs put up her hand and tried to explain that the Iroquois was not one group of people, but a confederacy of six nations – Mohawk, Cayuga, Oneida, Onondaga, Seneca and Tuscarora – that covered a vast territory ranging from what is now central eastern Canada down into the eastern United States as far as the Carolinas. Jacobs thought she could share her heritage with the class, instead the teacher told her the facts were not correct, she should check them in the text book. While not the physical

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reprimand which would likely have been dealt out in many of the residential schools to which Aboriginal students were sent for the better part of the last century, the rebuke was still upsetting to Jacobs. She felt devalued upon being told her history was not "correct" (Aboriginal Perspectives Round Table, July 12, 2002).

The question of who or what group of people gets to define what is considered as "valid" knowledge, is a question of power. Groups who are removed from the centers of power, do not have much if any impact on what constitutes "valid" knowledge within the dominant society. Bourdieu speaks of *symbolic violence* as a process of "progressive devaluation" of the cultural capital of people on the periphery of a society. "... their cultural capital is not valued and ... is insufficient to permit them to learn to use the discursive resources of the community" (Tobin, 1998, p. 208). Consequently, within education, the questions of "Whose knowledge?" and "What knowledge?" is taught are also of concern.

In his book, *Igniting the Sparkle: An Indigenous Science Education Model*, Gregory Cajete (1999) states:

> Since the earliest days of missionary education through the BIA[7] boarding school education to the present, replacing 'the primitive beliefs' of Native Americans with 'the correct ones' has been an integral part of the hidden curriculum. (p. 141)

He says, for the most part, Western education systems continue to ignore Aboriginal ways of knowing and to erase Aboriginal history and knowledge. Eber Hampton (1995), President of the Saskatchewan Indian Federated College states the case for symbolic violence more concretely, writing:

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[7] Bureau of Indian Affairs, the US equivalent of Indian and Northern Affairs Canada.

Western education is in context and structure hostile to Native people. It must be straightforwardly realized that education, as currently practiced, is cultural genocide. It seeks to brainwash the Native child, substituting non-Native for Native knowledge, values and identity, (p. 35)

underlining that symbolic violence, may not seem so symbolic to those upon whom it impacts. For young Aboriginal learners, like Lynn Jacobs, the means of addressing the symbolic violence of the Western education system is not easy:

The dilemma of not rejecting one's own rich cultural heritage, while preparing to be successful in a context which at best ignores or at worst contradicts such a heritage and its inherent values and ethics is not a simple one. (S.W. Johnson in Gilliland, 1988, p. 2)

At the same time, Aboriginal peoples know that there is no way to turn back the clock and return to precontact conditions. As previously stated, they are also seeking education which will allow for their participation within the global economy while serving their own communities' needs and goals:

We are acutely aware of, and we accept, the fact that education - either through schooling or life experience – involves cultural negotiation. ...

Many ... parents and Elders support teaching from the perspective of [our] ancestors, the 'science and mathematics' that will enable youth to walk forward in this world with, on the one hand, the First Nations teachings and wisdom, and, on the other, an understanding of the Western way of knowing. Only then will youth be able to see the relevance of Western education to their way of life. (LaFrance, 2000, p. 102)

So, the question becomes how to bring the two ways of knowing – Western and Aboriginal - together in a way that allows children to draw upon the strengths of both. The answer may be through constructivist approaches to teaching and learning.

2.06 Approaches to teaching and learning: Constructivism

> Constructivism is not a theory about teaching. It's a theory about knowledge and learning. Drawing on a synthesis of current work in cognitive psychology, philosophy and anthropology, the theory defines knowledge as temporary, developmental, socially and culturally mediated, and thus, non-objective. Learning from this perspective is understood to be a self-regulated process of resolving inner cognitive conflicts that often become apparent through concrete experiences, collaborative discourse and reflection. (Hankes & Fast, 2002, p. 42)

> One way to respect ... personal power and autonomy is to recognize and honour the knowledge and skills children bring with them into the classroom. (MacIvor, 1995, p. 82)

The seeds of constructivism are found in Jean Piaget's work on the cognitive development of children and Lev Vygotsky's work on problem-solving and "the cultural context in which the development of learning takes place" (Cajete, 1999, p. 35). At its most basic level constructivism is the idea that children (and in fact all people) come to learning with prior knowledge and experience, and only construct new concepts and knowledge through the window of this prior learning (Smith, 2001, p. 85).[8] By assuming a learning space in which the knowledge children bring with them to school *must* be acknowledged, constructivism allows for the dismantling of symbolic violence.

In constructivism, the assumption is that learning occurs only when prior knowledge is contradicted or problematized in some fashion. When this happens, the learner must reflect on what he or she knows, as an individual and as a member of a group of shared identity (i.e. community or culture), and readjust it to reflect the new input (American Society for Curriculum Development, 2002; Hankes & Fast, 2002; Larochelle &

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[8] Constructivist theories of education echo communication theories regarding negotiation of meaning and identity: "...culture involves the shared practices and experiences that we construct and express in our social relations and communication. Identity is not formed, then, in internal conceptions of the self, but in the adoption of changing representations and narratives that we generate, experience, and express in our individual and social experience" (Valaskakis, 2000, p. 76).

Bednarz, 1998; Jonassen, Hernandez-Serrano & Choi, 2000; Wulff, Hanor & Bulik, 2000). Interpreted in its most radical form, constructivism has nothing to do with communication, and proponents of the theory say that "knowledge is not transferable, only constructable" (Larcohelle & Bednarz, 1998, p. 8). Ironically, at this point, constructivism relies on the development of *mediating* environments, in which the teacher or teaching tool orients the learner "towards constructing meaning" (Ibid.). In other words, radical constructivism holds that there is no control over what knowledge or meaning a learner will construct with regard to any message, but that the message can be mediated in such a way that what the sender intended and what the learner constructs can more closely approach each other. I would submit, that in this case, the message which is intended and the means by which it is sent should still be carefully considered.

Constructivism is a type of learning which centers on relationships:

> ... the relationship between linear thinking and intuition, the relationship between mind and body, the relationship between various domains of knowledge, the relationship between the individual and the community, and the relationship between self and self. (Smith, 2001, p. 85)

In this way, constructivism is much like holistic education and very much reflects the way in which Aboriginal parents and Elders teach children at home and in the community (Cajete, 1999; Hankes & Fast, 2002; Hodgson-Smith, 2000; RCAP, 1996b). This reflection allows for teaching to be grounded in culturally relevant methods and content.

Judith Hankes and Gerald Fast (2002) have examined constructivist approaches to pedagogy in relation to Aboriginal approaches[9] to pedagogy. They have found that both approaches:

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[9] Because much of the educational research on Aboriginal learners' conducted to date has been faulty or inconclusive, all authors writing on Aboriginal learners and pedagogy caution about the dangers of making sweeping generalizations regarding such things as learning style etc. which may leave readers with essentialist ideas about Aboriginal people. For instance, Cajete (1999) writes: "In researching Native American learning styles, one needs to keep in mind the great diversity between and within tribal groups.

- View teachers as facilitators or guides to learning, rather than controllers of learning;

- Give students responsibility for their own learning by allowing them to make their own sense of a situation or information, rather than imposing singular right and wrong interpretations;

- Concentrate on highly contextualized problem-based instruction where "problems [are] situated in the culture and experience of the learner" rather than on the transmission of decontextualized knowledge;

- Focus on cooperative rather than competitive instruction;

- Allow for time-generous rather than time-driven instruction (pp. 39-43).

These similarities have led Hankes & Fast to conclude that:

> Learning environments in which traditional Native American ways of teaching and learning are applied share beliefs and perceptions as well as ways of evaluating and acting with environments in which constructivist-based teaching and methods are applied. Therefore, it is possible to propose that a constructivist approach to teaching promises to be responsive to cultures that value Native American ways of teaching. (p. 43)

2.06 Curriculum and learning resources

> To really make your instruction relevant to the children's lives you need to use local examples in every subject, to use Native American values and examples in all of your instruction, and show how they apply to whatever subject you are studying. (Gilliland, 1988, p. 7)

For example, research has shown that Native American students have visual spatial strength, a tendency towards global ability and reflectiveness. However, this tendency is filtered through the relative level of students' acculturation to school culture and expectations, inconsistent or inappropriate testing" (Cajete, 1999, p. 45). At the same time, based on their experiences (and the existence of some valid research) authors believe there are some commonalities among Aboriginal peoples. It is these commonalities which are discussed in this thesis-project.

Aboriginal peoples have not only been immersed in Western methods and approaches to teaching and learning, but also the learning resources and curricula which support that teaching. Until very recently (as witnessed by Lynn Jacobs), there was little if any reference to Aboriginal peoples in Canadian curricula, and what little reference there was tended to be negative and/or focus on their existence prior to or in the early years of Confederation. The Aboriginal person as a modern, dynamic person did not exist. Positive portrayals of and contributions made by Aboriginal people to the development of Canada did not receive any text book space. These portrayals, and lack thereof, negatively impacted attitudes of non-Aboriginal Canadian students towards Native peoples. They also negatively impacted the self-esteem and self-image of Aboriginal students, in too many cases creating long-term, damaging rifts between themselves and their families and cultures.

In the last 20 to 30 years attempts have been made to address some of these injustices. Blatantly racist references have been removed from Canadian curriculum. Provinces have developed some culturally-relevant curriculum for delivery in Aboriginal schools or schools with a high Aboriginal population. Some provinces, notably British Columbia,[10] are making efforts to include Aboriginal perspectives and accomplishments in the broader provincial curriculum for all students. But much work remains to be done before the curriculum is equitable and, more importantly, relevant for the teaching of First Nations students. As the authors of the Royal Commission on Aboriginal Peoples wrote, quick-fix, band-aid solutions do not address deeper problematic issues:

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[10] What is missing in BC's attempts to develop a new curriculum which integrates Aboriginal content is input from Native communities. A fall 2001 draft of proposed K-6 science learning outcomes, including Aboriginal content, was developed by a committee on which there was not one Aboriginal person (Monkman & DeMerchant, 2001).

> Revisions [to curriculum] often gloss over or avoid tackling the
> fundamental changes that are necessary to create curriculum that is rooted
> in an Aboriginal understanding of the world, in subjects such as history,
> art, health, mathematics and sciences.
>
> ...
>
> Adding Aboriginal content to curriculum usually consists of adding units
> designed to 'enrich' existing curriculum content rather than changing the
> core assumptions, values and logic of the curriculum itself. Language and
> culture classes may be added to a school's program without altering the
> basic English or French curriculum, the science curriculum, the maths
> curriculum, and the social studies curriculum (RCAP, 1996b, pp. 456-
> 460).

In addition, Sheila Watt-Cloutier (2000) warns that in trying to adapt mainstream

curriculum to Aboriginal needs and perspectives, it is possible to end up with results that

do "not adequately prepare our youth for life in either the North or the South" (pp. 116-

117).

At the same time, Aboriginal nations and communities across Canada have begun to

explore ways to more effectively teach their own children. The Dene in the Northwest

Territories, the Mohawks in Kahnawake and Akwesasne, the Algonquin in Kitigan-Zibi,

and the Inuit of Nunavik (northern Quebec), Nunavut and the Northwest Territories have

developed some innovative curriculum programs which integrate cultural perspective and

Aboriginal worldviews (RCAP, 1996b, pp. 456-460; LaFrance, 2000). For the most part,

these successful programs are holistic (or constructivist), involve the whole community

(parents, teachers, Elders), reflect and respect traditional practice and knowledge, focus

on relationships, and provide opportunities for students to negotiate Western and

Aboriginal world views.

Programmes such as those developed by the nations above serve as excellent, largely

replicable models for other communities, but very few, if any, are being reproduced. The

fact is curriculum innovation remains risky[11] for communities, especially if they want

their students to continue on to post-secondary education where entrance requirements

are generally based on performance in standard provincial curriculum (RCAP, 1996b, p.

461).[12]

2.07 Math and science

> Herman Michell grew up on his family's trap line in Northern
> Saskatchewan, moving with the seasons from one trapper's cabin to the
> next, living as his ancestors had for generations by the wolf, mink, beaver,
> fox and other small animals his father trapped. The closest settlement was
> the isolated reserve of Kinoosao, and even there, telephone, TV and other
> amenities did not exist.

> It is little wonder that, in the one-room schoolhouse and residential school
> where Mr. Michell got his formative education, math and science classes –
> as most urban youth experience them – did not exist either. The concept of
> Western science was completely alien. In his Cree language, the closest
> word for 'science' was simply 'life' (Mullens, 2001, p. 8).

No where is the need to meet provincial curriculum standards more imperative than in

math and science, the benchmarks for students entering post-secondary studies in

medicine, engineering, nursing, architecture and other professional programs. And,

perhaps nowhere is the need for learning resources and teaching methods which reflect or

allow for Aboriginal worldview more pressing than in math and science. As Cajete

(1999) says: "Given the poor results achieved during the prior history of Western

education of Native students, there is a need for a radically different approach" (p. 35).

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[11] Curriculum development at the community level is risky for a number of reasons. First, it is expensive
and time-consuming to produce. Second, it may not meet standards set in provincial curriculum. Finally,
even when it meets these prescribed standards, some provinces will not recognize locally developed
curricula (C. Mount Pleasant-Jetté, personal communication, August 5, 2002).

[12] There is debate about the method used by post-secondary institutions to admit students. And, in fact,
some institutions have made significant efforts to examine and implement alternate methods of evaluating
and admitting applicants. Alternatives include transition/bridging programs, Community-based programs
and Prior Learning Assessment Reviews (PLARs).

In OECD countries, at the beginning of the twenty-first century, the math and science achievements of school children as young as nine[13] are viewed as indicators of a country's future ability to innovate and remain competitive in a technological, global economy. Whether this measure is valid or not, whether the ongoing focus on science and math teaching and skills acquisition[14] should be challenged at the provincial and national levels, is largely irrelevant to Aboriginal communities. The stated goals of self-government and self-sufficiency will require people with skills in these areas; people who do not exist in numbers large enough to fill current community needs, let alone the needs which will develop as land claims settlements and treaties are signed:

> There is a critical shortage of Aboriginal people in science and health-related fields. If we are to have meaningful control of programs and services in an era of self-government, it is paramount that we have a pool of resource people with a balanced education background of the highest quality (Hermann Michell, Science Liaison Officer, Saskatchewan Indian Federated College, in Mullens, 2001, p. 9).

There is the recognition in many Aboriginal communities that something needs to be done to encourage more students to pursue math and sciences through to the post-secondary level, and that: "In this era of self-government, it is imperative that future leaders, providers and citizens be educated in all areas, including the hard sciences and mathematics" (LaFrance, 2000, p. 104). That recognition is accompanied by the real need to develop culturally-specific and appropriate materials in math and science, because these subjects as currently taught in mainstream Canada are particularly difficult for many Aboriginal students to negotiate.

Science and math as taught in Canada are grounded in the traditions of Platonic Greece and the rationality of Francis Bacon's scientific method - traditions "institutionalised" in

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[13] Yet, as MacIvor (1995) points out: "On rural reserves in the United States, science instruction seldom begins before grade six" and the same situation is "probably present in Canada" (p. 84).

[14] Often to the detriment of other subjects.

the West in the 1600s (Aikenhead, 1998, p. 88). Glen Aikenhead (1998) of the University

of Saskatchewan posits that science is a subculture of the dominant western culture, and

the teaching of science is "an attempt at transmitting a scientific subculture to students"

(p. 87) in which students must learn to "cross the border" between school culture and

school science (Ibid.). Negotiating this border can be difficult for Western students:

> Science is a strict knowledge culture prescribing the meanings of words,
> experimental design, the form of explanations, and even the methods of
> publication of its practitioners. For our students it is a whole new world of
> thought. Coming to feel comfortable within this new territory is, for most
> of our young students, as long and slow a process as joining a new tribe
> might be. To make it even more difficult, the students find that while they
> learn, their own culture of everyday life and meaning continues to intrude
> on every side. (Solomon, 1998, p. 171)

Because "their own culture of everyday life and meaning continues to intrude on every

side" Aboriginal students, who may already feel separated from the culture of school,

may feel doubly removed from the subculture of math and science classes, and, may find

it even more difficult to negotiate "meaning from one domain to another" (Cajete, 1999,

p. 97). So, as Thelma Perso (2001) writes on the mathematics experience of Aboriginal

students in Western Australia:

> We should not then, be surprised when Aboriginal children fail to meet
> benchmarks set by the dominant culture – indeed, would we pass a test on
> numeracy as set by Aboriginal people – bearing in mind that the test
> would focus on mathematics skills and knowledge as needed to survive in
> a totally unfamiliar environment.[15]

Recognizing mathematics and science as a subculture, says Aikenhead (1998), allows us

to see more clearly how:

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[15] However, this by no means implies that expectations for Aboriginal students should be lower than for other students. As Sheila Watt Cloutier (2000) emphasizes, the lowering of expectations is a "form of structural racism that we must make every attempt to stop. There is a balance of respect and challenge that can be met, and we must make it a priority to find it" (p. 115).

> If the subculture of science [and mathematics] generally harmonizes with a students life-world culture, science instruction will tend to support the student's view of the world ... On the other hand, if the subculture of science [and mathematics] is generally at odds with a student's life-world culture, science instruction will tend to disrupt the students' view by trying to replace it or marginalize it ... (pp. 86-87).

Again, when a student's knowledge is devalued he or she is faced with symbolic violence and may react accordingly. This reaction can manifest as frustration, anger, tension and what may seem to the Western teacher to be a refusal to study or conform to expected norms (Aikenhead, 1998; Cajete, 1999; Goulet, 2001, MacIvor, 1995). More disturbingly, some students faced with this situation will disengage from science and mathematics, and sometimes, drop-out of school all together.

In terms of basic communications theory, Aikenhead is referring obliquely to what Wilbur Schramm (1954) would call the shared experience of the sender and receiver. The "receiver and sender must be in tune" (pp.5-6), that is they must have some common ground upon which to base their exchange of information. The more common ground they share, the easier it is for a message to be sent and decoded by the receiver in a manner approaching what was intended by the receiver. However,

> ... if the experience of the source and destination have been strikingly unlike – then it is going to be very difficult to get an intended meaning across from one to another. That is the difficulty we face when a non-science-trained person tries to read Einstein, or when we try to communicate with another culture much different from ours. (Schramm, 1954, p. 6)

In discussing ways to reform science education for First Nations students, Madeleine MacIvor (1995) quotes Nan Armour, an educational consultant for the Labrador Inuit Association:

> ... one of the main problems with science education was that it had always been presented in 'white' terms and that examples of science in action were often chosen from the white world. Thus science is considered to be a largely foreign subject by the local population. (p. 76)

Cajete (1999) agrees saying: "Research indicates there is a 'mismatch' between the perspective from which science is traditionally presented in American schools and the general cultural and individual learning styles of Native Americans" (p. 14).

Very clearly science and mathematics have been presented to Aboriginal children in a manner which has not been in tune with their fields of experience or worldviews. Very clearly science and mathematics have not been introduced to Aboriginal children from within a constructivist. or holistic framework. But thinking scientifically and mathematically is not foreign to Aboriginal peoples. For at least twenty thousand years before contact with Europeans, they constructed shelters, made clothes and tools. managed crops. practiced medicine. conducted trade and acquired knowledge about the world in which they lived. All these achievements required what Westerners would refer to as mathematical and scientific reasoning. That this knowledge was framed in a worldview different from Western tradition in no way diminishes its value as scientific achievement.[16] It also suggests that there is a means to make science and mathematics speak to Aboriginal children.

In 1988. the Mohawk community of Akwesasne began a collaborative pilot project to develop mathematics and science curricula that were based in Mohawk ways of knowing, but that did not reject Western science and maths concepts. The resulting curricula were holistic. involved Elders and parents. and "include[d] experiential components that link the theory learned in the classroom to the life of the community" (MacIvor, 1995, pp. 457-458). From a constructivist point of view. the curriculum allowed students to see

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[16] In fact, Cajete (1999) notes that what he refers to as indigenous sciences are just as internally consistent as Western science

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"the underlying values and assumptions of Mohawk and western concepts" (Ibid.) and build an understanding of how the two worldviews could coexist and complement each other.

Unfortunately, development of programs like the Akwesasne Science and Mathematics Pilot Project which meet the needs of Aboriginal students are the exception rather than the rule. As Cajete (1999) writes: "Setting forward a process integrating Native and Western perspectives of science requires a relentless and systematic commitment to change" (p. 46). For the moment that commitment does not exist[17] and many successful programs never move beyond the pilot stage because ongoing funding for continued development is difficult to acquire.[18] In addition, there is, as yet, no formal mechanism for communicating information regarding successful models through all the 633 reserves in Canada.

2.08 Formal and informal learning

> In many ways, the barriers blocking aboriginal *sic* students from science fields are similar to those blocking women from science 20 years ago: lack of role models, lack of mentoring, lack of validation for the pursuit of science. (Mullens, 2001, p. 10)

While there are a wide variety of cultures and cultural differences in mainstream Canada, for the most part non-Aboriginal students are much better served by the dominant approach to education, and science/mathematics education, precisely because it does not represent a rift with their understanding of how the world works. In addition, these

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[17] The commitment may come when the Working Group on First Nations Education submits its report and recommendations to the Minister of Indian and Northern Affairs before the end of 2002. However, given the number of inquiries, recommendations, consultations and reports which INAC has commissioned and received on Aboriginal education since the 1970s, and the lack of systematic change, there appears to be a "wait and see" attitude on the part of the people who will be impacted by any significant change recommended by the Working Group.

[18] Multi-year funding from federal or provincial governments departments is notoriously difficult to obtain given that spending priorities can change with each budget.

students are supported by a whole network of informal learning opportunities and resources designed (where design is required) for them as an audience.

> Although no one would quibble with the importance of formal schooling and the necessity of working toward the improvement of science education, it is easy to lose sight of the science learning that also takes place in informal contexts. (Frenette, 1991, p. 17)

Informal learning is learning which takes place in settings outside the classroom. In terms of science and mathematics, informal learning may occur in a number of ways:

- family or school field trips to museums, aquaria, and planetaria;
- participation in science camps;
- reading of science magazines;
- viewing of science television shows;
- surfing science web sites on the Web;
- exposure to family and friends who work in the sciences and therefore act as role models.

Informal learning resources may be used by a classroom teacher to support formal learning, but they are often designed to be used by a child largely in the absence of a teacher.

Informal learning – spaces, resources, methods – in science and mathematics has not been extensively studied.[19] There is some sense that it provides "overlapping and reinforcement" of knowledge acquired in more formal settings, while providing "opportunities for learning, practicing, and applying skills and knowledge in supportive

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[19] This deficit of knowledge is perhaps brought about by the strong culture associated with Western mathematics and sciences which narrowly prescribes the acceptable means of pursuing knowledge in these domains. The US National Science Foundation has recently recognized the dearth of research in this area. It has contributed nearly $11 million (US) to the University Of California (Santa Cruz) and King's College, London for graduate research focused on the links between informal and formal learning (Centre for Informal Learning and Schools, 2002).

and positive surrounds" (Schauble, Beane, Coates, Martin & Sterling, 1996, p. 6). More importantly, especially for students who may not be well-served by classroom methods and resources: "In some instances out-of-school learning contexts are designed specifically to sideskirt the constraints and connotations of school-based education ..." (Ibid., pp. 6-7). As such, they provide excellent spaces in which to develop innovative ways of delivering materials and messages; ways which lead students to see science in a new light and acquire an ongoing interest in the subject.

The lack of culturally-appropriate learning resources in science and mathematics for Aboriginal students extends into the informal arena. In their presentation to the Royal Commission on Aboriginal Peoples, Vice Chief E. Lerat and Del Anaquod of the Saskatchewan Indian Nations Education Commission discussed Aboriginal peoples' desire for both formal and informal learning opportunities:

> Education is a lifelong, continuous process requiring stable and consistent support. First Nations people of every age group require appropriate formal and informal opportunities for learning and teaching. The education provided must be holistic. Education processes and institutions must address the intellectual, spiritual, emotional and physical development of participants. (RCAP, 1996b, Vol.3, p. 445)

From a traditional, historical standpoint, what Westerners would call formal learning is the foreign element in many Aboriginal cultures because, as Gail Valaskakis (2000) writes: "Oral tradition provides what Marshall McLuhan calls a 'classroom without walls,' in which 'the young learned by listening, watching, doing the language and skills of their elders'" (p. 86). The sense of a 'classroom without walls' may be echoed in informal learning because: "The boundaries between informal learning contexts and the rest of daily life seem more permeable than they are in school. These boundaries are fluidly crossed by parents, other adults in the community, and children of different ages"

(Schauble, Beane, Coates, Martin & Sterling, 1996, p. 8). In addition, informal learning opportunities are often constructed so that the learning occurs within a "community" where learners have contact with "An array of teachers, each with knowledge of a particular kind of domain or skill" (Ibid., pp. 8-9).

Chief Perry Bellegarde, Vice-Chief of the Assembly of First Nations and Chairman of the National Chiefs' Committee on Education has said: "We've got to get our kids excited and hooked on science" (Mullens, November, p. 17). Because of the strictly prescribed entrance requirements for post-secondary science and mathematics-based programs, students must follow the science and maths curriculum throughout their elementary and secondary schooling in order to gain admission. To get through all the preparatory work, it certainly helps if they become "hooked on science" at a young age; informal learning may provide the hook.

There are a growing number of informal science learning opportunities for Aboriginal children and youth in Canada. Several universities and school boards run summer science camps or science outreach programs designed through the collaboration of Elders, professors and/or community classroom teachers. Some science centres and museums have developed or adapted programs to more appropriately address Aboriginal students. Organizations such as the Canadian Aboriginal Science and Technology Society (CASTS) and the Canadian Aboriginal Science and Engineering Association (CASEA) provide Aboriginal role models who are willing to visit schools and participate in community events. CASEA also sponsors science fairs for Aboriginal students, with a focus on francophone nations in Quebec. The federal and provincial governments, as well as organizations such as the National Aboriginal Achievement Foundation, have developed programs like the National Aboriginal Career Symposium and Blueprint for Success, designed so that Aboriginal children from different nations can meet and further

explore science and mathematics careers options. Like most informal learning opportunities aimed at non-Aboriginal children, these programs emphasize connections between study and achievement, exploration and fun. What distinguishes most of them from opportunities designed for non-Aboriginal children is their grounding in Aboriginal worldviews.

While all these initiatives represent steps in the right direction, they are bound by restrictions of time and space. The opportunities need to be extended to more Aboriginal children, but, as already noted, there is no formal mechanism for communication of information regarding successful models throughout the country. Where informal science and mathematics learning opportunities for Aboriginal children are still largely missing, and may be able to overcome at least some restrictions of time and space, is in the media.

2.09 Science for children in the media

> Technology is central to Canada's social history. Like the transcontinental railroad of an earlier era, communications technologies and the cultural industries they generate shape the Canadian experience and identity. For Aboriginal people, however, the image and identity forged by the media all too often bear the traits of exclusion, stereotypical inclusion and misappropriation. (RCAP, 1996a, p. 621)

In acknowledging the significant role that media and technologies play in the development and construction of a people's "experience and identity," the Royal Commission on Aboriginal Peoples recognized the importance of ensuring Aboriginal access to media technologies and the inclusion in the media of content and programming developed from an Aboriginal perspective. The authors wrote that: "Aboriginal perspectives in mainstream and Aboriginal media should be central factors in the formation of Aboriginal and non-Aboriginal culture, identity and community" (Ibid.). So

doing, they underlined the role of the media, not only in the process of constructing one's own identity, but also in the process of constructing the identity of "the other"[20] and thus identified it as a site of struggle over identity and meaning. Gail Guthrie Valaskakis (2000), a contributor to RCAP agrees, saying that: "Communication is the dynamic ground in which individuals and communities are formed, and this process involves conflicting media images and the ideological messages they carry" (p. 77). Given the problematic relationship that Aboriginal learners have with science and mathematics in the formal arena, it is important to examine how these topics are presented in informal arenas, such as the media.

Non-Aboriginal children in North America have a wealth of informal media-based science and mathematics learning opportunities designed for and aimed at them. In the print media, this includes magazines such as *Owl, Chickadee, Chirps, YES Mag, National Geographic World* and *Les Débrouillards*, as well as books too numerous to list. On television it includes weekly series such as *Beakman's World, Bill Nye the Science Guy, Cyberchase, Newton's Apple,* and *Real Science*, along with one-time and special programming developed by organizations such as the National Geographic Society, the Public Broadcasting System (PBS) and cable networks such as the Discovery Channel and Animal Planet.

While Aboriginal children, for the most part, can access the above resources, as with more formal learning, media-based informal science learning resources and opportunities do not, as a general rule, show their faces, broadcast their voices or tell their stories. In terms of print media, there are no Aboriginal equivalents[21] to the magazines listed above.

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[20] While the authors of RCAP do not explicitly state that Canadian identity is in many ways constructed based in opposition to some other identity, their sense is reminiscent of Hall's work on construction of identities in the center and periphery of a society (Hall, 1991).

[21] As far as I am aware there are no print-based media focusing on science aimed at Aboriginal children.

The Aboriginal Peoples Television Network (APTN) does air *The Seventh Generation* and *Jump Start: Active Television for Busy Kids*. *The Seventh Generation* features three young Aboriginal role models in each episode. In the two seasons of production several episodes have featured people with science-based careers (Big Soul Productions). *Jump Start* focuses on sports achievement of youngsters (mainly Aboriginal) from across Canada and includes short segments relating sports to science.

Jump Start is hosted by three young people aged 11-13. Andrew Johnson, Liane Chiblow and Danielle Printup. The two young women are Native. The science segments on *Jump Start* are two and half minutes long. The segments are introduced by one of the show's hosts, but then cut to an explanation provided by an expert from the Exploratorium Museum in San Francisco (Leon, 2002). While the Exploratorium has an excellent international reputation for informal science teaching and learning, the fact remains that in a show which looks at children's achievements in community, the venue for explaining science is outside of the community. More importantly, the face given to that explanation is non-Native.[22]

While both APTN series feature segments on science, neither has science as its main focus or integrated into the overall narrative of the show. Much work remains to be done in order to ensure that Aboriginal children get exposed to media-based learning resources which present scientific and mathematical concepts from the perspectives and stories of

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[22] *Jump Start* also sends some mixed messages through its web site. In the section where viewers can meet the hosts, Andrew, the non-Aboriginal host, is quoted as saying his favourite subject is science and that if he had a million dollars he would "buy every gadget imaginable from the store to create his own laboratory ... And he would buy a really big telescope so that he could gaze at the stars." By contrast, Lianne says her least favourite subject is math and she wants "to be an actress, a veterinarian or marine biologist." Danielle is also not "too fond of math" but her second choice for a career would be to become a doctor (Genuine Pictures Inc.).

their own peoples, because: "Stories are not just entertainment. Stories are power. They reflect the deepest, the most intimate perceptions, relationships and attitudes of a people. Stories show how a people, a culture thinks. (Lenore Keeshig-Tobias in Valaskakis, 2000, p. 76).

The Royal Commission on Aboriginal Peoples (1996c) notes that Aboriginal media have made a significant contribution to public education in Aboriginal communities (p. 104). When communities are committed to improving educational opportunities for their children, these same media should be encouraged to extend that contribution to include programming related to science.

2.10 New media, new opportunities

> Today's technology provides possibilities for creating rich computer-mediated learning environments. At the same time, beliefs about how multimedia learning materials should be designed and about what they can and should be able to do in an educational context continue to evolve as new knowledge in the form of research findings, learning theory. technological innovations and applications. actual product development. and user feedback combine in unforeseen ways to inform those beliefs. (Ahola-Sidaway & McKinnon, 1999, p. 5)

In 1977, Wilbur Schramm wrote: "If there is *a* medium for nonformal education, it is radio" (p.228). While radio may remain the medium for nonformal (and informal) education in developing countries, I would suggest that in developed countries at the beginning of the twenty-first century, if there is *a* medium for informal education, it is the Internet. Since the beginning of the 1990s there has been a growing interest in how to effectively deliver education and educational resources via the Internet's graphical user interface, the World Wide Web. As with television and radio, this new medium was initially looked upon as a great equalizer - a means of bringing education to people all over the world. But information without a context is not knowledge, and many people

around the world are without the financial means and basic infrastructure required to access the Web. So, while initial hopes have not been entirely discarded, expectations have become more grounded in reality.

Today, some post-secondary institutions use the medium to effectively support and even deliver formal learning experiences to college and university-level students at a distance. The Centre for Rural Education and Distance Learning at the Memorial University of Newfoundland is in the third year of a pilot project which is examining the best means of delivering Advanced Placement courses in the languages and sciences to senior secondary students in small, remote fishing communities on the coast of Labrador. Without the project, the students would have little or no access to these courses, and the post-secondary opportunities they open. One of the Centre's key findings is that for students below the post-secondary level, it is very difficult to remove the teacher from the learning, and that formal learning experiences must be mediated by a teacher in order to be successful (K. Stevens & M. Barry, Centre for Rural Education and Distance Learning, Memorial University, personal communication, November 2000).

While the findings of Memorial's pilot project may one day serve Aboriginal students in rural and remote regions of the country, the focus of my project is informal learning. As with other informal learning resources, there is little research examining the effectiveness of informal online resources, for either Aboriginal or non-Aboriginal children. There are also many more online sources designed for Western, non-Aboriginal audiences. What is more, the resources developed for non-Aboriginal audiences more often take advantage of two of the key strengths of the medium: the ability to combine different channels (audio, video, text, graphics) of message delivery; and interactivity.

Conduct a Google search with the key words, "Native American," "Indian," "Aboriginal" and "Science" and a surprising number of hits are returned. Sites for associations like CASTS and CASEA, sub-units of the federal government's First Nations SchoolNet initiative, culturally-appropriate lessons plans built by community teachers, connections to Web sites built by students in northern schools etc. Most of the sites are highly textual and informational, use little interactivity, are designed largely for classroom or teacher use and offer little in terms of a holistic approach to presenting science.[23] Very few offer much in terms of engagement that would make the youngster exploring the Web from home want to bookmark the site and return.

By contrast, some of the more general science sites for children are much more appealing in terms of both content and presentation. They rely much more heavily on graphics as opposed to text, use interactive elements where appropriate, and are designed to speak to children in the absence of a teacher. Ironically, many of these sites, such as http://www.brainpop.com and http://www.exploratorium.edu, are engaging because they use storytelling, a traditional teaching tool in Aboriginal communities, within their formats.

On the positive side, because the World Wide Web is a new and evolving media, there are new and evolving opportunities to use it to develop effective online science and mathematics learning spaces designed specifically for Aboriginal students. The cutting edge in online learning focuses on using the computer not just as a broadcast medium, but as a true communications tool through which children can interact with peers and experts in various fields to actually build knowledge in constructivist-type explorations.

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[23] An exception to the rule is *Native American Indian Art, Culture, Education, History, Science* found at http://www.kstrom.net/isk. This site presents all materials from an Aboriginal perspective while offering links to other sites for further exploration. Unfortunately, the author died in 1997. While the content is still valuable, it would have been interesting to see where this site would have gone with the development of new Web-based technologies such as Flash and streaming video.

Laferrière, Bracewell and Breuleux (2001) talk about a changing paradigm in education, in which the computer plays a key role in "Reconfigurations of time and place for learning, but most importantly, [of] new ways for learners, including the teacher-as-learner, to collaborate and establish relationships with other individuals and knowledge objects" (Laferrière, Bracewell & Breuleux. 2001). Most cutting edge applications remain confined to a small number of classrooms working closely on long-term research projects[24] directed by university-based researchers. Very few of these projects address Aboriginal learners or their needs, and where they do, they are largely focused on post-secondary or adult education delivery.

There are some very pragmatic reasons for this deficiency. First, while research does not necessarily require broadband, high speed Internet access, it does require reliable Internet access, and in Aboriginal communities,[25] the reliability of the network is often more at issue than speed of access. Second, in order to obtain funding, cutting edge projects are very often built around immediate community needs, such as a lack of trained environmental officers or teachers. As such, the focus of these projects is necessarily adult learners.

While the cutting edge is exciting, it is beyond my expertise and scope. Given, the small audience which has access to cutting edge applications, I would also posit that it is not what is required as a starting point for Aboriginal learners. Because of the disconnect Aboriginal children (and people) often experience with science, I would argue that the

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[24] With significant funding.
[25] And other rural and remote communities.

starting point should be the creation of a learning space in which they feel comfortable exploring science. Such a space would show their faces, tell their stories and allow them to build connections between what they know and what other people know about how the world works.

3. Methodology and Research/Development Method

I draw on Sandra Harding's very simple distinction between methodology and method, that is, 'A research methodology is a theory and analysis of how research does or should proceed ...' and 'A research method is a technique for (or a way of proceeding) in gathering evidence.' Methodology is important because it frames the questions being asked, determines the set of instruments and methods to be employed and shapes the analyses. ... Methods become the means and procedures through which the central problems of the research are addressed. (Smith, 1999, p. 143)

This chapter provides both an analysis of how the media project proceeded, and summarizes means used for development and the gathering of evidence.

In constructing the methodology for the media project. I relied heavily on 8 years of experience in the development of print and web-based science learning resources for Aboriginal high school students. I also reviewed literature written by Indigenous people on academic research and collaborative or community-based research and development (Cajete, 1999; RCAP, 1996b; Smith, 1999). Merging experience with the review of good practice, I confirmed that the project would be best developed in collaboration and cooperation with educators, parents, and Elders at the community level. A collaborative approach would allow for community level input from conception through design and implementation, input which would be key if the site was to be grounded in Aboriginal perspectives and reflect community needs. In addition, because "Deciding how well a program has done after it is over does not contribute to making it better in the first place," (Solberg, 1977, p. 8) a collaborative approach would allow for both ongoing, formative evaluation and a summative evaluation of the site and its pilot content.[26]

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[26] As well as the development process itself.

Janet Solberg's (1977) examination of the research and development considerations for children's television programming in Canada, outlined the critical role of formative evaluation in the development of successful programming. Formative evaluation, she says, is "first and foremost, an exercise ... in which the investigators ask for value judgements from all groups to whom the results of the evaluation will be a matter of concern" (p. 26). She also underlined the value of testing material with members of the intended audience during the development process (p. 7). Because the thesis-project would only produce pilot content for the site - content which Solberg says should be "judged experimental in nature and mutable in result" (p. 14) – it was decided to test the site with five to ten children when it was approximately 90%-95% complete. Feedback gathered would be considered summative within the confines of the media project to be submitted for evaluation, but formative in the larger project of completing and expanding the Explore! site.

In terms of methods used in development, I again relied heavily on experience. I also reviewed literature on instructional design and curriculum development (Cajete, 1999; Gilliland, 1988; Kemp, Morrison & Ross, 1998; Schramm 1977), children's television programming (Solberg, 1977), and good practice in web site design/web-based instruction (Davies, 2002; Facey, 2001; Gillani, 2000; Haughey, 2002; Laferrière, Bracewell & Breuleux, 2001; Ungerleider & Burns, 2002; Wakeham, Silva & Bracewell, 1998; Wulff, Hanor & Bulik, 2000). Some of the latest work on best practice also emphasizes the need for collaborative development, particularly with respect to cultural groups on the periphery of dominant society. Ellen Facey (2001) of the University of Northern British Colombia, for instance, equates the development of online resources for Aboriginal peoples with other development projects. In order to ensure that development meets the needs and desires of the community, she says: "local people who will be the beneficiaries of the 'development' must be involved in the decision-making process from

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the beginning and at all planning stages, through testing, implementation, and evaluation."

Through the review of good practice, it became apparent that the process followed for the development of curriculum and learning resources – defining the audience, defining the message, outlining the desired outcomes of the message, determining how best to deliver the message, and establishing a means to measure the impact of the message - is much the same as the process followed for the development of media programming and content. Given Schramm's (1977) assertion that in using media for instruction "only the *use* is different" (p.12), these similarities are perhaps not that surprising.

So, the Explore! model web site was developed within a collaborative framework following the standard stages of media development - preproduction, production and postproduction. Within this process, formative evaluation occurred largely during production, and summative evaluation during post-production. This chapter examines preproduction and production phases, and the corresponding formative evaluation. Postproduction and summative evaluation are discussed in Chapter 4, Results: Postproduction summative evaluations.

3.01   Preproduction

Preproduction consisted of planning the development process for the web site. It included establishing the goals of the project, defining (to an extent) the target audience and identifying the challenges which would have to be addressed in the course of production. Preproduction also involved recruiting collaborators and developing a means by which we could communicate over distance and time.

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3.01.1 Choice of medium

As outlined in Chapter 2, there are very few media-based science resources aimed specifically at Aboriginal children. In considering the medium for delivery, I began by reviewing some existing programming targeted at children in the same age range. One of my initial thoughts was to reproduce the excitement of popular television shows such as *Bill Nye the Science Guy*,[27] but to build the content around Aboriginal perspectives. A television show format, however, would not allow for the depth of exploration or level of interactivity I would like to offer users. Print was another option, but because of language issues, and because many of the formal resources to which the children are exposed are already print-based, I decided against exclusive reliance on print.

I chose the World Wide Web as the medium of delivery because of its multimedia nature. The web allows for the integration of print, video, graphics, sound and animation. More importantly, it allows for interactivity, places control of the experience in users' hands, and provides a means of two-way communication between users and the site developer or web master. These features allow children to construct knowledge in their own fashion (within the limits of the content), and provide for dynamic content if users' experiences and knowledge are integrated into the site over time.

Other reasons for choosing the web as the medium for delivery were related to educational research. While academic research is still inconclusive on the impact of web-based or computer-mediated instruction on formal learning outcomes, studies do show a clear increase in learner interest and motivation when computers are used in instruction (Haughey, 2002; Laferrière, Bracewell & Breuleux, 2001; Ungerleider & Burns, 2002). Laferrière, Bracewell and Breuleux (2001) write:

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[27] *Bill Nye the Science Guy* is a syndicated children's television show produced by PBS, Disney and the NSF. The show presents science as a fun and exciting way of discovering more about the world.

This motivational effect may seem to be a 'soft' outcome of placing technology in the classroom, since the major benefit that one would like to see is an increase in learning on the part of the students. In the face, however, of drop-out rates of 30-40% at the secondary level, increasing student motivation to stay in school is a major issue.

While they are referring to computer use within formal learning contexts in mainstream schools, I believe the argument can be extended to informal contexts as well, especially with respect to Aboriginal youngsters. With many Aboriginal students leaving school before the age of 14, it is necessary to explore *any* means through which their interest and motivation can be captured and potentially increased. This point was underlined in my interview with Ojibway Elder, Lillian McGregor, who said: "We have to do whatever it takes to get them interested and back in school" (Personal communication , April 4, 2002).

In addition, while Aboriginal researchers in education (Cajete, 1999; Hampton, 1995; MacIvor, 1995; Miller Cleary & Peacock, 1998) caution against reliance on descriptors such as learning styles,[28] they do agree that research shows evidence of some shared characteristics among Aboriginal learners. These characteristics include a preference for:

- visual presentation of material;
- oral as opposed to written language;
- observation preceding performance;
- experiential, hands-on learning;
- practical, real world examples presented in context.

Again, through the multimedia format of the World Wide Web, it is easier to address and integrate these specific learner preferences than with other media.

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[28] Because they do not address the complexity of the change which needs to be brought about in order to effectively meet the educational needs of Aboriginal students.

Finally, there is an expressed desire at the community level for culturally relevant online resources (Davies, 2002; Wakeham, Silva & Bracewell, 1998). Unfortunately, this desire is not yet supported by sufficient local expertise or resources. So, at the most basic level, working with community members to develop a web site for Aboriginal children addresses an identified need.

It must be acknowledged that not all Aboriginal communities have the infrastructure to support access. Connectivity in Aboriginal communities varies widely across Canada, and, as Facey (2001) points out, there is a lack of solid information regarding computer usage and connectivity in First Nations communities. Despite Industry Canada's assertion that all Canadian schools are online, anecdotal evidence from reliable sources indicates that in reality some schools and communities are much better served than others. Experience and discussions with educators in community indicate that the country can almost be divided into thirds from north to south. In the south and far north, most communities seem to be connected to the Internet, with access speeds varying more in the south and number of available access points varying more in the north. Another problem in the north is maintenance; there is sometimes only one computer technician serving several communities or schools. In the middle third of the country, access ranges from non-existent to the use of high-end computers with high speed access. One of the major impediments to access in this middle part of the country is cost. The Kativik School Board had all of its schools wired and online until November 2001 when Bell Canada withdrew its moratorium on long distance charges for rural and remote schools accessing the Internet on Bell lines. The cost of access was too much for the school board to absorb, and so Kativik students had no access to the Internet for about three months when affordable arrangements were secured (B. Hannah, personal communication, January 11, 2002; B. Mesher, design questionnaire, April 18, 2002).

While access and access speed does vary, there are clear indications that more communities are getting online and services are improving. Still, in order to remain accessible for as broad an audience as possible, Explore! was designed to balance the download time and bandwidth requirements of interactive and media-rich elements with the need to keep end users engaged.

3.01.2 Foci, goals and challenges

In order to present collaborators with a clear vision of what I was hoping to accomplish in the media project, one of the initial steps of preproduction was to establish the project's focus and goals and identify potential challenges.

As previously stated, the project had three primary foci:

1. The development of a technological structure for an online, informal, science learning space aimed at Aboriginal children in mid- to late elementary school;

2. The production of the pilot content for the space;

3. The examination of a collaborative process as a means for developing effective learning spaces for Aboriginal children.

There were also a number of goals which I hoped to achieve in cooperation with collaborators.

1. To ground the site in Aboriginal worldviews[29] and take a holistic approach to the presentation of content so that Aboriginal children could investigate relationships and negotiate differences between Western and Aboriginal perspectives in a space which honours their knowledge.

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[29] In the plural because it will not be intended for use in any one community or by any one nation.

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2. To integrate the two ways of knowing within a structure which allows for a certain amount of self-guided discovery, fun and whimsy.

3. To contribute to the early development and maintenance of an interest in science.

4. To present positive Aboriginal role models in science.

5. To provide non-Aboriginal children with an alternative view of science, and an introduction to Aboriginal peoples in general.

6. To design a space that would be expandable and flexible enough to allow for the eventual addition of new topics, each to follow the format developed for the pilot content.

At the beginning of the project there were two clear challenges to be addressed during the development of the site.

1. As the site will likely be integrated into the larger body of work of the NAEP, it had to be designed for a multi-national audience.[30] As such, the first challenge was to try and find ways to integrate and address the perspectives of different Aboriginal nations and include different community examples.

2. For a growing number of Aboriginal children, their first language is a Native language. For others, first language is English or French, but the language of instruction is a Native language. While it would be ideal to create a web site using an Aboriginal language or languages, I have neither the expertise nor the access to the funds required for translation into the number of Aboriginal languages spoken within Canada.[31] At the same time, most Aboriginal children will learn English[32] at some point in their schooling.[33] As such, the language of the site is English and

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[30] The NAEP is federally mandated to serve all Aboriginal peoples living within the geographic boundaries of Canada. It also serves a growing number of nations located within the United States.

[31] There are over 60 Native languages groups (and about 200 languages and dialects) spoken by Aboriginal peoples in Canada, but – for the most part – English is the shared tongue.

[32] A small percentage will learn French.

[33] Second language instruction usually begins in grade 3 or 4. It may be introduced as a second language or become the language of instruction.

the challenge became to find ways to make the site accessible to English second-language (ESL) children and to children who understand English well, but may not have strong reading skills.

Other challenges presented themselves over the course of development.

3.01.3 Original concept

While the structure and content for Explore! ultimately grew out of the work with collaborators. I began the project with some sense of what elements should be incorporated into the site, and how it should be structured.

- The site would open with a general introduction, which would set the stage for the rest of the experience. My original plan was to animate a short introduction in Flash which could be skipped by users who had previously seen it or did not have the viewing capability.

- The introduction would lead to a home page based on a metaphor which would work over a range of topics and nations.

- Each topic, including the pilot, would consist of approximately 10-15 interlinked web pages (excluding the introduction and homepage). They would feature and link together Aboriginal and Western perspectives on science, Aboriginal role models in science, and interactive elements to demonstrate and solidify understanding.

- The learning space would incorporate some Flash elements, but little or no streaming audio/video as these require access to high speed download capability which is out of reach for much of the primary target audience.

3.01.4 Recruitment of participating collaborators

Recruitment of participants was the real beginning of the project. As the project is related to my work, adult participants/collaborators were largely recruited through an existing network of contacts in Aboriginal schools and school boards across Canada, as well as government agencies. I initiated contact with potential collaborators with whom I had previously worked via email and phone calls. Several of these people provided the names of colleagues or other community members who might be interested in working on the project. For the most part, they had confirmed the person or people's interest before forwarding names and contact information to me. I then followed up with a more formal invitation to participate either by phone or email. In order to keep the group manageable, I wanted to limit the number of collaborators on the project to between 10 and 15 people.

The following people participated as collaborators in the development of Explore!:

- Jim Barta - Professor of elementary school mathematics education, Utah State University, Logan, UT;
- Shannon Beauchamp (Ojibway) - Policy Analyst, Learning, Employment and Human Resources Development Directorate, Indian and Northern Affairs Canada, Ottawa, ON;
- Christine Diabo (Mohawk) - Parent, Kahnawake, QC;
- Joyce Diabo (Mohawk) - Middle school math and science teacher and parent, Kahnawake Survival School, Kahnawake, QC;
- Nicola Doughty – Elementary teacher, York House School, Vancouver, BC;
- Dannette Dubois (Ojibway) – Middle school math and science teacher, Children of the Earth School, Winnipeg, MB;
- Shelley Goodleaf-McComber (Mohawk) - Elementary teacher, Kateri School, Kahnawake, QC;

- Ann Grace - Elementary math and science/ESL Consultant,[34] Kativik School Board, Montreal, QC;

- Barry Hannah - Computer Consultant, Kativik School Board, Montreal, QC;

- Ann Lanteigne - Elementary school teacher, Ulluriaq School, Kangiqsualujjuaq, QC;

- Bob Mesher (Inuit) - Parent and grandparent, Kuujjuaq and Montreal, QC;

- Lylee Williams (Mohawk) - Parent and teacher, Kahnawake Survival School, Kahnawake, QC.

In addition, I also received feedback from, met with or had ongoing informal input from:

- Jerilyn Horn (Mohawk) – Programme Assistant, Native Access to Engineering Program, Concordia University, Kahnawake, QC;

- Lillian McGregor (Ojibway) - Elder, University of Toronto, Toronto, ON;

- Kathleen Mount Pleasant (Tuscarora) – Preservice elementary teacher, McGill University, Montreal, QC;

- Corinne Mount-Pleasant-Jetté (Tuscarora) - Founder, Native Access to Engineering Program, Concordia University, Montreal, QC.

For the summative evaluation by children towards the end of development, I received names through collaborators, and through others who were familiar with my project. In all 6 children, ranging in ages from 7 to 12, evaluated the web site.

3.01.5 The target audience

In preproduction, the primary audience was loosely defined as Aboriginal students across Canada in mid- to late elementary school, which corresponds to an age range of roughly 8

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[34] Pedagogical consultants are educators with extensive class room experience who work with in-class teachers to help them remain current in terms of pedagogy and curricular changes.

to 12 years. The age range was determined through research into childhood developmental stages (Henson & Eller, 1999; Frenette, 1991), and a survey of the age range of target audiences for current children's magazines and television programming on PBS and APTN. While I was reasonably confident the 8-12 age range could be served by the site, I wanted to confirm the age range of the audience with collaborators for a number of reasons.

First, I thought the age range may narrow because of language ability. As already mentioned, many Aboriginal students are ESL learners, or receive instruction in their Native language. As such, the English reading and comprehension skills of many children within the primary audience may be below the level expected for mainstream children in the same age group.

Second, the web has not been extensively studied as a delivery medium for children. As such, target audience definition is perhaps not as clear as for more established media. Part of the strength of delivering material via the web is its multi-channel delivery. While the project focused on the development of visually rich environment, it would also incorporate text. Here again, reading level and comprehension may impact engagement with the final result, and the age range of the primary audience could potentially have narrowed.

Finally, in the process of recruiting collaborators for the project, I mentioned the target age group I was considering to Jim Barta. Dr. Barta is a Professor of Elementary Mathematics Education at Utah State University with extensive experience in Aboriginal communities. He responded by email, writing:

We typically do cluster by age but we do so for our own convenience rather than in response to how groups of kids learn best. We create learning objectives for age categories, [but] again I believe for our instructional convenience. This is an easier way to do it, but if we want to really think outside the box, why not create a set of questions that kids at a variety of ages could respond to? A rich activity or activities allow kids at any age (almost) to create a response. Their response is what then becomes developmentally appropriate. When we set learning expectations for age groups, I worry that sometimes we hold kids back who, even though young, are wise beyond their years. (J. Barta, personal communication, February 4, 2002)

For these reasons, I felt it necessary to further define the characteristics of the primary target audience during the initial stages of collaboration.

I also wanted the web site to be accessible to two secondary audiences, the parents and teachers of children in the primary audience, and non-Aboriginal children in the same age group as the primary audience. Many of the parents and educators I spoke with indicated their children are not permitted to indiscriminately surf the web. Because these adults, to a greater or lesser extent, control and vet the sites which their children are allowed to visit, it was important that any site which was developed should be attractive and appealing to them as well as their children. I wanted the site to appeal to non-Aboriginal children for the simple reason that they are exposed to very little – if any – accurate information regarding Aboriginal people in the course of their daily lives. As much as I believe Aboriginal children will benefit from being exposed to ways and means of negotiating different perspectives and worldviews, I believe the experience is equally valid for non-Aboriginal children.

3.01.6 Eliciting feedback

During recruiting I explained to collaborators that they would be asked for feedback 3 to 5 times over the development of the web site. They were also invited to provide input at any point where it seemed relevant. The final decisions of preproduction were:

- how to allow collaborators to see the site as it developed and changed based on their feedback;

- how to most easily communicate and collaborate with a group of people who were, for the most part, working full time and located in different regions of the country.

In order to allow collaborators to see how the project was progressing, I set up two temporary web sites which they could access at their own convenience. Both sites can be found on the CD-ROM included with this report. The first website, http://www.hotzot.com/dawn, outlined where the project stood at any time and provided links to questionnaires and examples for feedback. The second site, http://www.hotzot.com/explore,[35] contained the web site itself. In this way, collaborators would experience the site in much the same way their children would eventually experience it. By accessing the site "live" they could comment on both the content of the developing site, and any technical problems they experienced; feedback on both these areas was required in order to build a site that would work for children.

I opted to use email as the primary means of communicating with collaborators. At key points in the development, collaborators were sent an email explaining where the project stood, what (if anything) they needed to explore in order to provide feedback and what they could expect following feedback or as next step. (See Appendix A for a sample introductory email.) While contact was always initiated by email, collaborators could (and did) respond in a variety of ways. Each request for feedback was accompanied by a questionnaire. The questionnaire was included as a Microsoft Word attachment with the

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[35] This web site, http://www.hotzot.com/explore, should be viewed in Internet Explorer as Netscape 6 has some difficulties with dynamic html which I have, as yet, been unable to resolve. In order to view all features, the Flash and Real Audio plug-ins are required.

email, and was also posted as an online form. Collaborators could choose to respond in the manner which was most comfortable for them – via the Web, by email or by fax. Collaborators were also told I was happy to discuss questionnaires by phone or, where feasible, in person. Over what was eventually five formal feedback points collaborators availed themselves of all these options.

3.02   Production/Formative Evaluation

Given the collaborative nature of the media project, production and formative evaluation proceeded concurrently. As stated, there were five points at which formal feedback was requested, four of these occurred within the production/formative evaluation stage.

Collaborators did not all respond at every feedback point. The number of responses in formative evaluation ranged from 4 to 11, with an average of 7.5 responses at each point. Any decrease in the number of responses appears to have been a function of collaborators' schedules and commitments as opposed to any loss of interest in the process; if a person missed one or two feedback points they generally responded again further along in the process.[36]

3.02.1 Design Questionnaire

The first step in production was to define more clearly the expectations and desires of collaborators, as well as to gather information about the audience and their ability to access the web. From the responses gathered I was hoping to pull out common themes and concerns. The design questionnaire (see Appendix B) covered questions related to expectations, access, audience, design/look and feel, and content.

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[36] When the number of responses were low 7-10 days after the initial email, I would send a reminder email to collaborators. This second email usually generated more responses.

Expectations

The first question of the design questionnaire asked collaborators what their expectations for the project were, given the goals and challenges I had outlined. Their responses indicated they were expecting the site to be fun, visually interesting and incorporate interactivity and choice. They also hoped that it would present the two different worldviews in tandem, and be designed in such a way that ESL learners would find appealing. These expectations were perhaps best summed up by Dannette Dubois:

> I expect the web-site *sic* to integrate Aboriginal knowledge of the world into current Western-society science curriculum. I understand that it will try to be inclusive of the various differences, even among our different Nations. I expect it to use basic language so that all students may understand the content of the web-site, even those with ESL issues, or lower literacy skills. I expect it to have a positive approach that entices students to explore and creates an interest, in place of fear and avoidance, of science. (Design questionnaire, April 18, 2002)

Finally, although I had outlined my intention to develop an informal learning space, collaborators (both parents and educators) expressed their desire for the site to support learning in such a way that it could be used in the class room as supplementary material or in the home to support school projects.

Access

Questions related to access provided information regarding how children actually access the web and the technologies/software which they use.

All of the collaborators indicated that their children have access to the Internet. In the north while access is available, it is less frequent due to cost and reliability of service. As expected, download capacity varies quite widely, from 14.4 modem to high speed cable and satellite, but most students have reasonable access through the local school. At the

site from which the Internet is accessed most often, all of the respondents said children have access to printers and CD-ROM drives. Most have access to computers with standard plug-ins including Acrobat Reader, Flash, Real Video and Real Audio, fewer can support streaming audio and video. Most have computers capable of screen resolutions of 800x600 or higher.

Audience

Questions related to audience were intended to further define the target audience.

Feedback from collaborators confirmed much of what has been written with regard to Aboriginal learners: they are not big risk takers, they prefer information placed in context, they are visual and hands-on learners. Collaborators also emphasized that their children are interested in the World Wide Web, have web sites they visited regularly, and usually spend more than 30 minutes online in any one sitting. Several underlined that the children are very curious about the way the world works. As one parent wrote: "They like to know 'why'" (C. Diabo, design questionnaire, April 13, 2002).

With respect to the age range which the site should target, the design questionnaire offered four options, 7-9, 8-10, 8-12 and Other. Seven respondents said the age range should be 8-12, two preferred 8-14, and one thought it should target 12-16 year-olds (one person offered no opinion). Collaborators had a number of comments with respect to the age range. Barry Hannah, Ann Grace and Ann Lanteigne, who work for the Kativik School Board, all emphasized that because of ESL issues, defining age is difficult:

It is important to keep in mind that regardless of the age range the site is created for, some of the clientele may be much older. Our students don't start second language learning until grade 3 and are thus a solid 3 years behind when it comes to reading. This may cause problems as they may be learning grade 6 science concepts but learning them with the vocabulary one would expect a grade 3 student to have. (B. Hannah, design questionnaire, April 3, 2002)

Shannon Beauchamp, who works with Aboriginal youth across Canada, pointed out that there are very few resources for children in mid- to late elementary school or middle school:

There is stuff for 0-6 and for 15-30 but nothing for the kids in the middle. Nothing. It's almost as if they do not exist. Our kids are dropping out at 13 or 14 – that's hardly surprising. (Design questionnaire, April 18, 2002)

Given the feedback and comments received, I elected to maintain the 8-12 age range I had previously chosen as a target, but to remain mindful of the differences which collaborators had indicated.

Design – Look and Feel

The look and feel of a web site is determined by concrete aspects, such as colour and layout, as well as more intangible aspects, such as the reaction it elicits in users. Questions about look and feel were intended to contribute to the design of the site environment and interface.

Collaborators said that the environment should be engaging and inviting, integrating colour, visuals and animation. They wanted navigation to be easily understood; users should not get trapped or lost in the site as it results in frustration. Users should also get somewhere "interesting" within three clicks of the mouse. They clearly indicated that because animations, visuals and interactivity considerably increase download times,

when these elements are used they should add value to the site; there has to be a payoff to any wait time. On this point, Nicola Doughty wrote: "Sometimes the medium obscures the message – and therefore visuals require careful reflection. ... basic is better and less is more" (Design questionnaire, April 23, 2002).

Collaborators liked the idea of having a guide character for the site. The also liked the idea of framing the web site within a metaphor, however, there was little consensus on what the metaphor should be. What they did clearly communicate was the need for the metaphor to be inclusive rather than specific to any Aboriginal group:

> Make sure the metaphor is relevant to all Aboriginal groups – for example a dream catcher is not part of Inuit culture, nor is the medicine wheel. Make sure the metaphor does not create stereotypes or project incorrect information: Inuit and Indians don't live in igloos or in tents. A science lab might be more appropriate – a living lab that includes the outdoors and indoors. (A. Grace, design questionnaire, March 26, 2002)

Based on this feedback, I decided to abandon the idea of creating an introductory animation for the entire web site. Given the comments of collaborators concerning children's frustration with slow downloads and material which does not have a clear point, it seemed likely that users would find an introductory animation frustrating or annoying.

I decided that animations incorporated into the site should be used only where they would have some impact and add value to the learning. I also decided to consider what metaphor and guide character might be appropriate for the site.

Content

Questions related to content were intended to determine what messages should be presented to children as they navigate through the site and how these messages should be presented.

Collaborators responded that one of the messages which should be clearly conveyed throughout the site was respect - respect for Elders, respect for the earth, respect for all living things. They also indicated that content should be presented in a way that balances factual information with storytelling.

There was no consensus on a specific topic to develop as pilot content. In general, collaborators suggested topics such as the Earth, the planets, animals etc. While these were all valid suggestions, they were too broad to address in the pilot content for the site.

Given the lack of consensus on content for the pilot, I decided to proceed by developing the interface for the site. I also began further research into what might be appropriate pilot content by looking at web sites and books which had been suggested by collaborators.

3.02.2 Look and feel: Interface design part I

While the topics collaborators suggested were too broad to develop as a pilot, they were a good indication about where priorities lay in terms of what their children should be learning. The earth and topics closely related to the earth, such as nature, animals, water and stars, were suggested by every person who responded to the design questionnaire. I concluded that the earth should, therefore, play a central role in the look and feel of the site.

While considering feedback from the design questionnaire, I also began to reflect on what it was I really wanted children to do in the site. I wanted them to look at science in new ways; I wanted them to feel like they wanted to discover more; I wanted them to ask questions and be moved to look for answers. What I wanted them to do was be excited about exploring the site and the topics presented within it. As such, I decided to propose that the site be called "Explore!" I thought the word worked because it could be read as both an instruction and an invitation, and because exploring is what scientists do.

Before developing any options for the interface design, I also considered how children would navigate from the home page to the second level of the site. This required determining the navigation options to be presented to users on the home page. Having chosen to focus on the exploring the earth, and revisiting topic areas suggested by collaborators, I decided to move from the earth to its constituent parts - water, land, sky/air and stars. With these decision taken, I proceeded to design three options for homepage design.

Option 1

Option 1, shown in Figure 2, featured an Elder on the land, sitting in front of a fire.

Figure 2. Home page option 1

Collaborators had expressed an interest in both a guide character and the need to send the message of respect for Elders. I had been considering how to convey "the sense" of an Elder within the site, and decided it would be most easily accomplished by using an Elder as the guide through the site. I positioned the Elder as shown in order to create a sense of peace and calm on the home page. I was also hoping the positioning of the character might suggest the need to reflect upon exploration in order to more completely understand what is discovered.

The elements of stars, sky, land and water were represented visually in the background and repeated as words in buttons running down the right hand side of the page. By placing the words in relation to what they represented, I hoped ESL children could more easily understand what would be contained within each section of the site.

Option 2

Option 2, shown in Figure 3, featured the planet Earth against a blue background.

Figure 3. Home page option 2
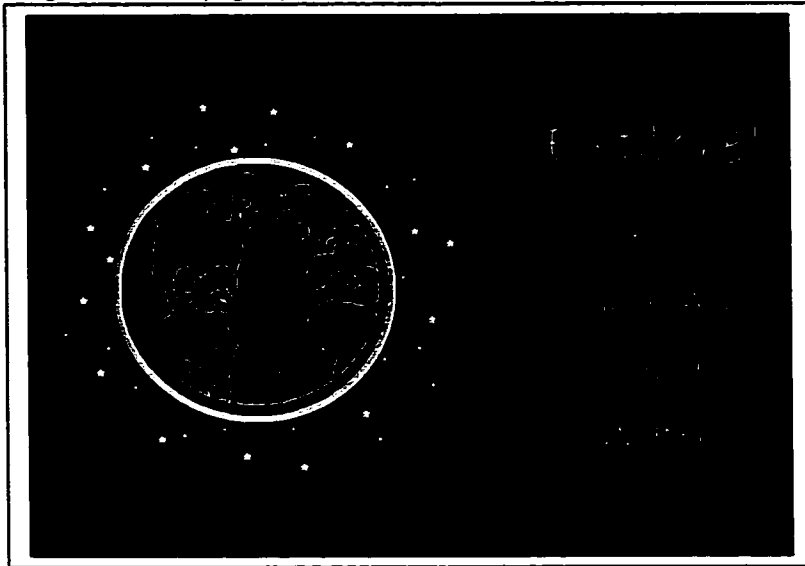
This option was considerably more straightforward than option 1. I wanted to provide collaborators with one choice which was visually interesting, but very simple.

Option 3

Option 3, shown in Figure 4, featured an adult inviting a group of children to explore the earth.

Figure 4. Home page option 3

Stars   Sky/Air   Land   Water
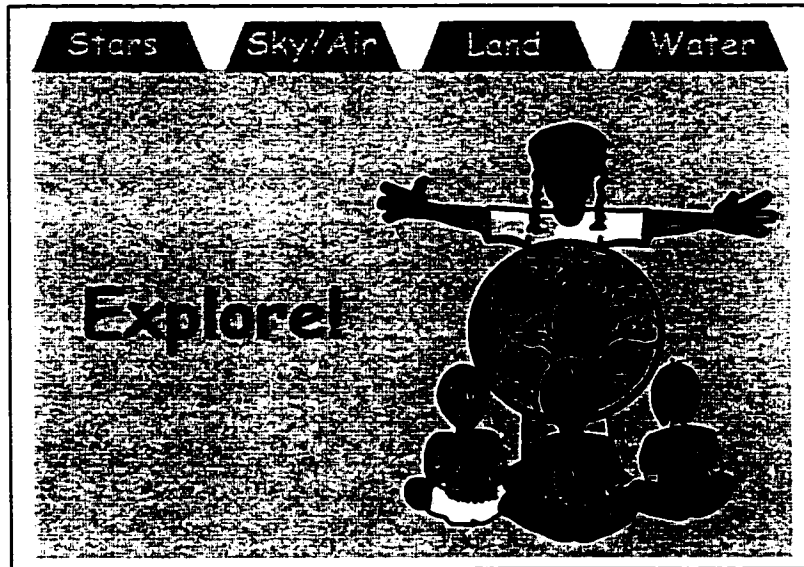
Explore!

With this option, the adult character, and potentially the child characters, could act as guides within the site. I also wanted to provide an option where children would have visual reference to themselves as explorers. By positioning the children in such a way that facial features were hidden, I thought users from any nation might be able to see themselves in the place of one of the characters.

Feedback

These three options were put online, and collaborators were asked to provide feedback through the short questionnaire included in Appendix C.

All of the responding collaborators liked the title "Explore!" Bob Mesher wrote: "It is inviting and you'd want the kids to feel they are 'exploring' rather then something like

'learning' or 'remembering.' Such things would be more subtle spin-offs from exploring"
(Look and feel questionnaire, April 1, 2002). Christine Diabo said: "I actually like the
title, after all that is what children like to do. Explore seems like a very good title. So
simple and then the kids can decide what they would like to explore" (Look and feel
questionnaire, April 26, 2002). Ann Lanteigne, whose Inuit students are ESL learners felt
that the word was easily taught for those who did not understand the meaning right away
(Look and feel questionnaire, April 19, 2002). Shelley McComber-Goodleaf suggested
another word be added to "Explore" to give it more impact: "Explore Today or Explore
Now or Explore More? I think there should be another word that goes with the word
explore that shows the modern tie with the old" (Look and feel questionnaire, April 22,
2002). While I did not change the title, I would eventually incorporate her suggestion into
the overall structure of the site by calling supplementary sections Explore fact, Explore
figure, Explore picture and Explore more.

One of the first responses I received on interface design was from Ann Grace at the
Kativik School Board. Her comments on the three options were:

> Option one is too Indian – the Inuit wouldn't go for it. Option 2 is general
> – our world and keeping it livable is an important focus of science. Option
> 3 is not bad, but again the figures are too Indian. (Look and feel
> questionnaire, April 16, 2002)

I took these comments seriously as I very much wanted the site to be inclusive and did
not want to discourage Inuit children as soon as they reached the home page. As such, I
paid very close attention to the responses from the three other collaborators from within
the Inuit community. None of them communicated the same concerns which Ms. Grace
had raised.[37]

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[37] In retrospect, one of the other collaborators had expressed some concern regarding the Elder in option 1.
I initially misread his comments. In his response to t he look and feel questionnaire, Bob Mesher wrote: "I
especially like the one of earth and the children. It shows we need to be appreciative of the whole planet.

Other collaborators indicated a clear preference for option 1 as long as the buttons and text were made larger and the children from option 3 were incorporated into the design:

> I would recommend ... that you add the children from option 3 and have them sit on the other side of the fire. This way, the young people can see themselves on your site and there is an implied circle of learning. (S. Beauchamp, look and feel questionnaire, April 23, 2002)

Given what I thought was a clear preference. I decided to proceed with the interface design based on option 1. While Ms. Grace's comments still concerned me, by this point I was exploring the possibility of building each lesson in the site (and thus the pilot content) around a story. I thought the concerns she had expressed might be allayed through the use of an Inuit story in the pilot.

3.02.3 Look and feel: Interface design part II

Moving forward with design of the site involved some further consideration of navigation and structure. I wanted to keep the navigation as clear as possible. I also wanted users to reach substantive content within three mouse clicks of the home page. Because the ultimate goal is to add much more content, any structure and navigation developed had to be easily replicable and expandable. At this stage of production, I planned the structure, shown in Figure 5, to the point where users would choose a specific topic to explore.

The man and the fire may be a bit too 'native' or something like that, and the on eof the earth and stars, I find the font is a bit too light" (April 1, 2002).

Figure 5. Basic structure of Explore web site

Home page	2nd level Topic Area	Level 2 buttons Topics	Level 3 Content
Explore!	Explore Stars!	Environment	Unit 1
			Unit 2
			Unit 3
		People	Unit 1
			Unit 2
			Unit 3
		Planets	Unit 1
			Unit 2
			Unit 3
		Stars	Unit 1
			Unit 2
			Unit 3
	Explore Sky/Air!	Animals	Unit 1
			Unit 2
			Unit 3
		Environment	Unit 1
			Unit 2
			Unit 3
		People	Unit 1
			Unit 2
			Unit 3
	Explore Land!	Animals	Unit 1
			Unit 2
			Unit 3
		Environment	Unit 1
			Unit 2
			Unit 3
		People	Unit 1
			Unit 2
			Unit 3
		Plants	Unit 1
			Unit 2
			Unit 3
		Rocks	Unit 1
			Unit 2
			Unit 3
	Explore Water!	Animals	Unit 1
			Unit 2
			Unit 3
		Environment	Unit 1
			Unit 2
			Unit 3
		People	Unit 1
			Unit 2
			Unit 3
		Plants	Unit 1
			Unit 2
			Unit 3

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Pilot content would be one unit in level 3.

With the above structure established, I redesigned the home page based on collaborators feedback (see Figure 6), and built second and third level pages for stars, sky, land and water (shown in Figure 7).

Figure 6. Redesigned home page

Figure 7. Second and third level pages for water (no buttons).
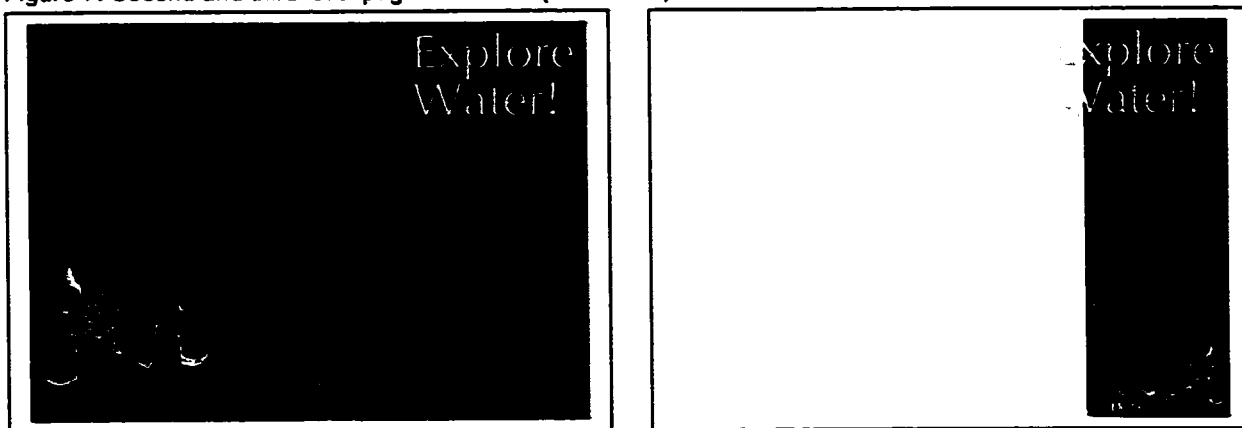
The corresponding pages for stars, sky and land, followed a similar format. These pages can be viewed in the "Stage 3: Look and Feel" section of http://www.hotzot.com/dawn on the CD-ROM which accompanies this thesis-project.

The completed designs were placed online. While I did not ask for any formal feedback from collaborators at this time, I did send an email telling them where they could view the images. All four collaborators connected to Inuit communities responded that the design would not work for their students:

> I noticed in your e-mail of this morning that you said that the majority of the people chose the page with the native story-teller and the children. I can tell you now, that it really won't fly with the Inuit. They are adamant about not being rolled into the "Aboriginal" mould and that image will jump out at them. They might even decide that your website is not for them at all. (B. Hannah, personnel communication, May 7, 2002)

I met with Barry Hannah and Ann Grace so that they could more thoroughly explain their concerns regarding the design. The discussion quickly focused the problem on the figure of the Elder. They did not like his positioning or facial features – they were too "distinctly southern." They agreed that if the Elder were changed, the design would likely work for Inuit users.

With this feedback, I revisited the interface design one more time, changing only the character of the Elder. Resulting changes to the home page are shown in Figure 8.

Figure 8. Final home page.
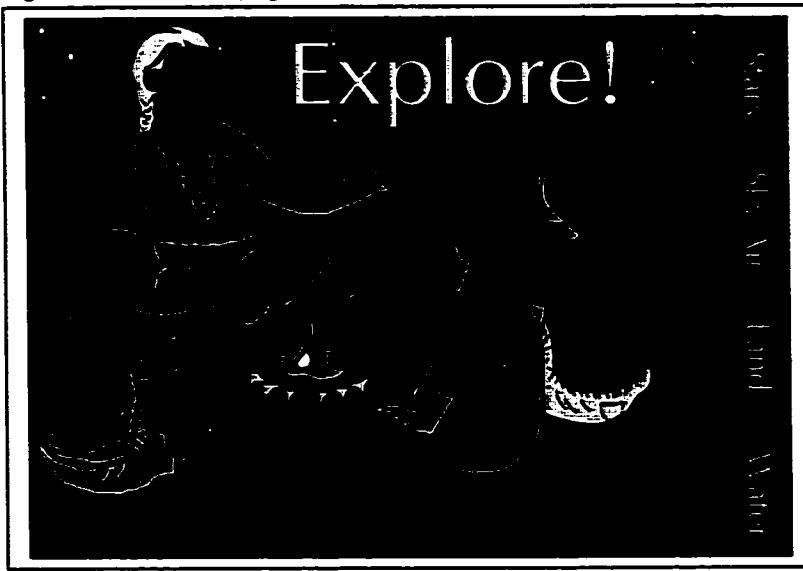
I redesigned the Elder to appear as if she were interacting with the children seated around the fire. Upon posting of the new design, Ann Grace responded by email: "I ... much prefer the story teller in the new version. I find the character shows more warmth. And, I like the idea that it is a woman" (Personal correspondence, June 10, 2002). Until this point, I had only thought of the character as "the Elder." When I received the email, the character very clearly became "the storyteller," the metaphor and the guide for the site.

3.02.4 Content

Storytelling

Storytelling is a tradition shared among many different peoples and cultures. Within Aboriginal cultures, storytelling plays a key role in more traditional means of teaching and learning:

> The oral literature of the Native American people is much more than
> something to entertain children and occupy the grandparents. It is an
> organized way of passing on the knowledge and behaviours necessary to
> the society.

> Stories slant the way a person sees the world, and in that way, change the
> world in which the child lives. The view of the world embodied in stories
> of the culture becomes for the child a 'natural' view. (Gilliland, 1988, p.
> 50)

Gilliland goes on to say that the power of storytelling can be harnessed to create a space

in which Aboriginal learners feel more comfortable negotiating unfamiliar territory:

> Written versions of stories children have heard - in their homes and in
> class - can build the bridge between oral and written communication and
> make beginning students feel 'at home' with the idea of reading, even if
> they have had no exposure to a reading environment before starting
> school. Stories from local culture can also provide the basis for the
> development of other skills - speaking, writing, creative dramatics,
> listening, even mathematics. (Gilliland, 1988, pp. 51)

Early on in the production process, I considered the possibility that stories, or a story,

might provide a means to ground the site so that children could begin exploring a topic

(in this case the pilot content) from a comfortable, familiar place. With the storyteller as

the guide and metaphor of the site, it would seem a natural transition to begin each topic

with the telling of a story. By choosing stories from different nations for each topic, I

could, over time, address the issue of including different nations and perspectives in the

site. To determine an appropriate topic for the pilot content, I began reading the stories of

different Aboriginal nations.

Within Aboriginal communities there are protocols associated with storytelling. Some

stories can only be told by people who have earned the right to tell them; other stories can

only be told at specific times or in specific contexts; still others are considered in the

public domain. Unfortunately, over time, a number of stories have been made public by people who did not understand these protocols. Not wanting to perpetuate misuse of any kind, I relied on the guidance of collaborators for reliable and appropriate sources of stories. Lylee Williams from Kahnawake, recommended a series of books by Michael Caduto and Joseph Bruchac which included *Keepers of the Animals: Native American Stories and Wildlife Activities for Children* (1992).[38] Each of the books in the series presents lessons and exploration activities built around Aboriginal stories and legends. The books were particularly useful because Caduto and Bruchac[39] (1995) clearly indicate that the stories and legends included in the books are acceptable for public sharing (p. 13). It was in *Keepers of the Animals* that I found the Inuit legend, "The Gift of the Whale."

"The Gift of the Whale" is a creation story from the north which focuses on the interrelationship between the Inuit (and other northern peoples) and the bowhead whale. The story is relatively short and, on the surface, easy to understand, however, upon deeper reading it touches on a number of themes including the environment, conservation, responsibility and the interconnectedness of all life. Younger users may not take the same meaning from the story that older users will, because their experience and understanding is different, but as Gregory Cajete writes:

> Native American storytellers utilized "coding" in their art of storytelling. "Coding" – the use of metaphor and symbolism within the contexts of particular stories – allowed and encouraged listeners to fully exercise their creative thoughts toward creative synthesis. They had to "read between the lines' to discover the underlying meaning, concepts or ideas. In short, they had to listen with the whole mind. "Coding' also allowed for flexibility in the *levels* of understanding that could be conveyed. (p. 56)

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[38] *Keepers of the Animals: Native American Stories and Wildlife Activities for Children* is recommended for children 8-11 by INAC (INAC, 2000a).
[39] Bruchac is Abenaki.

So, I felt that if the story was presented properly it would orient all users to what followed. Before making a final decision, I sent the text of the story to a number of collaborators. They responded that "The Gift of the Whale" was an appropriate choice for the target audience.

Pilot content

"The Gift of the Whale" opened a number of doors for potential pilot content: the Inuit's place in the north and how it is being threatened by global warming, endangered species, other types of whale found in northern waters etc. After some research, however, I opted to keep the pilot content closely related to the story and focus on bowhead whales.

The bowhead lives only in the Arctic, and is therefore an animal about which the Inuit have much lore and knowledge; the traditional hunt was one of the centrepieces of village life before the animals were almost wiped out by commercial fishing. More importantly, the bowhead is an animal which the Inuit and other northern Aboriginal peoples are currently studying in conjunction with Western scientists. The Inuit hope that sharing knowledge of the whale (which is a protected species) will result in a more accurate understanding of the animal's life cycles and breeding patterns, and ultimately in a more accurate count of bowhead populations. They are working with scientists, in order to one day prove the population is stable enough to support a limited sustenance hunt. They are combining what they know with what Western science knows in order to reclaim one of their traditions. Since Explore! is intended to help children understand how these two views can work together the bowhead whale seemed an ideal topic for the pilot content.

Structuring the content

In studying effective ways to build online learning opportunities, Wulff, Hanor and Bulik (2000) developed a number of questions which web site developers should consider during the construction process:

> Are there visible, cued paths for variable pace and flow through information and activities? Does the design accommodate experience diversity? How appropriate are the content, activities, and expectations of operation for the learners? Is there consistency and predictability in the design? What are the modes of learner operation? In other words, how will learners interact with the design – should they command, manipulate, or record? Do students receive immediate, functional, or motivating feedback on their actions? ... How does the design build visual impact through the coherence of textual, visual, and audio elements? How does the design of content and activities along with their display create an ·immersive experience· that engages students in learning through self-directness and social transaction? (p.157)

With an overall look and feel, a metaphor, and a topic for the pilot content, I still had to answer many of these questions in order to determine the best way to structure content so that the resulting pilot was easy to navigate, interesting and replicable.

In the design questionnaire, I had asked collaborators to provide web addresses for children's web sites which they liked. The site which most interested me in terms of structure was a web-based lesson at http://www.classroomconnect.com.[40] The lesson was built around 5 research questions. Users could click on any of the questions to read a short (100-200 word) response, and gain access to a substantial list of web sites where more information could be found. An appropriate visual, usually a photograph, supported the text. More interesting however, were the buttons that appeared in the side bar on each page. For each question, the user could choose to explore the topic more deeply and interactively through 3 options:

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[40] Classroom Connect is a fee-based educational site, which allows potential new users a free trial period.

- Think Fact, a question relating to the text the child had just read;

- Mystery Photo, a close-up or long-shot of some subject related to the topic;

- Connected Lesson, an in-depth experiment which could be conducted at home or in the classroom.

I very much liked the idea of building the site around questions and answers. If children were actually sitting around a fire listening to a storyteller, it is likely that they would ask questions about the story once it was told. Depending on the age and experience of the child, the questions would be simpler or more complex. To speak to the different levels of experience within the defined target audience. I could therefore build the content around issues of varying complexity.

I also thought it was good practice to provide clear answers to the questions, along with supplemental opportunities through which the children could further explore the topic. In this way, if a child was using the site for homework or a school project, the required information would be easy to find. If, however, the child was visiting the site for fun there would be extra spaces to discover and explore. I created four such spaces for Explore!:

- Explore fact, a fun or interesting fact associated with the question;

- Explore figure. a multiple choice question, including a hint and answers;

- Explore picture, an image much like Classroom Connect's Mystery Photo;

- Explore more, a more in-depth exploration of some topic related to the question.

A large part of the Explore!'s interactivity would be located in these spaces.

With these decisions, the structure of the web site was approximately as shown in Figure 9.

Figure 9. Basic web site structure
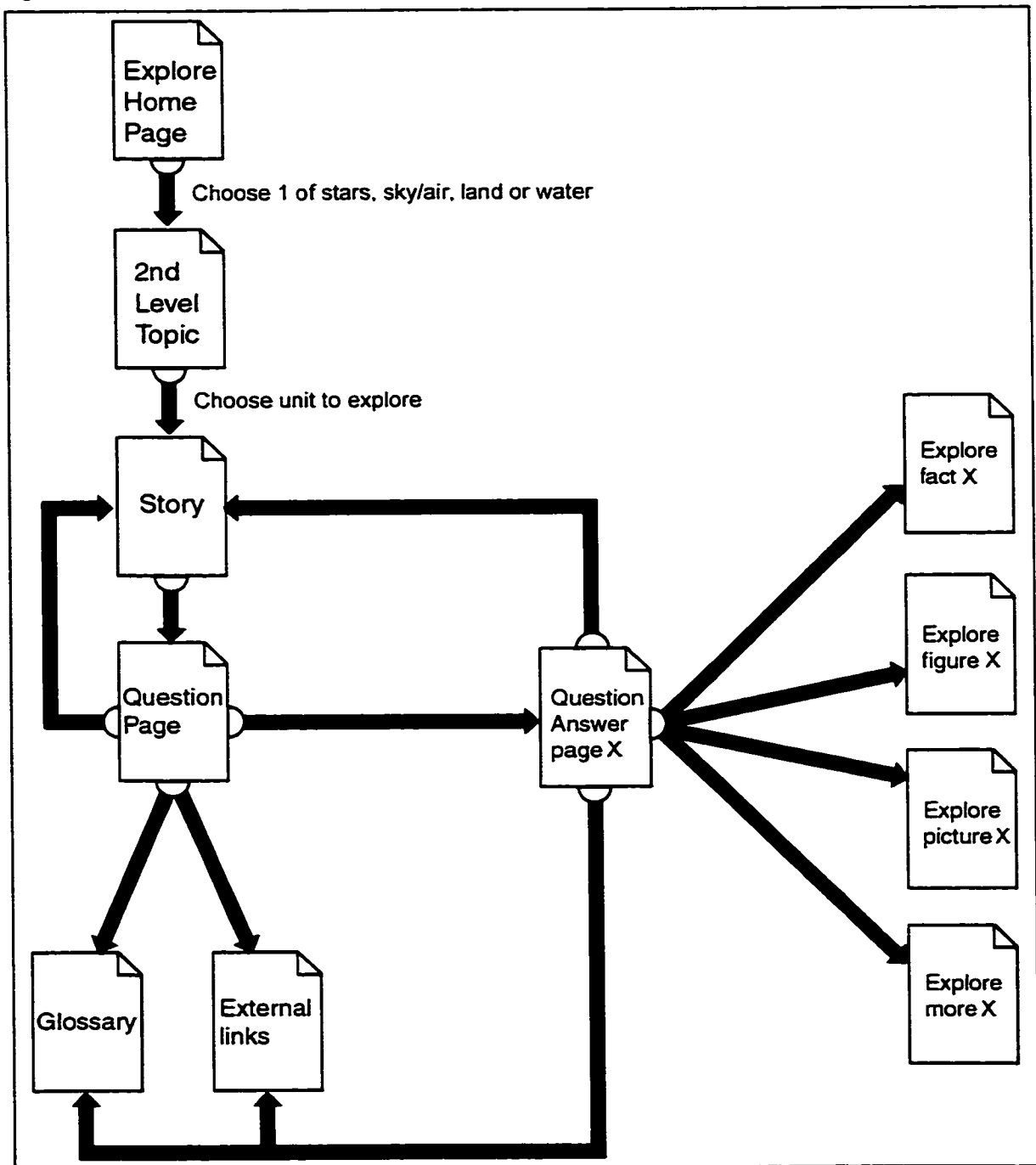
Note: The figure shows basic navigation through the web site to one question/answer page. There are several question/answer pages, and associated supplementary Explore pages, for each unit. Question/answer pages are interlinked, as are supplementary Explore pages.

I then created textual content around 7 questions:

- What is a bowhead whale?

- What do bowhead whales look like?

- Where do bowhead whales live?

- What do bowhead whales like to eat?

- Do bowhead whales communicate?

- Are there many bowhead whales?

- Will bowhead whales survive?

As the questions became more complex, so did the answers, the vocabulary and the content of the supplementary Explore links.

Pilot content was placed online as text, but linked together in a manner similar to how I envisioned the finished site. At the suggestion of Ann Grace, I built a glossary into the body of the site for ESL users. Words to be included in the glossary were highlighted in red so that they could be clearly identified by collaborators during their review of content. (See Appendix D for the content questionnaire.)

Feedback

Collaborators responded very positively to the textual content for the site. They liked framing the content by beginning with a story: "[The story] provides a kind of foreshadowing for [the users] and there may be some parts of the text that jump out at them because of a certain familiarity created by going through the story" (B. Hannah, content questionnaire, May 21, 2002). Jim Barta saw the placement of the story as vital to the site. For him it was "the link" between one worldview and the other (Content questionnaire, May 29, 2002).

Collaborators also indicated that, with the inclusion of the glossary, the language level was appropriate for the target age group: "Considering you are going to gear this to elementary students I see the reading level as a bit higher than grade 3" (J. Diabo, content questionnaire, May 27, 2002).

While most collaborators responded that the amount of cultural content was sufficient, Jim Barta believed there was something missing:

> Would there be an opportunity to 'hear' from a community elder who is saying something about the whales and the relationship to their people? I know that in the tribes with whom I have worked, having a 'voice' such as this carries clout ... Is there a way to more fully describe the interdependence of whales/environment/humans? This gets to paradigms (western vs. indigenous). One sees things in isolation, the other seeing a more holistic balance/tension. (Content questionnaire, May 29, 2002)

I later found a way to address at least part of his concerns.

Comments received at this stage actually had more impact on the final structure of the site than on content. By requiring collaborators to navigate through text in the same manner I had intended for users, they were able to point out where navigation became difficult and confusing. Barry Hannah offered advice that was particularly useful in constructing the actual site:

> I would stay away from underlining key words in your text, questions and answers. They tend to confuse people using the web since they resemble hyperlinks to other pages. ...
>
> I also found that when you click on a question and then on an Explore Picture and then on the answer to the question associated with the picture, it makes for a lot of clicking. And then, a whole lot more clicking to get back to the question page. You might want to have your Explore Picture link open in a new browser window ... that way when they want to return to the question page (or wherever they came from), all they have to do is just close this new window. (Content questionnaire, May 21, 2002)

The site was built to respond to this feedback:

- Glossary words are not underlined in the body of the site's text, but appear in a different colour. This "highlighting" provides a visual cue that there is something different about the word and invites users to try clicking.

- The supplementary Explore sections all open in new windows which are sized to fit their content. Because these windows are considerably smaller than the question/answer pages, users can always see the main body of content and navigation is much less confusing.

Ann Grace (Content questionnaire, May 21, 2002) suggested that the individual elements of each Explore space be linked together. So Explore fact 1 would link to Explore fact 2 which would link to Explore fact 3 etc. This suggestion was also incorporated into the final version of the site.

3.02.5 Building the site

In his contribution to *Issues in Web-Based Pedagogy: A Critical Primer*, Gillani (2000) writes that in order to engage young learners, web sites should incorporate elements familiar to the user:

> Effort should be made to include appropriate features for interface design to make students feel at home. These features include pictures, maps, artifacts, linguistically relevant signs, proverbs, cultural videos, cultural stories, audio, icons, metaphors, people, music, food, mythology, and other related features that are culturally appropriate. (Gillani, 2000, p. xxx)

With content, navigation and interface design in place, what remained was integration of these elements and the addition of features as suggested by Gillani.

Animating the story

I began building the site by animating "The Gift of the Whale." I had spent some time considering how to integrate narrative into the site. I very much wanted the story to provide members of the primary audience with a sense of belonging in the space. As such, it occurred to me that the story would work best as a narrated Flash animation. This format would be visually interesting and address the learning preference for oral, rather than textual presentation. By beginning with a presentation style with which Aboriginal learners would be comfortable, I hoped the story could act as a bridge into the more text-based areas of the site.

The narration was recorded directly onto PC, as read by Jerilyn Horn. There were some problems integrating the sound files into Flash, levels changed and a strange pop occasionally appeared, but, as taping and editing were time consuming, and the goal of the project was to develop a model, I decided not to rerecord the sound.

Pages in progress

When the animation was complete, I placed it in the http://www.hotzot.com/explore site. At the same time, I added a section called "Pages in Progress" to the http://www.hotzot.com/dawn site. During the main build sequence, Explore! would change frequently. The Pages in Progress section provided a space which collaborators could visit at their convenience to see how the final site was developing. In it, I provided a list of all the pages to be created and linked them to the corresponding pages under construction. Every time I changed or added something to a page, I added a comment to this effect next to its listing in the Pages in Progress section. Collaborators were invited to watch the site develop and to send comments to me at any point. They appeared to appreciate this practice: "What a good idea to be able to see the evolution of your project this way" (B. Mesher, personal communication, June 7, 2002).

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Extending the interface design

The construction of the site required that the interface design established for first, second and third level pages, be extended to all other pages in the site. It also required the design of linking elements, such as buttons, and their incorporation into existing template pages.

Buttons representing topic areas – animals, environment, people, plants etc. – were added to the second level pages, as shown in Figure 10. As the site expands, specific content under each topic area will be accessible through these buttons.

Figure 10. Second level page with topic area buttons
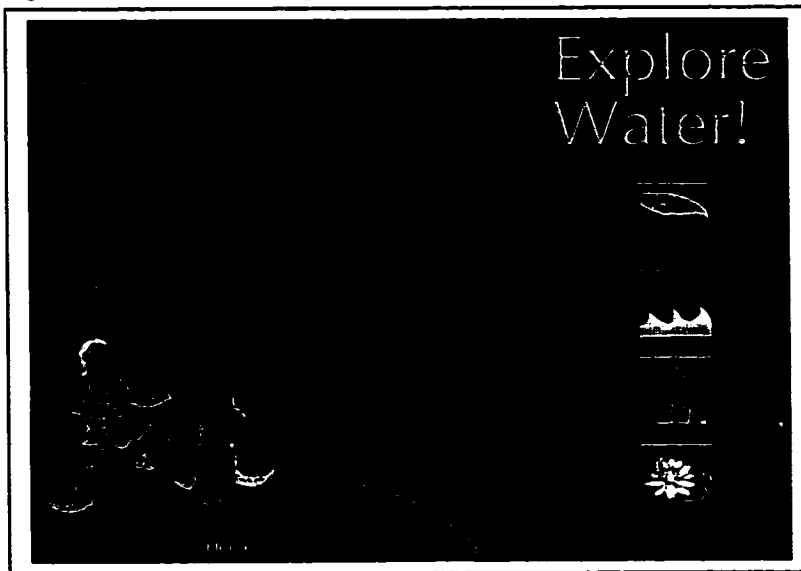
Third level question/answer pages were changed slightly. The menu bar was moved from the right hand side of the screen to the left hand side. Given the way most web browsers function, menus running down the right side of the screen can be lost if user screen resolutions are not high enough. Navigation buttons were added to the menu bar, and block colour was extended across the entire web page. A third level template is shown in Figure 11.

Figure 11. Third level question/answer page template
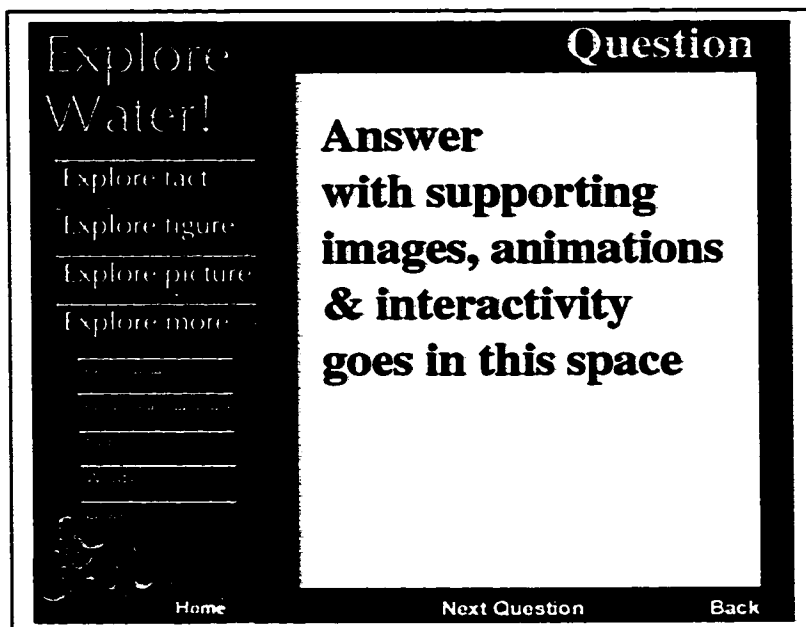
Template pages for Explore fact, Explore figure. Explore picture and Explore more were also designed. They all followed the same format. The storyteller/Elder sits in the upper left hand corner of the screen inviting users to explore the page. while a button on the left hand side of the screen allows users to link to the next page in the series. The template page for Explore fact is shown in Figure 12.

Figure 12. Explore Fact template
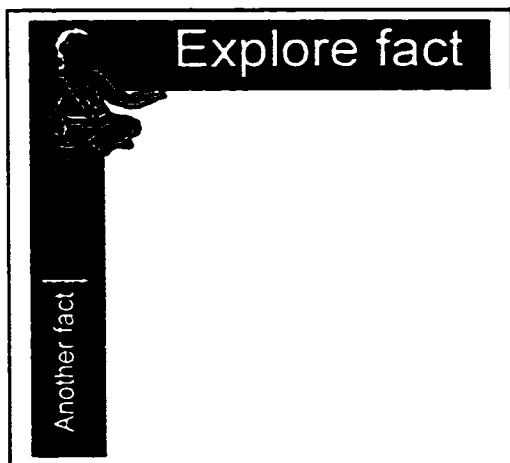
The only unique page within each topic is the question page which appears following the story. While this page will be unique for every lesson/topic added to the site, it is actually

a variation on the level three template. The question page for "The Gift of the Whale" is shown in Figure 13.
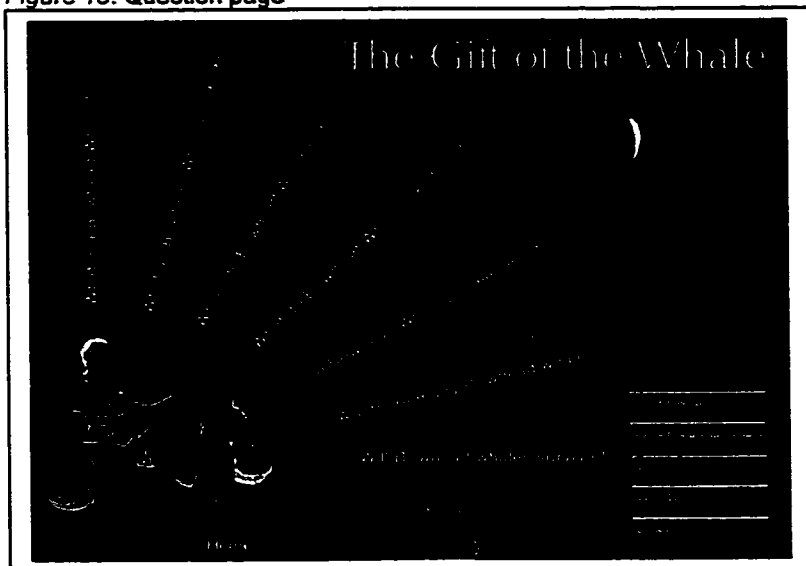
With the exception of the question page, all other pages constructed for the bowhead whale pilot content can be used as templates for future content related to water, and as models for content developed in stars, sky or land.

Finalizing Structure

The final structure for the site was very similar to that shown in Figure 9. I did, however, incorporate many of the suggestions made by collaborators in order to facilitate navigation. So, all supplementary Explore sections (Explore fact, figure, picture and more, including hints and answers) open in new browser windows which are sized to accommodate the amount of information (text and/or image) they contain. These sections are also interlinked, so that Explore fact 1 links to Explore fact 2 which links to Explore fact 3 etc. The last element in the section links back to the first, so navigation within each supplementary Explore section is circular.

All links to external sites also open in new browser windows, in this way Explore! remains on the desktop unless the user deliberately chooses to close the site.

Next question, back and home buttons were incorporated into each third level question/answer page. The next button takes users to the next question/answer page, the back button takes them to the question page, and the home button to the home page for Explore! In this way users can choose to navigate through content either in sequence or as they wish. Like the supplementary Explore sections, the last question/answer page is linked to the first so navigation can be circular.

Story and glossary buttons were also added to the question page and each question/answer page to provide easy access to these areas of the site. Planning for the future, I added two currently inactive buttons on the question page and each question/answer question page, Other Whales and Other Sea Mammals. As the site grows these buttons will provide links to topics closely related to bowhead whales.

Balancing download time with enhanced experience

Images, animation and interactive elements can significantly enhance the user experience of a web site. Unfortunately, they can also significantly increase the size of a web page, resulting in slow and frustrating downloads. Given the varying reliability and speed of the Internet infrastructure in many Aboriginal communities, the use of these elements had to be balanced against download time. As such, I made a decision early in the design process to use images, animations and interactivity only where I felt they would add value to the user's experience of the site or learning. I also opted to use formats which would keep file sizes manageable; animations and most interactive elements were developed in Flash, while images and graphics were converted from their original formats to the Graphics Interchange Format (gif). Testing indicated that the animation of

"The Gift of the Whale," one of the larger files on the site, could be downloaded by a 28.8 modem with only minor delays.

Integrating interactivity

Interactive elements allow the user to really engage with a web site's content. Responses to the design questionnaire clearly indicated that interactivity would be a necessary element in the site. In addition, though I had not yet involved children in the site development, I was aware that they would expect the site to be more than just an online book or movie. According to Laferrière, Bracewell and Breuleux (2001): "... the younger generation views Internet technology as a means for action, communication, and creativity; whereas the older generation views it as a much more passive and receptive medium analogous to television." And so, the choice of medium considered in conjunction with the defined target audience demanded interactivity.

The question and answer format of the content is, in fact, interactivity at the most basic level. For children accustomed to Nintendo and Sony Playstations, however, interactivity takes on a whole new meaning. Since I still had to contend with issues related to download times, I tried to develop and place interactive elements within the site so they do not significantly increase file size. Because the project was developing pilot content, I integrated a number of different interactive elements to gauge user preferences. These elements include the following:

- the visual glossary;
- the animated story;
- the Flash animations built into the question/answer pages:
  - bowhead name animation (What do bowhead whales look like?);
  - bowhead singing animation (Do bowhead whales communicate?);
  - loss of light animation (Do bowhead whales communicate?).

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- the Flash activities connected to Explore more sections:

  - Build an Arctic Food Web (What do bowhead whales eat?);

  - Animal Talk (Do bowhead whales communicate?).

- A grouping activity related to taxonomy created in dynamic html (What is a bowhead whale?);

- A blubber mitt experiment to be done at home where users were asked to send results back to Explore! (What do bowhead whales look like?);

- an open-ended "What do you think?" question where users were asked to share their opinions by sending email back to Explore! (Will bowhead whales survive?).

While the last two elements may not seem very interactive, they were included so that users who have technical difficulty accessing on-line features in Flash or dynamic html. still have an opportunity to deepen their understanding through exploration and interaction with the site. Wulff, Hanor and Bulik (2000) write that reflective activities such as these are an important element in educational web sites because they allow learners to

> become, in a sense, co-evaluators of learning, which enhances the interactivity of the learning process and contributes to the intimacy or personnel connections to the course as well as to closing the transactional distance. ... Defending the evidence of their own learning places the responsibility back on the student and enhances the constructivist, self-directed learning approach. (p. 158)

Integrating voice

One of the primary goals of this project was to provide a space in which Aboriginal children could explore science in a way that honoured their worldviews and knowledge. As Jim Barta pointed out in his evaluation of the textual content, including voice is an important element in honouring Aboriginal ways of knowing; there is always power in

having a voice. Within the pilot content a specific Aboriginal voice invites users into the site through the narration of "The Gift of the Whale." I wanted to extend that sense of voice through the areas of the site which were more text based.

One method of doing so was including Inuttitut words in the content where they were appropriate. During my visit with Lillian McGregor she said that language and explaining the meaning of words is very important because "We can only know what we have words for" (L. McGregor, personnel communication, April 4, 2002).[41] Inuit children visiting the site may not know the words "bowhead whale," but they will certainly know the word "arviq" because their grandparents tell them stories about the great celebrations which occurred when hunters would bring one back to the village. Inclusion of Inuttitut words acknowledges that Inuit children already come to Explore! with knowledge of their own. MacIvor (1995) and Cajete (1999) say this honouring of children's knowledge is essential to their success. It is my hope that the link to something familiar, even something as small as a word, will allow them to feel more comfortable venturing into areas which are perhaps less familiar. As content expands over time, it is my intention to incorporate words from other Aboriginal languages as appropriate to the introductory stories, and in this way develop a space in which Aboriginal children both see and hear their own voices connecting to science.

I also included voice by placing quotes from Inuit Elders and hunters throughout the site. For the most part, these quotes were taken from the Nunavut Wildlife Management Board's *Final Report of the Inuit Bowhead Knowledge Study*. Published in March of 2000, this public report summarizes a five-year project to gather Inuit traditional knowledge regarding the bowhead whale. It provides a great deal of information about

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[41] For this same reason the glossary was a necessary part of the site. ESL users need to have the opportunity to know the meaning of unfamiliar words in order to be able to construct understanding around them.

the animal's habits and habitat as observed by the Inuit. Given the goal of honouring both Western science and Aboriginal knowledge, the quotes and information pulled from the report allowed me to illustrate both where the two perspectives agreed, and where they differed. At the same time, it was very important to acknowledge that quotes from the *Final Report of the Inuit Bowhead Knowledge Study* were not my own. As such they are visually distinct from the other elements on question/answer pages, appearing as bold, white text in red boxes. They also appear in a different font than the rest of the text on the page. Each quote is followed by the speaker's name and community, and, where it exists, a link to the online source from which it originated.

Evaluation of a completed question

When all the links and pages related to one question were ready, I sent an evaluation questionnaire (included in Appendix E) to collaborators for feedback. This evaluation occurred towards the end of the school year when collaborators were very busy; only four responses were received.

Collaborators replied that navigation was intuitive and easy to understand. Nicola Doughty wrote: "I explored like a kid – fairly randomly and things seemed to really connect" (Question 2 questionnaire, June 14, 2002), while Bob Mesher said: "The clickable go here and there possibilities are easy to use. I like the ability to return to points of origin" (Question 2 questionnaire, June 14, 2002). They appreciated the option to follow information as they wished, commenting that the site was "Very sequential and at the same time recursive in the number of multilinks available" (J. Barta, question 2 questionnaire, June 26, 2002), and: "The information is provided such that it can be interesting in bits, even if not viewed in 'chronological' order" (B. Mesher, question 2 questionnaire, June 14, 2002).

According to feedback, the physical layout of images and text were mutually supportive,
"Where things appear in the layout within surrounding information should be useful to
keep the learner grounded in that they are 'learning' something in a certain context"
(Ibid.). Images and media were also appropriate and engaging. Collaborators particularly
liked the Flash animation: "I especially liked the animation of the whale and the bow and
the relationship between the object and the name – the symbolic connection is important
because it gets kids to think" (N. Doughty, question 2 questionnaire, June 14, 2002).

Some changes related to readability of the text (font, size, colour etc.) were suggested and
incorporated into the site. One collaborator expressed a preference for rollover buttons, as
opposed to the flat image buttons provided. It is likely that rollover buttons[42] will
ultimately used in Explore!, however, given the amount of time it would take to make the
requested changes I opted not to include them within the pilot section.

Having received an overwhelmingly positive response to the test question, I continued to
build the rest of the pilot section in a similar manner before beginning the summative
evaluation process.

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[42] A rollover button is one which changes appearance (e.g. colour, size or shape) when a user "rolls" the
cursor over the button. Rollover buttons indicate to the user that other content can be reached by clicking
the button.

4.   Results: Postproduction Summative Evaluations

As previously stated. summative evaluation began when the site was approximately 90-95% complete (within the context of this media project). In terms of content. very little was missing except a few photographs. What remained (and still remain) were a few technical problems which are beyond my expertise. These include:

- making dynamic html work in Netscape 6;

- fixing the audio component of "The Gift of the Whale" animation;

- adjusting the size of the text in the "Build an Arctic Food Web" activity.[43,44]

This chapter presents the summative evaluations conducted with collaborators and members of the target audience. as well as a review of how well the project has met the goals and challenges identified in preproduction.

With reference to the development of children's television programming, Janet Solberg (1977) writes that summative evaluation has three purposes:

1.   To assess the overall impact of the program;

2.   To gauge the impact of decisions and changes to programming based on formative feedback;

3.   To assess the effects of the programming (pp. 27-28).

With respect to the current media project, summative evaluation was also used to determine collaborators' satisfaction with the development process followed in the production of Explore! and its pilot content.

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[43] This activity was developed in Flash. I designated a readable font size for all text; however, in some places the font appears much smaller than it should. I tried to fix this problem in a number of ways to no avail.

[44] Ideally, I would also have added an interactive activity within the Explore More section connected to the question. "Are there many whales?" I had found a wonderful illustration of how the loss or addition of even one animal can impact the population of endangered species; however, it proved too complex to convert to interactive format within the time available to me.

Summative evaluations were conducted concurrently with members of the target audience and project collaborators. This chapter presents the results of these evaluations.

4.01 Summative evaluations: Target audience

The primary audience for Explore! is Aboriginal children aged 8-12. There are two secondary audiences; non-Aboriginal children in the same age group and the parents and teachers of children in the primary audience.

4.01.1 Evaluators

Six children. all boys[45], evaluated the web site: three Mohawk children form Kahnawake and three non-Aboriginal children from Montreal. Of the six, four speak English as a first language and two speak French: three attend school where the primary language of instruction is Mohawk, two where it is French and only one where it is English. They ranged in age from 7[46] to 12 and in grade level from 2 to 6.[47] The evaluators were:

- DD, 12. grade 6. Francophone:
- JSC, 10. grade 4, Francophone:
- JH, 11. grade 6, Mohawk:
- KW, 9, grade 3. Mohawk:

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[45] The gender and cultural mix of children who participated in the summative evaluation was not ideal. It should have included some girls (one was supposed to participate but did not due to family complications). It should also have involved Aboriginal children from other nations. These weaknesses are acknowledged. At the same time, as mentioned in chapter 3, because the site will continue to expand substantially, it was never my intention to limit evaluation by children to this one point. I noted that feedback from children would be considered summative within the framework of the media project to be submitted for evaluation, but formative in the larger project of completing and expanding the site. Had it been my intention to perform a comprehensive summative evaluation of the pilot content with children, I would have proposed a larger test group and ensured a more representative mix of age, gender and nation. I would suggest that such a comprehensive summative evaluation would require not only a larger and more representative sample of the target audience, but also more content - at least 2-3 more units.

[46] While 7 year-olds are technically not included in the target audience, this child was eager to attend the evaluation session when he learned what his older brother was going to do. When his mother asked if he could attend, I decided to include him to see how he interacted with and reacted to the material as a younger child.

[47] Grade level completed June 2002.

- OH, 7, grade 2, Mohawk;

- PMP, 11, grade 5, Anglophone.

While I offered to travel to the children in order to conduct evaluations, most parents preferred to bring the children to me. As such, five evaluations were conducted in the NAEP offices at Concordia University and one was conducted in the home. All of the children have home access to the World Wide Web and are reasonably sophisticated users. As such they had no trouble moving through the pilot content and really interacting with the material.

4.01.2 Evaluation session structure

At the beginning of each session.[48] I explained to children that I was in school like them and had to make a science web site for children their age as a project. I told them I needed their help because since I was not their age any more, it was hard for me to be sure that they would like and understand everything in the site. I explained that the site would eventually be a lot bigger and contain a lot more information and activities, but that I had made one section as a test. Finally, I assured them that it was okay to tell me about parts of the site they did not like because the only way I could make the project better was by fixing or changing those parts.

As there is only one complete unit within Explore!, I introduced the children to the site, showing them the homepage and second level pages where content will eventually be added. We then viewed "The Gift of the Whale" animation together. When the story was complete and the question page appeared on the screen, I told them they could go anywhere on the site, but that there was no content under the "Other Whales" and "Other

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[48] There were five evaluation sessions.

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Sea Mammals" buttons. Children were then allowed to explore the content on their own[49] for about 10-15 minutes. I remained close by, available to answer questions and to observe how they were reacting to the material. At the end of this period, I asked them if they had any questions or wanted some more time to look at the site. I allowed another few minutes for self-exploration, and then came back so we could look at some specific features of the site (a few animations, the interactive elements, some supplementary Explore sections) together. As we examined these sections of the site, I began asking the children some questions about what they were seeing and doing. When we completed these sections, I asked them more general questions about their experience and opinion of the site.[50]

4.01.3 Questions

Kemp, Morrison and Ross (1998) write that the purpose of obtaining summative feedback from students is to gauge interest and engagement in, as well as attentiveness and attitudes to material (p. 209). It is also used to determine positive affect or learning which occurs as a result of exposure to the material. Solberg (1977) indicates that summative evaluation with children should examine both the overall impact of programming and the effectiveness of individual segments within it (p.25). She suggests that evaluations be based around questions such as:

- What did you like/dislike?
- Would you like to see less/more/the same amount of ...?
- What would you tell your family/friends about ...?
- What did you think this part was trying to say?
- Did you learn anything?

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[49] The 7 year-old needed help reading the site. His aunt and I took turns helping him read the content, but he dictated navigation through the content and worked through the interactive sections largely on his own.
[50] One child, KW, did not want to answer many questions during the evaluation session. With the agreement of his parents, I sent the questions to his home by email and he responded this way.

I based my questioning on these suggestions and added:

- If you knew this site was on the web, would you go there? For what purpose?

- Was there anything you didn't understand?

- Did anything help you understand more?

- Did you think the site was good for kids your age?

- Did you notice anything different about this site compared to other ones you go to?

4.01.4 Results and Feedback

Within the time allotted children were able to see a good part (more than 60%) of the material contained in the unit. All of the children appeared relatively engaged in the material, particularly the animations, images and interactive features. While part of the engagement may have come from their parents explanations of how they were to behave,[51] there were indications - giggles, smiles, spontaneous "cool"s and similar reactions - to indicate they were genuinely enjoying the material.

In the course of navigating the site, only one child got a bit lost after following an external link which interested him; while the link had opened in a new window, it had completely covered the Explore! window, and he could not understand why the "Back" button would not take him back beyond the homepage of the external link.

The two Francophone children, who both attend school in French and speak mostly French in the home,[52] required some help with language, but generally, managed to understand content when supported by the glossary and accompanying images. JSD said

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[51] A number of parents left the children with variations of, "Remember, you're here to help Dawn, not just surf the net," so most children took the idea of helping me very seriously.
[52] Both have one Anglophone parent.

the glossary "really helped" and that the site would "even be okay" for his friends who did not speak English at home because they were " having English classes at school now" (JSD, site evaluation, July 30, 2002). All three Mohawk children also made use of the glossary, though to a lesser extent, probably because they all speak English in the home. They indicated that, where they did not understand a word, the glossary was helpful. PMP, the only evaluator to both study in English and speak it in the home noticed that the glossary only extended to words that were in the main text blocks of the question/answer pages. He suggested that words from other parts of the site, "especially the quotes," be integrated into the final version (PMP, site evaluation, June 29, 2002).

The children liked the story, and indicated that the interactive and animation features were their favourite parts of the site. PMP said: "The little cinematics were just fun" (Ibid.). No one interactive piece stood out as a favourite, although OH and JH, the two brothers who attended the session together became very involved in the Arctic Food Web activity, as they tried to see who could choose the correct answer fastest. OH, the 7 year-old, became very excited each time he outdid his older brother.

The children also liked the supplementary Explore sections. A few of the younger ones required some help in answering questions in Explore Figure, either because the math or language was a bit beyond their level. Most said the hints provided were helpful, but one believed they were too much so, telling me: "They are a giveaway" (Ibid.). Nearly all the children responded in a similar manner to one particular graphic in the site. Explore fact 2 says, "The Inuit have found Bowhead whales who are over 100 years old." It is accompanied by an image of a whale walking with the aid of a cane. Five of the six laughed or giggled and told me that some of the images "are really funny."

Each of the children was able to articulate something they had learned in viewing the pilot content. They were also able to explain what I considered to be one of the more difficult concepts presented in the content. The question/answer page for "Do bowhead whales communicate?" explains that because there is not a lot of light under water, whales often "see" by using sound. An accompanying animation shows how as a whale dives deeper and deeper below water there is less and less light. Each child was able to explain the animation and accompanying text in his own words.

When asked to rate Explore! overall, all the children said they liked it and would tell their friends about it when it was finished. JH said one reason he liked the site was because. "All the sound, information and pictures together, help you understand. I didn't realize how big the whale was until I saw the picture of its tongue. That made the connection to the whole whale"[53] (Site evaluation, June 10, 2002). Most thought it was aimed at their age level (even the 7 year-old), although PMP thought parts were a bit too young for him. The children indicated that they would go back to Explore! if they needed information for a school project. and "sometimes just for fun." They all wanted more interactive elements in the site. and KW said there should be an animated map showing the migration routes of the whales (Site evaluation. July 2. 2002).

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[53] The question/answer page for "What do bowhead whales look like?" includes a graphic showing how much a whale's tongue weighs compared to an average child. In the image, the tongue is shown on one side of a balanced scale while twenty children are on the other side.

At the end of each session I asked the children the same two questions:

- Can you tell me what Explore is all about?

- Did you notice anything different about this site compared to other sites you go to on the web?

Four of the children told me Explore! was about whales.[54] The other two made broader connections; DD said it was about nature, while JSC said it was about science. Their responses to the final question were the most interesting. All the Aboriginal children recognized that the site was built around Native people and legends. They thought that was "cool" because as JH said, "There aren't that many sites for Native kids on the web" (Site evaluation, June 10, 2002). None of the non-Aboriginal children made a connection between the site and Aboriginal people, even though all of them had earlier indicated they had learned something about Inuit people as they explored. In discussing these responses with one set of non-Aboriginal parents, the father responded, "Kids see what they are programmed to see. I think it's a good thing when they learn stuff without realizing it. Maybe it means they all felt included in what was on the site" (A. Wiseman, personal communication, July 30, 2002).

4.02 Summative evaluations: Collaborators

Collaborators were asked to provide a summative evaluation for both the site and the collaborative process in which they had participated. Both evaluations were contained in the same questionnaire which can be found in Appendix F. In order to obtain a fresh view on the project during summative evaluation, I also asked Kathleen Mount Pleasant, an Aboriginal preservice teacher studying at McGill, to comment on the site.

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[54] Perhaps not surprising given the pilot content in which they were immersed.

4.02.1 Site Evaluation

Collaborators were asked to rate the content, interface and interactivity of Explore! on a scale of 1 to 6, where 1 was "Completely disliked" and 6 was "Liked a lot." Individually, they rated all elements as 5 (liked) or 6. The average rating for content and interface was 5.86 and for interactivity 5.57.

Collaborators indicated that there was sufficient cultural content incorporated in the content, and that both Western and Aboriginal perspectives were well presented. Jim Barta, who had previously commented on the need for more cultural content, was pleased with the final result:

> The general nature encompasses a holistic perspective. I think this will allow access for all. Too much cultural content often gives those who look too narrowly the impression there is not something also available for them. (Final questionnaire, July 17, 2002)

Barry Hannah also appreciated the balancing of views:

> Although it is nice to have Aboriginal content, it is also important for there to be content based on how most of the world perceives the issue(s). This may help students in isolated areas to develop a different view of things that have already been associated with their culture. (Final questionnaire, July 17, 2002)

All collaborators responded that they had found the interactive elements, even though some were several levels removed from where they entered the pilot content. Most, thought the amount of interactivity was sufficient, especially given that downloading can take some time. One commented that he would like to see more interactivity, but qualified his response by saying: "I think you can never have enough interactivity for students" (Ibid.). Collaborators made multiple comments about 3 interactive elements in particular.

- Blubber mitt experiment. Found in the Explore more section of "What do bowhead whales look like?" several people wrote that this was an excellent activity to use with children both at home and in school. Jim Barta added: "I want to make a blubber mitt" (Final questionnaire, July 17, 2002).

- Whale diving animation. Found on the "Do bowhead whales communicate?" page, feedback indicated this animation to have been particularly effective in illustrating a concept.

- The right to hunt: What do you think? Found in the Explore more section of "Will bowhead whales survive?" Collaborators appreciated that children were asked to form their own opinion on a controversial subject.

Feedback on the animation of "The Gift of the Whale" (apart form the obvious problems related to sound quality) had been positive throughout the development process. Collaborators still very much approved of the way the story framed content when the unit was presented to them as a whole. They repeated comments regarding appropriateness of length and effectiveness for focusing the lesson. Shannon Beauchamp said:

> As an oral/aural person and a visual learner, I was so happy when something started talking to me. I've never gone to a web site that has spoken to me visually, it was great. It immediately told me this was going to be fun and different from other places I go online. I just smiled. (Final questionnaire, July 19, 2002).

Ann Grace wrote that she would like to have the option of downloading a PDF version of the story, as access to a print version would make it easier for classroom teachers to build lessons around the content (Final questionnaire, August 6, 2002).

Collaborators replied that the site would support both teaching and learning, and that they would send children in their care to Explore! Kathleen Mount Pleasant wrote she would

definitely send children to the site because there was so much material to support their learning (Personal communication, July 3, 2002). Ann Grace went one step further sending an email immediately following the submission of her final questionnaire: "If I want to send teachers to the site, what do I give them as an address? When do you want people to start visiting the site?" (Personal communication, August 6, 2002).

While there was nothing collaborators would remove from the content, they had a number of suggestions about what could be added including:

- an audio component for the glossary;
- rollover buttons;
- some way to put non-Inuit children using the site in contact with children in Inuit communities "who would accept questions ... about Arctic living" (B. Mesher, final questionnaire, July 15, 2002);
- more Aboriginal teachings (over time);
- connections to books: "We need to take every opportunity we can to turn the kids on to reading" (S. Beauchamp, final questionnaire, July 19, 2002);
- visual cues for navigation.

Collaborators also made some suggestions regarding technical issues related to layout and delivery.[55] For instance, Bob Mesher who lives part-time in Nunavik, a region where Internet access is currently expensive and unreliable, suggested the final product could be packaged on CD-ROM for delivery to schools in that region (Final questionnaire, July 15, 2002).

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[55] They also pointed out remaining technical glitches.

When asked to rate the entire project out of 10, collaborators gave Explore! marks from 8 to 10, with an average of 8.71, and commented that the site had exceeded any expectations they had at the beginning of the process. Barry Hannah concluded his site evaluation with the comment: "Nice work. I think that it is well on its way to becoming a useful tool for teachers and students. I also think it will be useful for non-Aboriginal students: (Final questionnaire, July 17, 2002). Jim Barta wrote these words:

> The structure is sound and allows children to venture about 'wondering' where a link might take them and what they might find there. As I clicked on the links. I felt as if I were opening wrapped presents ... I always found something interesting and delightful inside. ... It really has exceeded my expectations. ... [You have] taken the bold and challenging step of designing curriculum for children rather than using the typically generic commercial materials we all too often use with children. (Final questionnaire, July 17, 2002)

4.02.2 Process evaluation

The second half of the final questionnaire was designed in order to gauge collaborators impression of the process used to develop Explore! Nearly all responded that they enjoyed the process. Dannette Dubois wrote that she had not enjoyed the process very much, but this was due to the demands on her time which had resulted in her not being able to participate as much as she had originally hoped (Final questionnaire, July 17, 2002). About half of the collaborators indicated that the development had taken more time than they had anticipated. but all of them said they would be willing to continue participating as the site developed further. Bob Mesher added that he thought it was necessary that development should continue in a collaborative manner including teachers as well as "parents/grandparents and other caretakers" (Final questionnaire, July 15, 2002).

Collaborators indicated that they felt their input had significantly impacted the project as it developed: "As soon as I saw the three kids with the Elder around the fire, I thought, 'Wow! That was my idea.'" (S. Beauchamp, final questionnaire, July 19, 2002). They also appreciated the attempts made to reach consensus.

Most importantly, collaborators believe the project has resulted in a web site that will work better for their children than other sites that are currently available: "Much respect is shown to the learner here. The learner is invited to participate and interact and to become an active learner constructing new knowledge and insights" (J. Barta, final questionnaire, July 17, 2002)

4.03 A review of goals and challenges

While the project was not devised to provide empirical measures of the impact of pilot content, the feedback obtained from both formative and summative evaluations allows for some assessment of how well goals and challenges have been met.

As a whole the project has proven quite successful in meeting the goals identified established during preproduction.

- Feedback from collaborators indicates that the pilot content manages to integrate both Western and Aboriginal perspectives and worldviews on science. The inclusion of and grounding in Aboriginal perspectives also seems apparent to Aboriginal children. While it is too early to tell whether this approach will help them to investigate relationships and negotiate differences between Western and Aboriginal worldviews, the Mohawk children who evaluated the pilot content did express an appreciation for the effort made to create a space which spoke to them.

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- Comments by both collaborators and children suggest the pilot was well-structured for self-directed discovery, an aspect of the site which should expand as more units are developed and interlinked. Comments also suggest that efforts to include elements which add humour and fun to the experience were successful.

- Children who evaluated the site – both Aboriginal and non-Aboriginal – were all reasonably interested in science. I was unable to measure whether the site contributed to an increased interest in science. The relative success or failure of this aspect of the project will only become evident over time.[56]

- Aboriginal role models in science are included within the site, however, they are not presented as I originally conceived. At the beginning of the project, I envisioned profiling a specific Aboriginal scientist within each unit. In the pilot, role models have emerged as the Elders, and other community people, who are working to gather information about the bowhead whale and bridge understanding between what they know and what Western science knows. In retrospect, I believe this is a more appropriate manner through which to introduce Aboriginal children to the role of science and scientific activity in real life, as it approaches methods more traditionally used in communities, and focuses on people with whom they can identify. It by no means excludes, at some later date, the inclusion of Aboriginal role models working in more traditionally Western scientific fields. In fact, one of the topic area buttons within each topic – stars, sky/air, land and water – is called "People" and will eventually lead to units which may be built around specific role models or human impacts.

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[56] I believe measuring increased interest could, in fact, only be measured over a significant period of time - perhaps a school year.

- Non-Aboriginal children did not appear to overtly connect Explore! with Aboriginal peoples in the same way Native children did. At the same time, they did indicate that they had learned something about the Inuit over the course of navigating the pilot content. As such, I believe the site will be able to introduce them to more accurate information and understanding of Aboriginal peoples, especially as content is added.

- Comments made by the children taken in conjunction with those of Jim Barta regarding cultural content, lead me to believe that the pilot presents a balance of views which is inviting to Aboriginal children but not exclusionary for non-Aboriginal children.

- It is too early to make any conclusions about whether exposure to an alternative view of science has had any impact on non-Aboriginal children.

- The interface model and pilot content structure developed for Explore! should lend itself to expansion and be relatively flexible. Second and third level templates exist for each topic – stars, sky/air. land and water. It will be easy to integrate text and images for new units into these templates. What will continue to be time-consuming in the development of further units will be the animation of introductory stories and illustrative examples as well as the creation of new interactive features.

The project has also successfully addressed the challenges identified in preproduction.

- Perspectives of different Aboriginal nations and communities will be represented in the web site over the course of further expansion and development. Just as the pilot content of the bowhead whale unit is introduced by an Inuit story, other units in the site will be introduced by stories from other nations. As units are added to the site, different Aboriginal nations and their perspectives will be represented within Explore! Christine Diabo extrapolated this structure from viewing the pilot content in text format, writing, "I can't wait until the whole site is up and running so I can learn more about native cultures other than my own" (Content questionnaire, 23 May, 2002).

- Pilot content was carefully developed so that language level would be appropriate to the age group of the target audience. In addition, to support children with weaker language skills, a glossary was built into the pilot content structure. Feedback from both collaborators and the children who evaluated the site indicates that the language (and content) of the pilot content should be accessible to most children in the target audience.

It was suggested at the beginning of this paper that constructivist approaches to teaching and learning might work well for Aboriginal children because they more closely approximate the holistic approaches traditionally used in Aboriginal communities. As it stands, pilot content would certainly not fit within a radical constructivist framework. It does, however, integrate constructivist elements which allow users control of the experience and the way in which knowledge is constructed.

Where the project has been less successful than hoped is in its development as an informal learning resource. There appears to be a disconnect between what adult collaborators think would work as informal learning and children's perceptions of the site. Feedback from children indicates that they would visit the site primarily for use in school projects and assignments. While they did enjoy the experience, and say they would "sometimes" visit to see what is new, the site is perhaps too structured and too clearly associated with a topic they connect with school and learning to have the same "cool factor" as something they consider purely fun. This shortcoming may be addressed through the implementation of some of the recommendations which follow.

Finally, I believe the collaborative approach was key in the project's development. No matter how good their intentions, researchers in universities cannot develop tools and resources that truly address community needs and perspectives, without a bridge into the community. For Explore! that bridge was provided by the collaborators who contributed their time and wisdom to the construction, development and evaluation of the site.

4.04 Recommendations

Based on the conclusions and feedback received during both formative and summative evaluation, the following recommendations are offered for the further development and expansion of Explore!

Parents, educators and Elders should continue to be involved in the development of any new units. As mentioned, their input is key in grounding the content in appropriate perspectives and worldviews. Input from collaborators will also provide an ongoing fresh view on materials through which new ideas will emerge. In addition, one or two children should be involved earlier in the development process. The inclusion of members of the

target audience would likely help in making the web site more attractive to them in terms of informal learning.

In order to increase the amount of interactivity, some units of the site should be developed completely in Macromedia Flash. These units could be constructed using an interface very similar to the html interface developed within this project. Flash interfaces have the potential to make each user's experience unique, as the program coding allows for different responses depending on user actions. A Flash interface was considered for this project, but was rejected because of user-based technical issues such as download speed. For these same reasons, it is recommended only some units be developed completely in Flash while others continue to be developed in html. In this way the site will be accessible to users with different technical capabilities.

A bank of ten to twelve interactive Flash elements should be developed for integration into new units. While it is relatively simple to recycle the structure of the Flash elements developed for the pilot content,[57] I believe children will become frustrated and bored with the site if their experience of every unit follows the same pattern. With a bank of interactive Flash elements, three or four could be chosen for each new unit and customized with appropriate text and images to reflect subject matter. By mixing and matching interactive elements in this manner each unit should be a unique experience for the user.

In addition to the above, it is recommended that many of the suggestions made by collaborators during formative and summative evaluations be integrated into future units.

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[57] The coding and technical structure can be reused while text and images are replaced to reflect the subject matter of new units

To make Explore! accessible for public use, the remaining technical problems will need to be resolved. The site can then be transferred from its current server to the Industry Canada server which hosts the NAEP web site. Some testing will be required in order ensure all interactive elements and coding are compatible with the new server, then links can be created between the two sites.

When the site is made public, further evaluation of the pilot content by educators, parents, Elders and members of the target audience will be solicited before the development of any new units. This feedback will form the basis of a development plan to integrate 4-6 new units per year into Explore!

5.   Conclusion

> A team should be able to provide fresh views of things and bring up ideas that the individual might not have come up with on his/her own, or that might have taken the individual a long time to come across. (Barry Hannah, final questionnaire, date)

In undertaking this media project. *Reconstructing knowledge, negotiating cultural difference: Using web-based media to build inclusive learning spaces for math and science*, I examined how new media, particularly the graphical user interface of the World Wide Web, could be used to deliver informal, science learning opportunities for Aboriginal children. To do so, I:

1.   developed the technological structure for an online, informal, science learning space aimed at Aboriginal children in mid- to late elementary school;

2.   produced the pilot content for the space;

3.   examined the collaborative process as a means for developing effective online learning spaces for Aboriginal children.

The resulting Explore! web site is simply a media project which provides a model for building learning spaces which respect, and are inclusive of, Aboriginal children's perspectives and worldviews related to science. Its framework lies in the space where education, educational technology and media studies meet. It integrates "known" elements of effective design, good practice and clear communication. From a technical point of view, the model is relatively easy to replicate. While the project presented some technological challenges, they were not insurmountable, and, in the end, I must conclude that the project (and its relative success) had little to do with technology or technical know-how.

This project begins and ends with the simple premise that children (and all people) frame their learning within the context of what they already know. For learning spaces to be effective then, they must value pre-existing knowledge, acknowledge differences and provide a supportive and safe framework within which children can deconstruct and reconstruct their understandings of how the world works. Such spaces should therefore contain appropriate features which speak directly to children by showing their faces and telling their stories. This type of grounding in the world and experience of the child is particularly important in learning spaces related to mathematics and science which tend to be more difficult for children – especially those on the periphery of dominant society – to negotiate. I would argue; however, that beginning from the perspective of valuing children's knowledge makes it easier to develop effective learning spaces for any children, regardless of their cultural background.

That being said, because this project is intended to address an audience of Aboriginal children – a group which generally falls outside the mainstream - the key to grounding the resulting learning space was the recruitment and contributions of willing and knowledgeable collaborators from within Aboriginal communities. Aboriginal people (and peoples) are justifiably skeptical regarding academic research: historically, it has not served them well. As such, they are reticent to serve as subjects for research, and even more reticent to submit their children to such scrutiny. However, Aboriginal people, and people who work in Native communities. are willing and eager to work *with* academic researchers (and others) who are open to the development of truly collaborative solutions which address community needs - especially needs related to their children.

Collaborative research and development, as I have experienced it, does not fit the traditional notion of academic research. There is no distant observer here. In order to be successful, this type of collaboration, particularly when undertaken in a cross-cultural or

multicultural setting, has to be understood as a meeting of experts, in which the knowledge, experiences and understandings of each person must be considered valid. This does not mean that each participant is an expert in all areas to be addressed in the collaboration, but that each brings some required expert knowledge to the process.[58] Successful collaborations also require that lines of communication are two-way and remain open for the duration of the project, and if necessary beyond. Everyone involved, particularly the lead researcher, must be willing to take the time required to clearly understand what other people are saying and readjust preconceived notions of what will work based on new understandings. The role of the lead researcher in this process is not easy. It requires that the researcher have enough grounding in the subject matter(s) being addressed to offer clear end goals and outcomes to collaborators at the beginning of the project. It also requires that the researcher be able to maintain a focus on the end product, while at the same time actively engaging in a negotiation process with collaborators which will likely result in the reconceptualization and reframing of at least some identified goals and outcomes. While the collaborative process is not a simple one, when understood as a meeting of experts, it provides a means through which we can begin to redefine relationships.

Within the context of Explore! collaboration was essential in meeting the goals and challenges identified during preproduction. More importantly, it was the means through which we successfully identified and addressed difficult issues related to representation. One of my primary goals in pursuing this thesis-project was to develop online content to bridge the distance between Aboriginal and Western worldviews of science. By developing the project in collaboration and cooperation with people at the community level, the project itself became an exercise in bridging that distance. At times it required

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[58] Indeed, there would be no need for collaboration if any one person knew it all.

that both I and my collaborators step back from our own preconceptions about science, teaching and learning[59] in order to reorient ourselves towards the goal of developing a space which would really work for and be centered on the needs of Aboriginal learners. We had to deconstruct and reconstruct new understandings of what science and learning might be. On difficult issues, we struggled to find an inclusive, effective consensus, as opposed to an ineffectual middle ground. We were able to do so because at all times our audience remained paramount. By focusing on the children, it was easier to let go of preconceptions and move forward in a constructive manner. What we developed together is not perfect, but it is a step in the right direction. As such, I must share the credit for Explore! with all the people who generously gave their time and wisdom to help in its development.

In her work on children's programming Anne Solberg (1977) quotes Maurice Falardeau, a Radio-Canada producer, who says: "Programs have to be based on a broadcaster's love for children so they can be shown a world more beautiful to see and hear" (p. 60). I would submit that it is a love for children, and the prospect of letting them see and hear a more beautiful world, which allowed us to successfully reconstruct knowledge and negotiate cultural difference in the production of Explore!

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[59] ... and perhaps even each other ...

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Appendix A
Sample introductory email

Hi everyone:

First of all thanks, for agreeing to take part in my MA project. I apologize for the delay in getting started but I was waiting for the human ethics review approval for the project.

Attached you will find the first (and longest) step in the design process - the design questionnaire. It contains 43 questions related to access, audience, design and content. The questions are designed to provide a starting point for site development. I have tried to cover all aspects of development, but if you feel some point is missing please feel free to add any other comments you have.

Because different people are bringing different experiences to the project, not everyone will be able to answer all the questions, so dont worry if you leave some questions or sections blank.

There are a number of ways to reply to the questions, please choose the one that is easiest for you. You can:

• type directly into the Word file you received in my email, save it and send it back to me electronically at dawn@encs.concordia.ca,

or

• print out the Word file, write in your responses by hand and return it to me by fax at 514-848-4596,

or

• click go to http://www.hotzot.com/dawn to fill out the questionnaire online. You get to the questionnaire by clicking on the button at the end of the explanation. Your answers will be forwarded to me when you click on submit at the end of the form.

If you would feel more comfortable discussing the questions with me by phone or in person, please let me know, and we will arrange a time.

If it is at all possible, I would very much appreciate receiving your responses within a week to 10 days, as it will take time to reach everyone and to develop the beginnings of the site once your input is received.

Finally, if anything is unclear or confusing, or if you just have some questions regarding the project, please email or call me and I will try to provide the information you need. You can reach me by phone weekdays at (514) 848-7847 and evenings and weekends at (514) 343-0836.

Thanks,
Dawn

Design questionnaire Attachment

Appendix B
Design questionnaire

Welcome to the design questionnaire.

Thanks for you help. Below I've listed the project goals and challenges, as I see them. They may help you as you go through the questionnaire. I've also supplied my contact coordinates in case you have any questions as you move through the questions.

It is my hope that by developing the site in a collaborative process, we will be able to create an on-line learning space in which Aboriginal children will feel comfortable and have fun exploring science. The experience of First Nations communities, like Akwesasne, which have developed their own curriculum in science and mathematics indicates that successful materials are those which are grounded in Aboriginal perspectives, integrate community values and examples, and take a holistic approach to the presentation of content. In this way, children can begin to look at relationships and differences between western and Aboriginal perspectives of science from a familiar and safe place.

Project Goals:

The primary goals for the web site are to:
- develop the structure for an science web site aimed at Aboriginal children in mid- to late elementary school:
- produce the pilot content for the web site on a topic to be determined;
- develop both structure and content in collaboration with community teachers, parents and Elders.

I also hope the web site we develop will:
- contribute to the early development of an interest in science among elementary-aged children;
- introduce these children to Aboriginal role models in science;
- expose non-Aboriginal children in the same age group to different ways of knowing;
- be expandable and flexible enough to allow for the eventual addition of new topics, which will follow the format to be developed for the pilot content.

Challenges
There are a few obvious challenges to be faced in the web site design.

First, because the site will eventually reside at the Native Access to Engineering Programme at Concordia which has a national focus, it needs to be designed for a pan-Canadian audience. As such, we have to try and find ways to integrate and address the perspectives of different Aboriginal nations and different community examples.

Second, because the audience is pan-Canadian, and I do not have access to funds for translation into the number of Aboriginal languages spoken across the country. I think the language of the site will need to be English. So, we will need to find some ways to make the site usable by English second-language students and for students who understand English well but may not have strong reading skills.

The design questions

Keeping in mind the goals and challenges of the project, the questions which follow are designed to provide a starting point for site development. They cover issues related to access, audience, design and content. I have tried to cover all aspects of development, but if you feel some point is missing please feel free to add any other comments. Because different people are bringing different experiences to the project, not everyone will be able to answer all the questions, so don't worry if you leave some questions or sections blank.

There are 43 questions in the design questionnaire. All other evaluation/feedback questionnaires will be much shorter, only 8-10 questions.

If it is at all possible, I would very much appreciate receiving your responses within a week to 10 days, as it will take time to reach everyone and to develop the beginnings of the site once your input is received.

Finally, if anything is unclear or confusing, or if you just have some questions regarding the project, please email or call me and I will try to provide the information you need. You can reach me by phone weekdays at (514) 848-7847 and evenings and weekends at (514) 343-0836.
Thanks.
Dawn

Name:

1. Given the goals and challenges listed above, what are your expectations for the web site?

```



```

Access

Questions related to access will provide information regarding how children in your community or communities access the Web. It will also provide information about the technologies/software to which they have access.

2. Can your child/children access the Web from any of the following sites? (Check all that apply)
   [ ] Home
   [ ] School
   [ ] Community Centre
   [ ] Other (please specify)

   ```


   ```

   [ ] No Web access at this time

3. If your children have no Web access at all...

... is there a specific reason your children cannot access the Web? For example, some communities and schools have recently had to stop Web access from school because long distance charges, which had been waived, now apply.

```
┌─────────────────────────────────────────────────────────────────┐
│                                                                   │
│                                                                   │
│                                                                   │
│                                                                   │
│                                                                   │
└─────────────────────────────────────────────────────────────────┘
```

... have they had web access in the past?
[ ] Yes
[ ] No

... are there plans to establish or re-establish access?
[ ] Yes
[ ] Not at this time

4. From which site do your children most often access the Web?
[ ] Home
[ ] School
[ ] Community Centre
[ ] Other (please specify)

```
┌─────────────────────────────────────────┐
│                                           │
│                                           │
└─────────────────────────────────────────┘
```

5. How is the Web accessed at the sites where your children have access? (check all that apply)

Access Method	Home	School	Community Centre	Other
14.4 modem				
28.8 modem				
36.6 modem				
56.6 modem				
High speed phone line				
High speed cable				
Satellite				

6. Do you have any existing guidelines for letting your kids surf the web?
[ ] Yes
[ ] No

If yes, what are they?

```
┌─────────────────────────────────────────────────────────────────┐
│                                                                   │
└─────────────────────────────────────────────────────────────────┘
```

7. What browser(s) are they using? What version of the browser? (Check all that apply)
    [ ] Netscape 6
    [ ] Netscape 4
    [ ] Netscape 3
    [ ] Another version of Netscape
    [ ] Internet Explorer 6
    [ ] Internet Explorer 5
    [ ] Internet Explorer 4
    [ ] Another version of Internet Explorer
    [ ] Another browser (please specify)

8. Do your children have access to a printer at the site where they use computers most often?
    [ ] Yes
    [ ] No

9. Is there a CD-ROM or DVD drive on the computer your children use most often?
    [ ] CD-ROM
    [ ] DVD
    [ ] Both
    [ ] Neither

10. Do your children have access to any of the following browser plug-ins? (Check all that apply.)
    [ ] Flash
    [ ] Real Audio
    [ ] Real Video
    [ ] Adobe Acrobat (PDF)
    [ ] Others (please specify)

Audience

Defining the audience is key in the development of any media project. These questions will help identify the characteristics of the audience which need to be kept in mind during development.

11. Are your children interested in surfing the Web?
    [ ] Yes
    [ ] No

12. Are there any Web sites they visit often?
    [ ] Yes
    [ ] No

If yes, which sites are they?

13. What do your children do for fun?

14. What television shows do your children enjoy watching?

15. What language do your children speak at home? (Check all that apply.)
   [ ]   Cree
   [ ]   English
   [ ]   French
   [ ]   Inuktitut
   [ ]   Mohawk
   [ ]   Other (please specify)

16. What language do your children speak at school? (Check all that apply.)
   [ ]   Cree
   [ ]   English
   [ ]   French
   [ ]   Inuktitut
   [ ]   Mohawk
   [ ]   Other (please specify)

17.   What language do your children speak with their friends? (Check all that apply.)
    [ ]   Cree
    [ ]   English
    [ ]   French
    [ ]   Inuktitut
    [ ]   Mohawk
    [ ]   Other (please specify)

18.   Do your children enjoy reading?
    [ ]   Yes
    [ ]   No

What was the last book they read?

19.   What are most important things that someone working with your children should know about them?

20.   What elementary age range do you think the site should be aimed at?
    [ ]   7-9
    [ ]   8-10
    [ ]   8-12
    [ ]   Other (please specifiy)

Design – Look and Feel

The look and feel of a web site is determined by concrete aspects such as colour and layout, as well as more intangible aspects such as the reaction it brings out in users. Questions about look and feel will help in the design of the overall environment of the site.

20.   What colours do you think would work well?

```



```

21.   Images should be ... (check all that apply)
    [ ]   black and white
    [ ]   colour
    [ ]   cartoons
    [ ]   drawings
    [ ]   photographs
    [ ]   Other (please specify)

```


```

22.   What specific types of images would work well? For example, photographs of faces, sketches of community projects etc.

```




```

23.   What features do you think your kids would like? (Check all that apply)
    [ ]   Text with to the point information
    [ ]   Animations, slide shows
    [ ]   Videos
    [ ]   Sounds/audio clips
    [ ]   Printable downloads – PDF
    [ ]   Interactivity/Flash
    [ ]   Streaming audio and video
    [ ]   Other (please specify)

```

```

24.   Identify a few web sites you like. What is it you like about these sites?

25.   Identify a few web sites you do not like. What is it you do not like about these web
        sites?

26.   Web sites are often built around metaphors which reinforce the experience of the site. For
        example, a travel site may be designed using the metaphor of packing luggage, or a site
        about plastics may be designed using the metaphor of a shopping mall. Are there any
        metaphors which would be appropriate and effective for the design of the site? For
        example, a dreamcatcher, a science lab, a medicine wheel, a canoe trip. Please explain
        why you think your suggested metaphor might work well.

27.   How often do your children normally surf the Web?
        [ ]   Less than once a week
        [ ]   1 to 5 times a week
        [ ]   More than 5 times a week

135

28. How long will they spend on a Web site they like?

[ ] Less than 15 minutes
[ ] More than 15 minutes
[ ] More than 30 minutes
[ ] More than an hour

29. Have you noticed any thing which they particularly like on web sites?

```



```

30. Have you noticed anything which frustrates them when they are on a web site?

```



```

Content

Questions relating to content will help determine what message the children get when they go through the web site and how that message is presented.

31. My children would prefer content presented as ...

[ ] a story
[ ] information
[ ] a mixture of the two
[ ] in some other format (please specify)

```

```

32.   I would like the content to be presented as ...
       [ ]   a story
       [ ]   information
       [ ]   a mixture of the two
       [ ]   in some other format (please specify)

33.   What topics (eg. water, air, fish, birds) should be covered by the web site?

34.   Which of these topics would you develop first?

35.   What will your children want from the web site?

36.   Should there be a narrator or guide character for the site?
       [ ]   Yes
       [ ]   No

37.   Are there any sites which you currently direct your children to for their content?

38. Do you know any one in your community who would be a good scientific role model? This person doesn't have to be a scientist, but should have some connection to math and/or science.

```
[                                                                    ]
[                                                                    ]
[                                                                    ]
[                                                                    ]
[                                                                    ]
[                                                                    ]
[                                                                    ]
```

39. What, if anything, should your children learn from the web site?

```
[                                                                    ]
[                                                                    ]
[                                                                    ]
[                                                                    ]
[                                                                    ]
[                                                                    ]
```

40. What values, if any, should the content clearly present? For example, respect for environment, respect for Elders etc.

```
[                                                                    ]
[                                                                    ]
[                                                                    ]
[                                                                    ]
[                                                                    ]
[                                                                    ]
```

41. How often do you think content should be updated in order to keep your children interested
in the site?
[ ]   Once a month
[ ]   Once every two months
[ ]   Four times per year

42.   If there any resources (books, Web sites, movies. TV shows) or people you think should
        be used to support the development of this project, please list them here.

43.   Other comments:

Thank you.

Appendix C
Look and feel questionnaire

Look and Feel Questionnaire

Name:

1. Rank the following elements in your order of preference for each option.
   1 = Like best   3 = Like least

	Option 1	Option 2	Option 3
Text/Font			
Colour scheme			
Graphic Elements			

2. Which option do you like best overall?

   Option 1 [ ]   Option 2 [ ]   Option 3 [ ]

   Why is this your favourite option?

3. Each option was designed for a screen resolution of 800x600. In other words, your kids should be able to see the entire image without scrolling up/down or left/right.
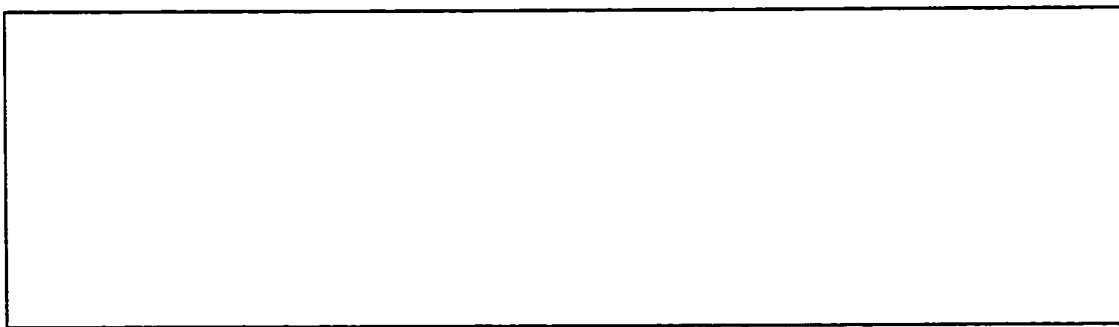
   Did you have to scroll to see the entire image?

   Yes [ ]   No [ ]
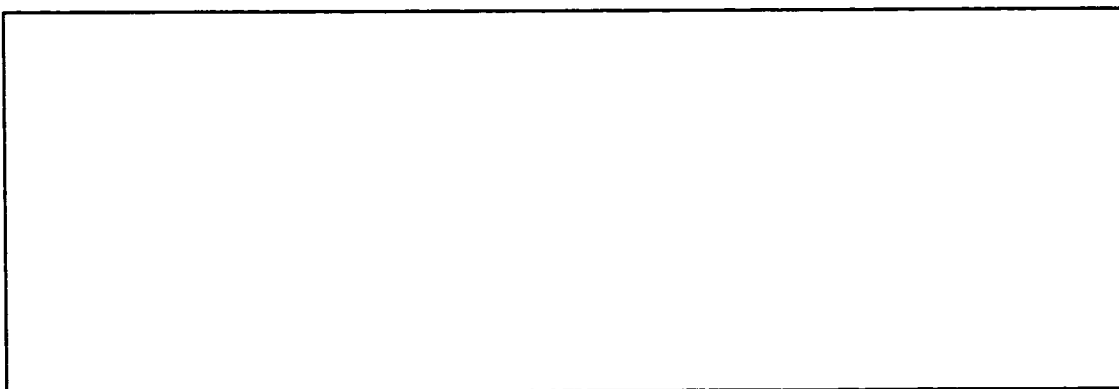
   Will the 800x600 resolution be okay for your kids?

   Yes [ ]   No [ ]

4. Right now I'm calling the site "Explore!" but I'm open to suggestions. Can you think of any other name which might be better or more appropriate for the site?

5. Other comments

Thank you.

Appendix D
Content questionnaire

Text Content Questionnaire

Name:

1. Did you like the story?   Yes [ ]   No [ ]

   Comments about story

   ```
   ┌─────────────────────────────────────────────────┐
   │                                                 │
   │                                                 │
   │                                                 │
   │                                                 │
   │                                                 │
   │                                                 │
   │                                                 │
   └─────────────────────────────────────────────────┘
   ```

2. Do you think it's a good idea to have the kids see the story before they move into the content?

Yes [ ]   No [ ]

Comments

```
┌─────────────────────────────────────────────────┐
│                                                 │
│                                                 │
│                                                 │
│                                                 │
│                                                 │
│                                                 │
│                                                 │
└─────────────────────────────────────────────────┘
```

3. Do you like using questions to move through the content?

   Yes [ ]   No [ ]

   Comments

   +--+
   | |
   | |
   | |
   | |
   | |
   | |
   +--+

4. There are ...

   ...   too many questions   [ ]
   ...   the right number of questions   [ ]
   ...   too few questions [ ]

5. The content was ...

	Yes	No
was age-appropriate (8-12)	⊆	⊆
was easy to read	⊆	⊆
flowed well	⊆	⊆
made sense	⊆	⊆

6. There was enough cultural content.

   Yes [ ]   No [ ]

7. Did you like the following features, or the idea of having the following features?

	Yes	No
Explore Fact	☐	☐
Explore Figure	☐	☐
Explore Picture	☐	☐
Explore More	☐	☐
Glossary	☐	☐
Other whales	☐	☐
Other sea mammals	☐	☐
Cool links	☐	☐

8. Keeping in mind there will be a glossary. was the language level appropriate?

Yes [ ]   No [ ]

Comments

9. What was missing in terms of content? What would you change?

10. Other Comments

Thank you!

Appendix E

Question 2 questionnaire

Question 2 questionnaire

Name:

1. Is the site easy to navigate/intuitive?

    Yes [ ]   No [ ]

    Comments:

    _____

2. Does the layout flow properly?

    Yes [ ]   No [ ]

    Comments:

    _____

3. Was anything confusing?

    Yes [ ]   No [ ]

    Comments:

    _____

4. Is the look and feel welcoming and engaging?

Yes [ ]   No [ ]

Comments:

```



```

5. Do the images/media support the text in an appropriate manner?

Yes [ ]   No [ ]

Comments:

```



```

6. Are the images a good size?

Good size [ ]   Too big [ ]   Too small [ ]

Comments:

```



```

7. Is the text easy to read?

Yes [ ]   No [ ]

Comments:

```



```

8. What did you like best about the sample question?

9. What did you like least about the sample question?

10. Other comments

Thank you!

Appendix F
Final questionnaire

Final evaluation and project feedback questionnaire

Name:

Site evaluation

1. Please rank each of the following on a scale of 1-6.

	1 Completely disliked	2 Disliked	3 Disliked a little	4 Liked a little	5 Liked	6 Liked a lot
Content						
Look & feel						
Interactivity						

Comments:

2. Was there enough culturally appropriate content?
   Yes [ ]   No [ ]

Comments

3. Does story work as an introduction?

Yes [ ] No [ ]

Comments

```



```

4. Is the language level appropriate for 8-12 year-olds?

Yes [ ] No [ ]

5. Was the glossary helpful?

Yes [ ] No [ ]

6. Did you find the interactive elements?

Yes [ ] No [ ]

If not. interactive (and active) elements can be found at these places
Grouping: Similarities
Adaptions: Blubber mitt
What eats what: Food Web
Animal Talk
The right to hunt: What do you think?

7. The amount of interactivity was ...

Not enough [ ]   Too much [ ]   Just right [ ]

8. Do the animations and images support understanding?

Yes [ ] No [ ]

9. Would the site support teaching?

Yes [ ] No [ ]

10. The download time was...

Too long [ ]   Not bad [ ]   Okay [ ]

11.   What would you add to the site?

```



```

12.   What would you delete from the site?

```



```

13.   Would you send children to the site?

Yes [ ]   No [ ]

14. Compared to the other sites my children use I like Explore ...

More   [ ]   Less   [ ]   The same [ ]

Comments:

```



```

15. Rank the site overall out of 10.

16. How well does the site meet your original expectations?

17. Other comments about site.

Process

18. How did you enjoy the process of building the web site?

Did not like it [ ]   Liked it a little [ ]   Liked it [ ]   Liked a lot [ ]

comments:

```




```

19. Did the process take too much of your time?

Yes [ ] No [ ]

20. Did you feel your comments made a difference to the developing web site?

Yes [ ] No [ ]

21. Do you think the result of the collaboration has resulted in a web site which will work better for your children than most sites that are currently available?

Yes [ ] No [ ]

comments:

```




```

22. Would you participate in this type of development again?

Yes [ ]   No [ ]

comments:

23. Other Comments about the development process.

I hope you have enjoyed collaborating on this project. I truly appreciate the time you have taken to share your wisdom and experience with me. I will be writing a report to accompany the project. Both must be handed in by August 16, 2003 and finalized by September 16, 2003. If you would like a copy, please let me know. I will let you know how the defence goes.

Thank you!