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COMBINING THE VIEWS OF "BOTH WORLDS":

SCIENCE EDUCATION IN NUNAVUT

PIQUSIIT TAMAINIK KATISUGIT [1, 2]

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This paper reports on several phases of a five-year science education development project in Nunavut, Canada. The project, in its entirety, was established as a Pilot Program for Nunavut schools in effort to understand school community aspirations for science education and potential contributors and impediments to fostering the realization of identified goals. This paper focuses on the cases of three Inuit school communities in identifying and achieving their aspirations for science education. This paper describes the goals collaboratively identified and the processes utilized to work towards the realizations of such goals. Of importance is the identification by the school communities to offer an educational experience that combines the knowledge, processes and values of "both worlds" (western science and *Inuit Qaujimajatuqangit*) and to employ both traditional and contemporary methods for implementing and evaluating the success of the project. Finally, based upon the outcomes of this project, suggestions are provided for supporting developments in other jurisdictions aspiring to see the realization of local and Indigenous aspirations for science education. Of critical importance to seeing such efforts realized are the policy and leadership conditions manifest at the school-community, divisional and territorial level for fostering culture-based education programs.

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[2] *Editor's Note*: Most of the articles that CJEAP publishes are in the range of 20-25 pages in length, similar to most print journals in education. However, our electronic format does allow us greater flexibility with regard to length and, on occasion, where the content warrants, we may publish longer manuscripts. Issue 98 is one such article.

Introduction

The establishment of the territory of Nunavut in 1999 emanated from a deep-rooted and overwhelming call through years of lobbying by the Inuit of northern Canada to move toward self-governance in all aspects of Inuit society. In no context was there greater resonance of voice for self-determination than in the domain of education. Through the establishment of Nunavut, Inuit in policy gained self-rule and control over their own institutions including schools. Since 1999, Nunavut has moved towards the establishment of an *Education Act* (Government of Nunavut, 2008) that sets the course for future developments in education across Nunavut. As the past-Minister of Education, Ed Picco, purported in legitimizing the length of time it has taken to come to a collectively accepted document, "Nunavummiut want a made-in-Nunavut *Education Act* that reflects Inuit values and culture. We want to ensure [it provides the foundation for] the best quality of education for our children" (Picco, 2006).

With the establishment of Nunavut and, ultimately, the *Education Act*, the territory faces the challenge of reversing assimilation and regaining a sense of identity especially within the processes that influence the education of their children. Typical of most Indigenous peoples, Inuit in Nunavut presently participate in a school system that has been drawn over time from the dominant culture, in their case southern Canadian school system models. Although Inuit staff work in the schools, especially elementary schools, the majority of teachers, principals and school operations administrators are non-Inuit, and the curricula and pedagogy of classrooms is based on southern models. Because of this, school practices such as the content of curricula, pedagogical practices and language of instruction have both intentionally and unintentionally denied the inclusion of those aspects of culture that have value and are important to its' children (Bishop & Glynn, 1999). As French sociologist Bourdieu (1979) purports, it is likely that the

existing educational system in many Nunavut schools and classrooms is symbolically violent because there is an imposition of categories of thought and perception upon dominated social agents who over time, unconsciously, take the social order to be just. Through this domination, many educational workers in Nunavut schools may continue to take their southern model position to be "right" and by so doing, perpetuate the legitimacy of the existing social order within their schools and classrooms.

Thus, it is likely not surprising that the new policy statements by the Government of Nunavut (GN) endorse "culture-based education" as one of the foundational principles for school development. The GN policy requires the activities of organizations, including schools, in Nunavut communities to create, preserve, promote, and enhance their culture, including arts, heritage and language. This policy is based upon the principle that culture in all its expression, provides a foundation for learning and growth, and that the GN should support individuals, organizations and communities to promote, preserve and enhance their culture (GN, 2004). The underlying premise of culture-based education is that the educational experiences provided for children should reflect, validate and promote the culture and language of Nunavummiut. These experiences should be reflected not only in the management and operation of the school but also in the curricula, programs implemented and the pedagogy of classrooms.

The focus of this paper is to provide a detailed description of the processes and outcomes of a science development project in three Nunavut school communities who seek to see the establishment of a culture-based science education program. The paper will focus on the processes used to determine community aspirations for science education, mechanisms employed to foster the realization of these goals, and an evaluation of these goals. It is perceived by the authors that since the processes used and outcomes testify to the practical and efficacious nature

of the underlying frameworks both of an Inuit and non-Inuit foundation, the description will be of benefit to other Indigenous communities in supporting their endeavors for science education development.

Science Education in Aboriginal Settings

Although significant attention to and improvement in the delivery of science programs at Kindergarten through Grade 6 levels have been recognized over the past two decades, there is continued acknowledgement of the complex set of factors impeding effective science delivery at these levels in many educational jurisdictions (Lewthwaite, Stoeber & Renaud, 2007). Teacher personal attributes, or intrinsic factors, such as science teaching self-efficacy, professional science knowledge, and science teaching interest and motivation are critical dimensions and frequently cited barriers or risk factors in the delivery of science programs (Abell & Roth, 1992; Eick & Reed, 2002; Harlen, 1997, 1988; Harlen, Holroyd, & Byrne, 1995; Levitt, 2002; Lewthwaite, Stableford & Fisher, 2001; Seatter, 2003). As well, environmental factors, also referred to as extrinsic factors, are identified equally as critical elements to the effective delivery of science programs in elementary schools (Harlen, 1997, 1988; Lewthwaite, 2000). The commonly cited list of environmental factors includes more salient features such as time constraints and resource inadequacy associated with limited equipment, space, and facilities. Less commonly cited factors such as poor administrative support and the overall low priority placed on science as a curriculum area are identified as further critical agents impeding science delivery internationally (Lewthwaite, Stableford & Fisher, 2001). Because of the many complex, interrelated, and difficult to address factors that can interfere with science delivery, it is not

surprising that some authors regard science education, particularly from Kindergarten through Grade 6, to be in a perilous state (Mulholland & Wallace, 1996).

The concerns expressed by Mulholland and Wallace are more often than not magnified in Aboriginal settings where isolation from professional support, the inadequacy of culturally relevant resources, high teacher turnover especially among non-Aboriginal teachers, the limited science teaching experience of teachers, multi-level classroom teaching responsibilities, poor student attendance and second language development collectively amplify the factors impeding the delivery of science programs (Lewthwaite, 1992). Several of these factors have been identified as possible contributors to the comparatively poor performance of Canadian students in the Northwest Territories in the recently conducted School Achievement Indicators Program (SAIP) (Council of Ministers of Education, 2006).

Compounding the problems associated with effective science program delivery in indigenous communities are the more acute epistemological issues cited in the literature. As an example, school science improvement literature has been criticized for universalizing schools and students, paying insufficient attention to context, especially in terms of racial, class, and gender differences (Harlen, 1997). Science curricula, in particular, tend to focus on western science and in so doing ignore indigenous epistemologies and aspirations (McKinley, 2000). As suggested by Ezeife (2003), science instruction often fails to give priority to harmonizing the science being learned with students' life-world culture, including their native language and culturally appropriate learning strategies. McKinley (2000) argues that mandated science curricula are largely expressions of the dominant culture, and that the intentions of these curricula are not adequately grounded in the priorities of indigenous communities. McKinley goes further to suggest that the lack of inclusion of indigenous perspectives in science curricula

and teaching is a reflection of science improvement initiatives as being "nationalizing' in aspiration for economic and technological gain. By being so, such government mandated science curricula fail to acknowledge and thereby override the aspirations of local indigenous communities along with their knowledge, ways of coming to know, values, and beliefs as thoughtful and purposeful cultures.

Ezeife (2003) maintains that every effort has to be made to harmonize the science being taught with Aboriginal students' life-world culture, including their first language. Such thinking underlies cross-cultural approaches to science teaching referred to as "two-way' learning (Fleer, 1997) or "both-ways education" (McTaggert, 1991) (both cited by Aikenhead, 2001). Within the Igloolik region (in which one of the schools is located) this "both-ways education" that combines the knowledge, practices, values, beliefs, and ways of knowing of both the community of scientists and Inuit culture is known as *piqusiit tamainik katisugit.* Although a both-ways effort is admirable it magnifies the complexity of factors influencing effective science delivery. Berger and Epp (2005) identified in their analysis of practices in selected Nunavut schools that for most Qallunaat (non-Inuit) teachers, teaching to the intent of a both-ways orientation is beyond their ability as it deals with traditional Inuit knowledge, beliefs, practices, values, and ways of knowing. This is consistent with Aikenhead and Otsiji's (2000) identification of the role of teacher-as-culture-broker as complex. This complexity is a consequence of most curriculum developers and teachers of science being members of the mainstream culture and having limited knowledge of Aboriginal knowledge systems and culturally appropriate pedagogies. In this context, it's not surprising to read that teachers in Lewthwaite's (2005) Yukon case study recognized and admitted their limited interest, efficacy, and knowledge to teach in a manner that honoured student traditional epistemologies. Christianson (2004) extends this limitation by

suggesting that despite efforts in New Zealand to promote science and mathematics instruction in a manner that honours Māori epistemology, even many indigenous Māori teachers have difficulty in teaching mathematics and science because of their inadequate language and epistemological base. Clearly, if teachers cite a limited professional science knowledge base for teaching in mainstream schools, this knowledge base is even less adequate for teaching in settings where the teaching of science calls for teachers to help students move back-and-forth between their indigenous culture and Western science.

Theoretical Framework for the Research

Two theoretical frameworks guided the facilitation of this project: the guiding principles of *Inuit Qaujimajatuqangit* (IQ) and Bronfenbrenner's bio-ecological theory. Both frameworks are perceived, by the authors, to both systematically identify potential risk and protective (supporting) factors likely to impact on the project and, further, suggest culturally accepted processes for fostering the achievement of project goals.

Likely capable of supporting the development of Nunavut curricula and overall school operation and management structures as well as classroom practices are the guiding principles of *Inuit Qaujimajatuqangit* (IQ). To many people, the "traditional knowledge" aspect of IQ is often the only side that is seen, but that describes only one half of it as IQ is equally and probably more importantly about process (Arnakak, 2001). IQ is really about healthy, sustainable communities, including school communities, regaining their rights to a say in the governance of their lives using processes, principles and values they regard as integral to who and what they are (Arnakak, 2001). A basic foundation of IQ is the ground rules, customs and ways of doing things for Inuit. It is likely that IQ evolved organically out of discussions within Inuit communities

including senior members of government as a deliberate means to comprehend, resist, and transform crises related to dual concerns of Inuit marginalization and underachievement and the ongoing erosion of Inuit language, knowledge and culture as a result of colonization. As Graham Smith, a Māori education academic would assert IQ contests the positional superiority of Western knowledge (and in Canada's case, southern knowledge) and processes and endeavors to re-establish Indigenous knowledge and processes within contemporary society (Smith, 1997). Although these principles are identified by Inuit as foundations of social operation in traditional Inuit society they are asserted as being the operative procedures or "living technology" for all aspects of social development in Nunavut, including schools whether or not the participants in the social development process are Inuit. It is a means of rationalizing thought and action, a means of organizing tasks and resources, a means of organizing family and society into coherent wholes (Arnakak, 2001). Although not listed here, there are several commonly cited principles of *Inuit Qaujimajatuqangit.* Of importance to this study are the principles of *pilimmaksarniq* and *piliriqatigiinniq*. These principles endorse the need for development through practice and action ensuring that the community is a full and meaningful partner in educational development activities; a collaborative relationship that is often cited as lacking in northern education processes (Goddard & Foster, 2002). Working together for common cause ensuring equal power relationships becomes imperative to any successful project. Ensuring that there is a re-establishing of the importance of Inuit knowledge, values and processes within schools becomes a fundamental journey in re-establishing Inuit priorities in Nunavut schools and classrooms, including in science education, the focus of this study.

Understanding how personal attribute factors and multi-system environmental factors influence successful science delivery and development that harmonizes traditional epistemology

and contemporary science teaching is likely to be best understood by considering cultural-contextual theories of development. One such theory appropriate for the context of this project is put forward in the work of Urie Bronfenbrenner (1979, 1989, 2005). Although this theory is believed to offer little insight as to how existing power differentials can be addressed in Aboriginal settings, it, nevertheless, provides insight into the identification of multi-system factors that can support or impede development projects (Wood & Lewthwaite, 2008). Bronfenbrenner's (1979) bio-ecological theory of development posits that development (both individual and group) is a joint function of the person and all levels of their environment. The former includes personal attribute factors that are both biological and psychological (e.g., genetic heritage and personality) (Moen, 1995, p.1). As suggested by other studies (for example, Lewthwaite, 2000), teacher personal attribute factors such as professional science knowledge, science teaching efficacy, interest and motivation in teaching science, and interest and motivation in 'both-ways education' are likely to be important determinants influencing the delivery of science in a manner that honors Inuit epistemology. The latter, all levels of one's environment, encompasses the physical, social, and cultural features of immediate settings in which one lives (e.g., family, school, and neighborhood) (Ibid, p.1). Bronfenbrenner sees the ecological environment as a system of five nested structures. The innermost structure represents the individual which in this case is the teacher. The remaining four nested structures range from the immediate face-to-face setting to the more remote setting of the larger culture (Hoffman, Paris & Hall, 1994, p. 47). The first of these four structures is labeled the microsystem. The microsystem consists of a teacher's students, colleagues, and possibly friends and family. As the immediate proximal setting with which the teacher directly interacts, it invites, permits, or inhibits activity (Bronfenbrenner, 2005). It is likely that if students are very responsive to using

or learning their traditional knowledge, a teacher is more likely to make reference to it in her teaching. Conversely, if students do not respond well to a teacher's inclusion of traditional knowledge the teacher is less apt to include it in the future. The developmental processes that occur within the microsystem are in good part defined and limited by the beliefs and practices of the mesosystem, the second of the four nested structures. The mesosystem contains society's blueprint for a particular culture or subculture (Hoffman, Paris & Hall, 1994, p. 47). Thus, the school's belief systems and values may strongly influence the expectations endorsed by members of a microsystem. As an example, within the school context the belief systems held by senior teachers, the principal, and school administration (including the District Educational Authority (DEA) and School Services Division) concerning the importance of delivering a science program in a manner that honors Inuit epistemology are likely to strongly influence the school's ethos for such an initiative. If a principal and an instructional leader advocate such a stance, their viewpoint is likely to influence or support individual teacher's orientations to two-way science teaching. The third structure, the exosystem, refers to environmental influences that do not directly involve the developing person, or teacher in this case, but even so influence the setting in an indirect manner. As an example, the community's or school division's aspirations for science and the support provided by community members and regional school division are likely to impinge on school-based policy decision making and implementation. Again, a school working collaboratively with its community in regard to its instructional and philosophical orientation is likely to be more successful in providing two-way experiences for its students. Finally, the structure most removed from the individual teacher, the macrosystem, refers to societal and cultural ideologies and laws that impinge on the individual. In the context of this inquiry,

Nunavut's cultural inclusion policies, curriculum agenda, and teacher education protocols are likely to positively support and influence the school's response to science as a curriculum area.

Of importance to this inquiry is the acknowledgement that, as Bronfenbrenner suggests, supporting processes within these overlapping environments are "engines" for development. As well, Bronfenbrenner (2005) proposes that these engines are context-, time-, and process-dependent. This implies that the factors that influence a teacher's and school's ability to successfully deliver a science program that harmonizes traditional indigenous knowledge and contemporary science cannot be generalized but, instead, are multi-system in nature and unique to each setting. That is, in fostering successful science curriculum delivery one must take into account teachers' personal attributes, the context in which the development takes place, the time at which the development process is occurring, and the processes each person experiences. When one considers the principles of *Inuit Qaujimajatuqangit*, successful science delivery and school development that honours local epistemology is likely to be a product of a variety of system elements and processes, but critical to this development will be strong collaborative relationships and consensus decision making among teachers, administrators and the school community for a common purpose. Simply put, things need to "come together" just at the right time for an individual teacher or school community in seeing the realization of such an aspiration. Similarly, individual or multi-system factors can neutralize any attempt to work towards this aspiration.

Context of the Study

In response to understanding and addressing this complexity, this study endeavours to support three Inuit communities in northern Qikiqtani in the realization of their goals for science education. The project sequence will, in its entirety, (1) establish the current situation in

Kindergarten to Grade 7 science education in the three communities, and (2) identify developmental aspirations for stakeholders within the communities and potential contributors and constraints to the achievement of these aspirations. Further components of this research and development project will endeavour to (3) implement mechanisms for achieving identified aspirations, and (4) evaluate the effectiveness of such mechanisms with the aspiration that the project overall will serve as a pilot study for school community development projects in other Nunavut regions and Aboriginal settings internationally. This research inquiry employs an action research methodology. In line with such a research methodology, this inquiry is an ongoing three-step spiral process (Lewin, 1951). This first reconnaissance phase of this project is focused on understanding the processes influencing science delivery through teacher and school community perceptions and reflections of their past and current experiences. As well, it identifies aspirations for science delivery in these settings and possible constraints (risk factors) and contributors (supportive factors) for attaining these aspirations. The second phase identifies and implements mechanisms for fostering development based upon these initial understandings. Finally, the project, in the third phase, goes on to evaluate the effectiveness of mechanisms designed and responds to the evaluative outcomes. Based upon a synthesis of all of these phases, this summation provides insights appropriate for enhancing the achievement of culture-based curriculum development efforts in other Inuit, and potentially, Aboriginal settings.

This research and development project is based in three Inuit communities in the northern Qikiqtani Region of Nunavut. The relative political infancy of Nunavut and the first author's perceptions of the risk factors likely to impede the realization of its science education aspirations based on his previous research (Lewthwaite, 1992) prompted the University of Manitoba's Centre for Research, Youth, Science Teaching and Learning (CRYSTAL) to approach the

Nunavut Department of Education to support a research and development project in science education. The three communities were identified by the Nunavut Department of Education and Qikiqtani School Service Division as being a logical site for the development project. Identification was based on the geographical situation of the communities (both in terms of proximity to one another and their remoteness from other communities in Nunavut); the community's aspiration to work toward a science program that honored community epistemology; and the high level of Inuktitut language use in the school and community. The three school communities involved in this research and development project include a Kindergarten to Grade 6 school in one community; a Kindergarten to Grade 7 school in a second community; and a Kindergarten to Grade 8 sector of a Kindergarten to Grade 12 school in a third community. Within the context of the goals of this study, the differences among the communities (and these are not that great) included the following: (1) the degree to which the school community is presently supporting the inclusion of Inuit perspectives within the school curriculum; (2) the mechanisms that are currently being used to incorporate Inuit perspectives within the school curriculum; (3) the amount of instruction in Inuktitut and traditional knowledge that occurs within the school; and (4) the number of Inuit teachers within the school.

Data Collection Methods in the Reconnaissance Phase

Four data collection methods were used in the preliminary, reconnaissance analysis. First, formal and informal interviews and conversations were conducted in Inuktitut or English (depending on the respondents' preference) with a total of over sixty science education stakeholders within each of the three school communities. As suggested by Bishop (1996), the formal interview was more of a conversation, while the informal interview was more of a chat.

The second involved the use of PATHing, a full-day process where stakeholders collectively identified through discussion and negotiation aspirations; strengths; weaknesses; and steps towards achievement of goals. This process involved principal, teachers, parents and other community members. In the illustration the authors facilitated discussions among stakeholders identifies in each column the identified goals, suggested existing and required resources, potential contributing and impeding factors, timelines and individuals to be committed to specific tasks. The third involved the use of a focus group to verify the outcomes of the initial two stages of the study and to further elucidate factors influencing the science education aspirations of the school communities and to identify a sequence of action appropriate for each community. This group consisted of the authors and one project Inuit teacher-leader or co-leaders from each of the three communities. Finally, a comprehensive, validated instrument, the *Science Delivery Evaluation Instrument for Nunavut Settings* (Appendix One) was developed specifically for this study. Its development is described in another publication (Lewthwaite & Renaud, 2009). Essentially, it gauges teacher perceptions of their professional ability and the school community's commitment to fostering the achievement of a both-ways science education program.

The SDEINS is a statistically validated instrument that contains 28 items. The seven factor categories of the SDEINS and examples of individual items from the SDEINS are presented in Table 1. The seven scales have been developed with the intent of gauging teacher's perceptions on a 1 (Strongly Disagree) to 5 (Strongly Agree) scale in areas that are identified as major impediments or contributors to science program delivery in Nunavut settings. The instrument when answered by teachers provides data to give an indication of where teachers and schools are perceived to be, and by so doing, provide developmental information for

collaborative action to the schools involved in this study. Mean (average) calculations were performed to identify general trends in perceptions for each scale and each item. Standard deviations were calculated to determine the degree of consistency amongst respondents for each scale and each item. The instrument was invigilated at the start of the project in May 2005 and also in May 2008. By this stage, resources in both Inuktitut and English had been developed and used in schools. As well, teachers had been encouraged and exposed to strategies for teaching that were regarded by students as effective strategies for fostering their learning.

Factor	**Description of the Factor**	**Example of Items from Each Factor Scale**
Pedagogical Capability – Cultural	Teacher perceptions of their pedagogical ability/efficacy to teach science from a culture-based perspective.	I feel prepared to teach science from the perspective of Inuit values, beliefs and knowledge.
Teacher Interest	Teacher interest in teaching science, especially with a two-way orientation.	I am committed to teaching science from the perspective of Inuit culture and values.
Pedagogical Capability – Knowledge	Teacher perceptions of their knowledge appropriateness for teaching science with a two-way orientation.	I have a good knowledge of the both the contemporary science and traditional knowledge we want students to learn.
Pedagogical Capability - General	Teacher perceptions of their science teaching capability without yet making it culturally located.	I have a good understanding of the science ideas we are to teach our students.
Resources	Teacher perceptions of the resources, including professional development, time and resource people that influence realization of goals.	I have the resources and materials I need to teach science from the perspective of Inuit culture and values.
School- Community Priority – Cultural	Factors external to the school that influence the priority placed on a 'two-way' orientation.	The school community places a strong emphasis on learning science from the perspective of Inuit culture and values.
General School Priority	Teacher perceptions of forces working within the school that influence realization of a 'two-way' science orientation.	There is leadership from the school administration for the teaching of curricula such science from an Inuit perspective.

Table 1: Dimensions and Sample items from the Science Delivery Evaluation Instrument for Nunavut Schools

Outcomes of the Interviews and SDEINS Application

The formal interviews and conversations were used to (1) authenticate and elaborate on the data collected from the SDEINS applications, (2) elicit stakeholder aspirations for science education, and (3) identify through stakeholder comment perceived risk and protective factors for the delivery of contemporary science from an Inuit perspective. The common theme, without exception, advocated for a science education experience that combined the views of "both worlds"; that is combined the knowledge, values and skills of both Inuit ways of knowing and ways Inuit come to know and western science. Stakeholders indicated a high regard for and in many cases an obligation to see science that integrated traditional (cultural) and contemporary science knowledge and practices. Two comments are representative of this advocacy:

> For a long time we would put away our knowledge [at school] and the way we do things and it wasn't important. For my children I want that to change. I want them to be raised to proud of who they are and learn things that are important to their lives in the future, both if they live here or away. They have to learn both ways. (Inuk teacher and grandparent).

> I was told for so long [through schooling] what I knew wasn't important. That has changed but it still needs to change for better. There are things we need to learn but there are things [about or culture] we need to be reminded are important, not just about what we know but the way we do things. (Inuk Local Education Authority member).

These comments were characteristic of many stakeholders who indicated that the high regard for teaching science in a manner that honours local epistemology was essential in schools. Implied within these comments is the desire to see a re-positioning of the knowledge and process aspects of *Inuit Qaujimajatuqangit* alongside of contemporary Western science thought and practice ensuring its validity within the classroom. Also implied is an assertion that stakeholders are unwilling to see their children experience science educational success at the expense of their cultural and psycho-social well-being (Fordham, 1988) affirming McKinley's (1996, 2000)

comments that curricula must begin to acknowledge local indigenous communities and their knowledge, values, beliefs and pedagogies as thoughtful and purposeful cultures.

The follow-up interviews, conversations and meetings provided a more thorough and accurate understanding of both the school community aspirations towards science delivery and likely contributors and impediments to science delivery within these northern Qikiqtani schools. Although there were some minor variations among the communities, both in terms of aspirations and perceived risk and protective factors for achieving these aspirations, common themes were clearly evident. For the remainder of this section, two perceived supportive factors and four perceived risk factors will be presented and discussed.

Supportive Factors Influencing Science Delivery from an Inuit Perspective

Rutter (1977, 1987) suggests that supportive factors are those personal attribute and environmental factors that foster development. Two such factors were commonly identified.

1. Interest in teaching with reference to the Inuit perspective. The conversations quickly indicated that the SDEINS was able to identify that stakeholders within these settings aspired to teach science, or at least deliver science, in a manner that acknowledged community epistemology. Although the SDEINS data indicated there was an acceptable level of interest in teaching science, the follow-up conversations and interviews revealed there was equally if not more interest in seeing science taught collaterally. Unlike a previous northern study where interest in teaching with reference to local epistemology was the exception (Lewthwaite, 2005), Qikiqtani stakeholders indicated a high regard for and even an obligation to see science that integrated traditional Inuit and contemporary science knowledge and practices. Two comments are representative of this advocacy:

> Learning about our own culture is important, and I don't want us to turn our back on that [knowledge] that is valuable for our students. It's who they are. [At the same time] it's really important to integrate this knowledge [with non-traditional knowledge]. Students will benefit from both. They'll feel better about themselves as Inuit. (Inuk Grade 1 Teacher).

> We want an education that brings the best of both worlds to our students. There are some things best learned in the classroom and some things best learned from elders. Both ways have their benefits, and that's what it should be like. Bring the best of both worlds. Try to combine the two. (Inuk Elder & DEA Member).

These comments were characteristic of many stakeholders who indicated that the high regard for teaching science in a manner that honours local epistemology is commonly fostered by both Nunavut government expectation, an environmental macrosystem factor, and teacher personal interest and motivation, an individual personal attribute factor. No stakeholder adversely referred to the expectation that curricula should be taught with reference to an Inuit perspective. It would appear that this interest is the most significant supportive factor likely to influence any effort to develop science programs that honour local epistemology. As Fullan (2002) suggests, change is more likely to occur when there is interest and identified need for change.

2. *School community supportive factors.* Stakeholders in each of the three school communities referred to existing mechanisms that were available for supporting the incorporation of traditional knowledge into science education. Three major sources of traditional knowledge were identified. In one community, elders work within the school as Cultural Specialists and are available for use by teachers upon request. In all three schools, funding is available for teachers, individually and on their own initiative, to invite elders or members of the community into their classroom as instructional providers. In one of the three communities, elders have been interviewed to canonize traditional knowledge (IQ). This information has been recorded and incorporated into an electronic database that is available for educators. The third

community has commenced videotaping elders' accounts of traditional knowledge. Although these forms of information were available, most stakeholders suggested it was being under-utilized, especially in integrating Inuit knowledge and the knowledge of contemporary science.

Risk Factors Influencing Science Delivery

Rutter (1977, 1987) suggests that risk factors are those personal attribute and environmental factors that impede development. If these three communities aspire to develop science programs that provide students with collateral learning experiences in science, four factors were perceived to potentially impede this development process.

1. Teacher capability in teaching science from an Inuit perspective. As might be expected the most commonly cited concern about teaching science from an Inuit perspective was teacher capability to do so. Teachers shared a concern about their level of confidence and knowledge of both contemporary science and traditional Inuit knowledge and process (IQ). Clearly, teachers perceived their knowledge and understanding of contemporary science knowledge more favourably. As previously mentioned, teaching to the intent of a 'two-way' orientation is beyond the ability of most Qallunaat (non-Inuit) teachers as it deals with traditional Inuit knowledge (Berger & Epp, 2005). Clearly for most teachers, teaching collaterally was not possible because of the inadequacy of their knowledge of traditional epistemology and, for some, the inadequacy as well of their contemporary science knowledge. As suggested by Christianson (2004), the inadequacy of traditional Inuit knowledge and understanding of the entire IQ perspective was also an issue for some Inuit teachers.

> Sometimes you are teaching and you come to a barrier [because you don't know any more about the traditional knowledge]. You want to say more to your students but you have no more to say. (Grade 5 Inuk Teacher).

> I find my own experiences are not that strong. I know lots of things but not in some of the areas in the curriculum. We do themes like plants and there is much I need for my students to learn from the elders and not me. Other areas are easier. It really depends where your experiences have been. (Grade Two Inuk Teacher).

As well, Inuit teachers identified that they teach science from an Inuit perspective. To teach from a Western science perspective can be very difficult as the following comments suggest.

> Our cultural upbringing really has a lot of effect on how we teach science. English and Inuktitut - the culture, our way of doing things, not the language - are quite opposite. The way English teach gets confusing. Science is not a barrier, the English way is. (Grade 1 Inuk Teacher).

> They can teach science very well as it relates to the way they were brought up. Curriculum guides confuse our way of thinking. (Inuk Principal).

Several teachers identified that teaching science which acknowledges Inuit perspectives is likely to be best and most realistically facilitated by utilizing other physical and human resources within the school community.

> The foundations of IQ appear to be pretty straight forward but they aren't. You can know things about the local community and the culture but presenting it in a way that fits with the principles of IQ isn't easy. I think the elders on staff [who serve as Culture Specialists] understand the IQ perspective and can present things much more meaningfully. (Grade Seven non-Inuk Teacher).

> We are able to use the elders a lot in our teaching. Being able to teach a topic and then get their perspective on the same idea. When we did weather I looked more at the characteristics of air and ways we measure weather conditions whereas they looked at traditional ways of understanding and reading weather. That went well. I think that's an ideal way to get the Inuit perspective. (Grade Seven non-Inuk Teacher).

It is apparent from the comments made by stakeholders that mechanisms in addition to developing teacher capability to teach collaterally need to be considered for these three Qikiqtani schools.

2. Adequacy of physical and, to a lesser extent, human resources. As identified by Berger and Epp (2005), the adequacy of relevant resource materials appropriate for Nunavut, especially the Qikiqtani region, were seen to be critically important for the teaching of science from an Inuit perspective. Some teachers recognized there were resources available that to some extent linked to their teaching. Most, however, identified the need for resources that made connections explicit in terms of traditional Inuit knowledge and contemporary science.

> You have a sense of what it should look like in a unit of work, but there is nothing available that merges this for me. I just don't have all of the time to do this [as a newer teacher]. Maybe in time, but not now. I can't get it through my mind that there has been teaching going on here for years and those resources to draw from have not been put together. (Grade 7 non-Inuk Teacher).

Several commented on the value of older resources developed by the Department of Education of the Northwest Territories and other resources developed for secondary science topics. Teachers that taught in Inuktitut repeatedly emphasized that the lack of resources for their students was a critical aspect needing immediate attention. The presence of elders within the school to assist with the traditional knowledge integration was seen to be very valuable and advocated by some teachers in schools where elders were currently not employed. Mechanisms for making use of community elders within the classroom as cultural knowledge specialists in some communities were established, in others they were not.

> The Culture Specialists within the school are pretty well available whenever we make the request. It's great to have that support there. I think it is one of the most positive things about working in this school. (Grade 5 non-Inuk teacher).

3. Language background of students and teaching of English as a Second Language (ESL) competencies. Non-Inuit teachers repeatedly mentioned that a major factor influencing the effectiveness of their teaching in all curriculum areas was their students' English language competencies. Teachers identified their need to not only possess a knowledge base that equipped

them to teach science collaterally but also to teach students whose first language was Inuktitut. As Berger and Epp (2005) identified, teachers acknowledged the need for strategies for teaching content areas such as science to EAL learners. Many teachers recognized that science was a difficult curriculum area to teach because of the terminology used in contemporary science. Despite this, teachers often cited that the first hand experiences science provides open the door to language development both in Inuktitut and English. Again, teachers frequently mentioned the value of the Government of Northwest Territories science resources that provide instructional support for science topics from a language development perspective.

4. Clearly identified educational, in particular, science curriculum direction. Teachers often conveyed frustration and a need for clear educational leadership in the area of instructional orientation relative to the incorporation of traditional knowledge, specifically those orientations representative of the principles of *Inuit Qaujimajatuqangit* that would facilitate two-way or collateral teaching. Although there is a requirement for classroom experiences to reflect an Inuit perspectives, making this a reality was perceived to be the responsibility of individual teachers provided with minimal guidance.

> You're really on your own journey as a teacher. We [as teachers] do talk about the way we would like to see it happening, but you are on your own. As a school it isn't a priority. You are always dealing with other issues and the way you teach sometimes ends up at the bottom of the deck. There is a requirement for the IQ orientation, but I look for some guidance as to how this comes about in my classroom. (Non-Inuk Grade 4 Teacher).

Other studies have shown that change in instructional practice is largely a reflection of the emphasis placed on instructional improvement through the instructional leadership provided by school principals and superintendents (Lewthwaite, 2007a). Clearly, teachers would identify that they, individually, can make some progress in seeing two-way learning occur, but for school-wide and divisional change to occur, this needs to be assisted by senior teachers,

principals and superintendents as instructional leader. It is they that are critical to fostering the development of strong collaborative relationships and consensus decision making and action for a common cause among teachers, administrators and the school community.

Teachers commonly mentioned that the absence of a Nunavut science curriculum that affirmed a culture-based science education experience was a critical factor limiting their effectiveness as teachers. Many remarked that the absence of a more detailed science curriculum gave them a great deal of liberty in what they explored with their students, but tended to limit science teaching to areas in which teachers felt competent, especially those related to the biological sciences. Thus, particular topics like the seal or caribou tended to be used repetitively by teachers at each grade level. Many followed the guidelines set by the Alberta, NWT, or the Council of Minister's of Education's (1997) *Common Framework of Common Learning Outcomes*, commonly referred to as the Pan-Canadian Science Framework. A more detailed science curriculum for Nunavut that corresponded to the Pan-Canadian Science Framework yet made explicit opportunities for the Inuit perspective was the preferred curriculum guidance advocated. As well, typical of most Kindergarten to Grade 8 schools (Lewthwaite *et al*, 2001) no apparent formalized leadership for science education either from a science teacher-leader or senior administrator was currently encouraging science development according to the aspirations of the school community.

Summary of the Introductory Phase

The factors identified as influences on the realization of a two-way science orientation are illustrated in Figure 1. Although the factors are listed as isolated spheres, it is obvious from this study that there is interplay among these spheres, especially in terms of how environmental

factors may influence teachers' and school's ability to provide students with two-way learning opportunities. Of particular importance is how evident the principles of *Inuit Qaujimajatuqangit* need to be incorporated in order to see the realization of goals. The principles likely to be most closely connected to this include (1) the principle of decision-making through discussion and consensus (*aajiiqatiginniq*); and (2) the principle of collaborative relationships or working together for a common purpose (*piliriqatigiinniq/ikajuqtigiinniq*). The illustration also assists in identifying the key priorities to address if the aspiration of providing students with a science experience that honours Inuit epistemology in this development is to be realized. In order to harmonize science learning with their life-world culture some priorities in this project were able to be identified. They included:

1. Ensuring that policy that places priority on instruction that honours two-way learning is supported through to implementation by supportive measures by educational leadership at the school and divisional level;

2. Ensuring that the strong collaborative relationships and consensus decision making among teachers, administrators and the school community for a common purpose is encouraged throughout the development process;

3.Ensuring that any professional development and resources developed focus on language development for in Inuktitut and in English for ELA learners through engaging science experiences;

4. Developing the most appropriate physical and human resource base for integrating traditional knowledge into a science program. This human resource base might include the use of school-based culture specialists, audio-visual and audio recordings of community members, and teachers themselves; and

5. Identifying how traditional Inuit knowledge and contemporary science knowledge development opportunities, potentially in alignment with the Pan-Canadian Science curriculum framework, can be fostered.

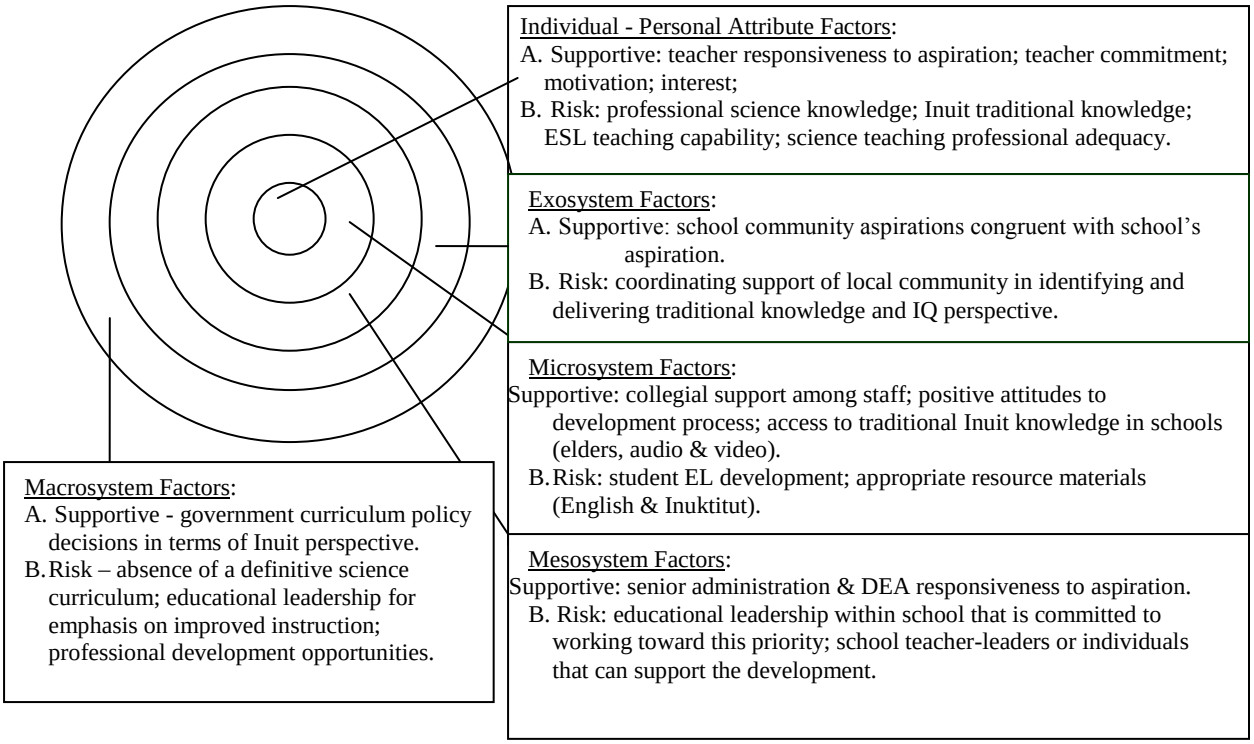

Figure 1: Factors perceived to likely constrain or contribute to the delivery of science programs that honour traditional epistemologies in Qikiqtani schools

The next phase of this study focused on consultations with the individual schools to establish, implement and evaluate agendas for development in accordance with the aspiration of developing science programs that honour local epistemology while taking into consideration the priorities listed above. It was envisaged that the resources and programs developed and the processes used and identified as constructive in achieving these goals at the school and classroom level, especially in regards to the principles of *Inuit Qaujimajatuqangit*, could be used as examples for other Nunavut schools of how contemporary science and traditional Inuit knowledge and process can be integrated.

Mechanisms Implemented to Meet Community Aspirations

Identification of School-based Teacher Leaders

Based upon the first author's experience with fostering and identifying characteristics of successful school-based curriculum developments (Lewthwaite, 2006), it was deemed to be essential to identify a teacher or administrator at each school who could carry on the role of a teacher-leader for the project at the individual school level. These were not to be financially paid positions, but they would provide the opportunity for teacher-leaders to be a part of the development project and, if required, represent the project at regional, territorial, national and internationally conferences. The individuals selected for each of the three schools included a non-Inuk teacher who had taught at her school for over twenty years, an Inuk teacher who had taught at her school for twelve years, and an Inuk teacher who was in her first year of teaching at her school). They were all endorsed by their principals and colleagues to have the characteristics regarded as consistent with effective teacher leaders (Lewthwaite, 2006). They were all interested in and motivated to see the project succeed and were willing to be a part of the project from its initial conceptualization to its end when the final evaluations were completed. They had the respect of their school community. They also possessed the knowledge of both western science and *Inuit Qaujimajatuqangit* central to the topics to be developed. They also could lead in teacher development. They were able to model good teaching practice and, at the same time, assist people in their teaching and expect fellow teachers to carry out their responsibilities associated with the goals of the project.

Resource Development

Over the past four years members of the Centre for Research, Youth, Science Teaching

and Learning have been working with each of the school communities to collaboratively develop with teachers (both Inuit and non-Inuit) and community members, especially elders knowledgeable in *Inuit Qaujimajatuqangit*, place-based learning materials that are consistent with the community's aspirations for science education and are aligned with the Pan-Canadian Science Protocol. These resources, in both English and Inuktitut, are made available to all Nunavut teachers on-line through http://www.umanitoba.ca/outreach/crystal/nunavut.html. CRYSTAL members work collaboratively with individual or teams of school teachers and as a school teaching staff collectively in modeling appropriate teaching practice and monitoring student progress as a result of their two-way learning experiences. The initial PATHing included an opportunity for the communities to determine what topics they deemed as important for development. Not surprisingly, topics focused primarily on the natural environment. Examples included Weather (Sila) and Sound (Nipiq). As well, individual teachers volunteered to assist in the development of these topics based upon their having interest in the topic under development and knowledge of the topic from a Western Science and/or *Inuit Qaujimajatuqangit* perspective. The researcher then works with the teacher to assist in the development of the unit so it will purposely attempt to blend or bring into comparison the views of both worlds, without treating either as inferior. Usually the teacher and researcher together conduct elders' interview often facilitated by a translator to develop better understandings of the IQ appropriate to the context under study. An important source of information for this project is database of elders' interviews archived as digital English translation recordings at the Government of Nunavut Igloolik Research Institute. The CRYSTAL researchers spend in total two, three week terms in the three communities each year assisting teachers in the development of and classroom implementation of the resources. The developed lessons and units developed are trialed and modified based upon

student response to the activities developed.

Guiding Principles of the Units

The stakeholders of the project have identified several guiding principles that are used in the development and delivery of the units. These principles were established at a meeting of representatives from each community when the overall project was being conceptualized. The principles have their origin in a variety of sources, one primarily being the knowledge and experience of all stakeholders (teachers both Inuit and non-Inuit, science education professors, elders). Many of these foundations are identified in the forward to *Inuuqatigiit: The Curriculum from the Inuit Perspective* (GNWT, 1996). Again, these foundations of preferred pedagogy for Inuit students are noted to be embedded within traditional and contemporary Inuit society. These include:

- Provide two-way learning experiences by integrating Inuit knowledge, ways of knowing, beliefs and values and contemporary scientific knowledge, processes and attitudes.

- Draw upon traditional and contemporary Inuit cultural examples as contexts for student learning.

- Include the local community and its people in students' learning opportunities as the classroom is an extension of the school and local community

- Foster language development in Inuktitut and, where required or encouraged, English.

- Use locally recognized pedagogical practices to promote student learning.

- Use science experiences as a rich context for promoting literacy and numeracy skill development.

- Use diagnostic and formative assessment to inform planning and teaching and monitor student learning.

- Engage students by starting lessons by providing first-hand experiences for students or drawing upon common experience.

- When using story to engage students, use the interrupted-story-line as a vehicle to prompt first-hand investigations.

- Deliberately promote scientific attitudes of mind (curiosity, problem-solving, working to end) student through thoughtful independent consideration of questions and challenges posed.

- Move from the experiential, first-hand experiences to the psychological; that is, after providing concrete experiences assist students in making sense of experiences by using purposeful strategies to promote understanding such as role plays, illustrations and analogies.

- Assist students in their consolidation of ideas only as an extension of the initial experiential and psychological learning experiences.

- Within the lesson and throughout the unit, move from concrete to more abstract ideas.

- Provide opportunities for student-initiated and directed investigations.

- Provide opportunity for students to make connections among science and all other learning areas.

- Foster student independence, creativity and curiosity by providing opportunity for students' ideas and questions and follow-up opportunities for problem-solving and investigation.

- Provide students the opportunity to make connections between what they are learning and career opportunities.

It is noteworthy that this list is constantly being modified according to the research teams' ongoing understandings of what contributes to positive learning outcomes for Inuit students. A further framework identified as useful, especially for assisting non-Inuit educators, including both non-Inuit teachers and CRYSTAL researchers in adopting a broad culture-based perspective in their teaching, is advocated by Arlene Stairs (1995). This framework is of value to non-Inuit in understanding the various school and classroom practices that can be acknowledged

in developing and implementing a culture-based program. It is noteworthy that her model goes beyond the incorporation of local language and culturally-relevant materials. She advocates teachers using socio-cognitive pedagogical processes to assist students in their learning. Although the research team had some preliminary understanding of these processes prior to the commencement of this project, it is the knowledge of these processes, in particular, that is constantly being refined as more is learned about effective teaching practices for Nunavummiut. Examples of social and cognitive processes that have been identified as a result of the intervention will be identified in the next section.

Outcomes of the Project

SDEINS Teacher Development Outcomes

The instrument previously discussed is used as a means of monitoring progress and promoting staff discussion in terms of where development is occurring at each school and where further improvement is necessary. In this section only the quantitative data are included as the follow-up discussions with teachers have provided confirmation of the accuracy of this data. Examples of data collected from two of the schools participating in the development project are shown below. These two schools are chosen because they best elucidate the complexity of factors influencing progress in the achievement of the school community aspirations for science education. In the first school, in 2005 the school had a full Inuit staff, including principal at the commencement of the project who all taught in Inuktitut and currently has, because of a variety of unavoidable reasons, moved to having a non-Inuit principal and several non-Inuit teachers. Figure 2 represents the outcomes from the survey being implemented in this school in Year One of the project in January, 2005 and Year Three of the project in May, 2008.

This school's data is presented because it helps to show the complexity of the multi-system factors commonly impeding the achievement of an Inuit school community's aspirations for science education, especially as a result of the high staffing turnover that occurs within northern schools. In both cases, the graphs represent the mean (on a scale of 1 – strongly disagree to 5-strongly agree) of the perceptions of factors identified as influences on the achievement of the common aspiration; a science program that honors *Inuit Qaujimajatuqangit*. Although a considerable amount of effort has been expended in this school community to assist the school in moving towards a greater inclusion of science teaching from the perspective of *Inuit Qaujimajatuqangit*, it is evident that teachers' perceptions of the progress towards this end in all dimensions other than Resources evaluated by the SDEINS have had minimal success. In fact, in the areas most central to the development project (Cultural Capability, Cultural Knowledge and School and Community Cultural Priority) there has been a decrease in teachers' perceptions of progress made. There were several inferences made from these data, and discussions with staff collectively have substantiated these inferences. Of greatest importance is staff acknowledgment in response to these data that the staff changes at both the principal and teacher level during this time period because of a loss of Inuit teachers, including the teacher-leader and principal and replacement with southern teachers had brought with it an orientation to teaching across the curriculum, and science curriculum delivery specifically that has placed less emphasis on *Inuit Qaujimajatuqangit* and science as a curriculum area. As mentioned previously, school practices such as the content of curricula, pedagogical practices and language of instruction have (probably) unintentionally denied the inclusion of those aspects of Inuit culture that have value and are important to Inuit children. From the principles of IQ perspective, the breakdown of a collaborative vision among school community members as a result of staffing

changes, especially the principal and teacher-leader, is likely to be the most critical aspect influencing negatively the initial aspirations for the school community. The principles of *pilimmaksarniq* and *piliriqatigiinniq*, which encourage the participation of the community as a full and meaningful partner in educational development activities, have largely been ignored in the re-establishing of the importance of Inuit knowledge, values and processes within schools and assist in re-establishing Inuit priorities for Nunavut schools and classrooms.

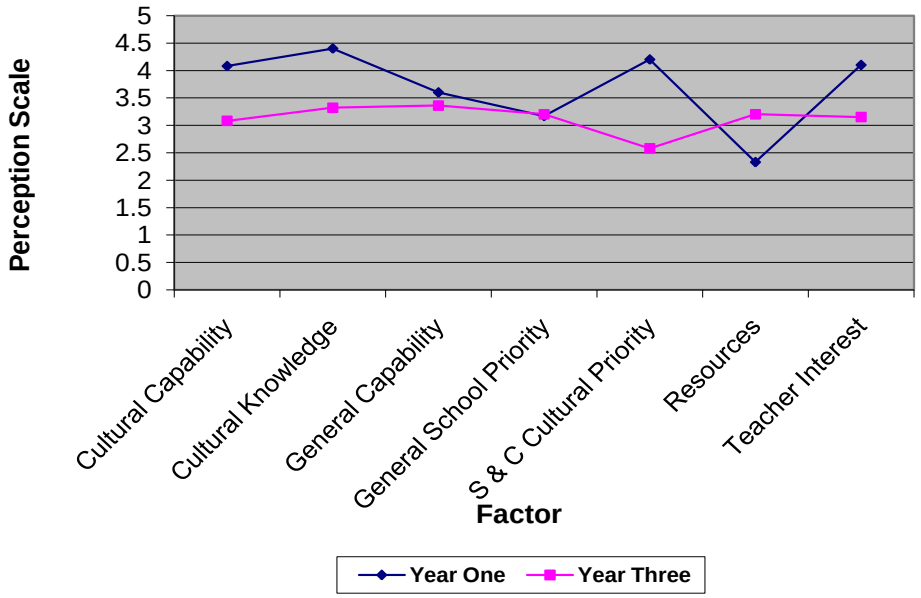

Figure 2: **SDEINS School A Comparison January 2005 and May 2008**

In the second school, the data gathered from the SDEINS and conversations with teachers and principals show, in contrast, evidence of significant development (Figure 3). The data collection from the SDEINS in this community, as well as the third, has been more positive in terms of the achievement of the intended goals of this development project. Although staff turnover is a problem experienced in all other settings as well, the focus on the efforts to foster

the inclusion of *Inuit Qaujimajatuqangit* has not been jeopardized because of the minor turnover changes in school administration and senior teachers. Of particular importance to this latter school community has been a stable administrative staff supportive of the CRYSTAL efforts and the committed support provided for teachers by a Learning Support Teacher who was appointed as the teacher-leader for this project who has lived in the community for several years and advocates a combining of a two-worlds orientation to teaching and learning.

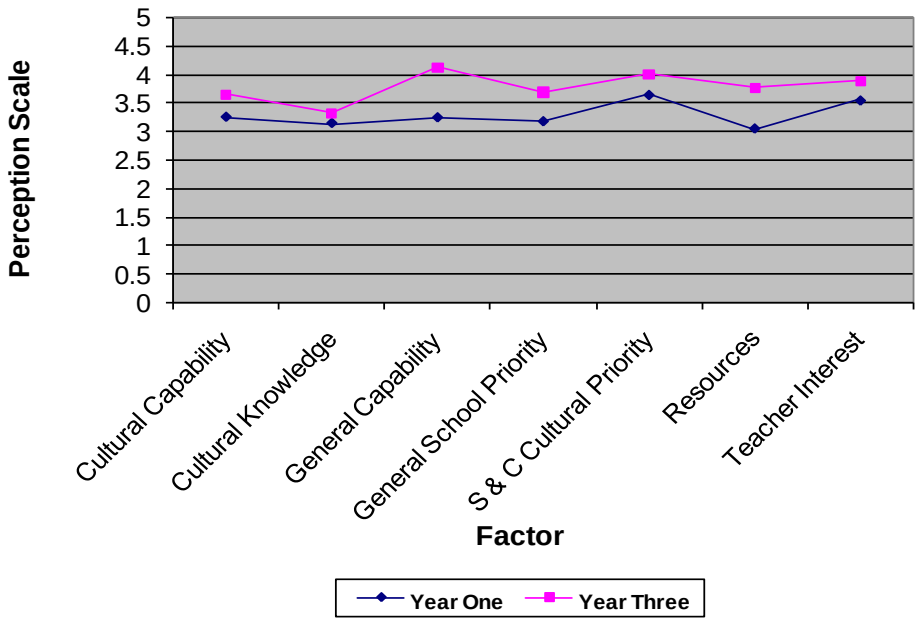

Figure 3: **SDEINS School B Comparison January 2005 and May 2008**

Student Outcomes: Intent and Methodology

It was anticipated that the learning experiences provided for students currently, and through the ongoing efforts, would help identify classroom-based pedagogical and interactive

processes that influence students' perceptions of their own school success. It is these pedagogical aspects that move beyond the *what* of science classrooms to, more importantly, the *how* of science classrooms. Although this stage of the project is ongoing, preliminary data collection, primarily based upon conversations with children and teachers and observations of successful classrooms, provides ample evidence to make some preliminary assertions about classroom pedagogical and interactive processes influencing student success which are valuable to many, especially teachers in these communities and, potentially, Nunavut schools in general. That is, what do students and teachers of these students identify as the pedagogical and interactive processes that influence Inuit students' perceptions of their own school success?

This part of the research is informed by the ideas and explanations of culturally responsive teaching; defined as using the cultural knowledge, prior experiences, frames of reference, and performance styles of students to make learning encounters more relevant to and effective for them (Gay, 2000). Two research and development projects in particular, one based in Canada and the other in New Zealand, have provided an invaluable platform for this study. As well, one document, *Inuuqatigiit: The Curriculum from the Inuit Perspective* (Government of the Northwest Territories, 1996) written for Inuit educators by Inuit educators provides considerable insight into the classroom and interactive processes influencing Inuit student learning. The document outlines traditional Inuit practices for teaching and how these are translated into contemporary classroom practice. This document provides evidence to support Stairs assertion (1995) that in Baffin Island (Qikiqtani) communities the formal learning of schools (referred to as *ilisayuq*) is radically different than the informal learning of Inuit home culture (referred to as *isumaqsayuq*) and that successful classrooms are likely to reflect these practices. This study attempts to determine what practices are indicative of good practice. All three of the

aforementioned publications or projects are similar in that they seek to inform improvement in educational success in response to what students are saying about their learning in Aboriginal settings, especially where educational success has been thwarted by a variety of factors, in particular, the marginalization of Aboriginal culture from the formal education landscape. First, Kanu (2002, 2006) engaged Aboriginal students of inner-city Winnipeg in conversations to identify the pedagogical and interaction patterns that have resulted in negative and positive learning experiences for these students as learners. In this analysis she focused on determining the curriculum materials, teaching strategies, and classroom processes that influenced student learning. By developing an understanding of the processes that supported or inhibited student engagement and learning, Kanu was able to assist teachers in developing effective teaching and classrooms that reduced the rupture between home culture and school. Second, Bishop and colleagues in New Zealand in their *Te Kotahitanga* project have been able to identify, through their conversations with Grade 9 and 10 Māori, students a variety of practices that contribute to both positive learning environments and student success in learning. By so doing they have been able to develop an Effective Teaching Profile for teachers of Māori based on operationalizing interaction and reciprocal practices that students believe address and promote their educational achievement. Both projects are similar in that they attempt to determine from the perceptions of Aboriginal students within mainstream settings what teaching practices contribute to their success as learners. Both studies place authority on students' ability to identify and communicate their understanding of mediators influencing their learning. This authority is then used to question the protocols of the mainstream classroom and in response promote a dynamic and synergistic relationship between home and community culture and school culture (Ladson-Billings, 1995). This questioning ultimately and purposely 'problematizes' teaching by upsetting

the orthodoxy of classrooms by encouraging teachers to ask about the nature of student-teacher relationship, the curriculum and schooling (Ibid). By creating this disequilibrium it demands that educators seek resolution of these issues so that their classrooms move towards becoming more culturally responsive as they employ a culturally preferred pedagogy. As suggested by Gay (2000) culturally responsive teachers respond to the cultural knowledge, prior experiences and performance and learning styles of students to make learning more appropriate and effective for them. They teach to and through the strength of their students.

As purported by Bevan-Brown (1998), the overall aim of this phase of the research is motivated by the researchers to better inform and benefit Inuit students and their teachers in seeing Inuit aspirations for education realized. It focused on the question: what do Inuit (or in their case First Nations and Māori students perceive as educational success, and what teacher specific and learning environment characteristics and processes contribute to this success? In answering this question a variety of data sources have been employed in order to triangulate data and increase reliability and validity of results (Bogden and Bilken, 1998). These sources of student data include (1) completion of a questionnaire in English or Inuktitut by a total of 36 Grade 5-8 students in two of the communities, (2) individual interviews with 24 Grade 7 and 8 students in three communities, and (3) group interviews with 39 students from three Grade 7 and 8 classes from three communities. In both the questionnaire and interviews the questions asked focused on students identifying (1) the last time they felt they had been successful in school, (2) what the teacher does to help them to learn, (3) what is happening in my classroom when they are learning best, and (4) what they would change about their teacher's teaching or what is happening in their classroom to assist them in learning. As well six teachers (2 Inuit, 1 First Nations, 1 Indo-Canadian, 2 Caucasian) identified by their teaching peers, principals and

CRYSTAL researchers as successful classroom teachers in regards to creating positive learning environments were observed repeatedly over three CRYSTAL researcher visits to the schools. Furthermore, eight teachers (6 being non-Inuit) who were completing their teaching term were interviewed and asked to consider teacher, student and classroom characteristics that promoted the creation of positive learning environments and facilitated engagement and learning. Finally, in two schools results of the interviews with students were shared with teachers at a staff meeting and teachers were asked to similarly respond to students' responses to teacher behaviors that influenced their learning. As suggested by Bishop (1996), in all cases the formal interview was more of a conversation, the informal interview was a chat and based upon the need for collaboration between researchers and researched in constructing the final story as evidenced in the vignettes and themes that follow. In all cases researchers looked for consensus among the conversations among respondents. What is reported herewith is limited to where consensus was evident among students or teachers and between teachers and students.

Since the purpose of this aspect of the research is to identify what students identify as educational success and the classroom based pedagogical and interactive processes that influence students' perceptions of their own school success, the results from the data collection will be organized around these three headings. Again what is reported primarily focuses on comments where consensus was evident among students or teachers or between teachers and students. Although several more emerging themes are evident from this data analysis, the lack of consensus limits their inclusion in this paper. Kanu (2002) suggests that these themes are likely to be manifest in students' home and community culture, and some attempt is made to these connections in the accounts that follow, especially by drawing upon the assertions made by Inuit

educators in *Inuuqatigiit: The Curriculum from the Inuit Perspective*. Again, since the project is within the context of science many of the comments made refer to science-related topics.

Student Perceptions of Success

It was evident through the questionnaire surveys, individual conversations and group conversations that students' perceptions of educational success, without exception focused upon their identification of achievement of 'working to an educational end' or assisting someone in working to an educational end in some first-hand experience. The focus of comments was on the satisfaction received from something being completed or accomplished individually or collaboratively through effort, much more than any mention of the external formal evaluation of the completed project. Performance was evaluated primarily on physical product and the knowledge that effort had been required to work to end. As examples, the 'product' often included mastering a series of mathematics problems, completing a poster or model, or assisting others in their efforts to work to completion. Praise from a teacher or peers was always valued and helped students to identify the completion of the product, but students most commonly were able to identify when they had persevered and individually worked to end, implying that students were able to self-evaluate. Comments and illustrations elucidating their views of success include:

> Interviewer: When was the last time you felt successful at school?
> Elijah: The turbines [wind rotators]. Mine worked good. It went around fast.
> Interviewer: Why did you feel successful?
> Elijah: It wasn't easy. You had to work at it. We tried this, then this, working to make it go and it went. Then we tried some more and it went better.

> Elisapee: When you help someone [with math] and then they can do it because you helped.
> Interviewer: Why did this make you feel successful?
> Elisapee: They didn't get it and then because you helped them and they didn't give up, they were really happy. You worked together to make it ok.

> Shane: We made the [string] telephones and ours worked. You could tell they weren't all working. We changed it and got it to work well in the end.
>
> Eli: I worked on the [model of the] village. It was just like the real village long ago, but very small. We made it really close to what it was like. It took a long time but we made it. I felt proud.
>
> James: We do the story-writing and then we drew a picture. [Another student] could read my story and she could see the picture. It was the first time someone reads my story. I was happy and wanted to do it [again] in the afternoon.

These repeated comments were confirmed by Tuqqassie, a well-experienced Inuit teacher.

> We want our students to persevere and see the result of their work. They need to know that they can do something on their own. Being helped is ok, but they need to know they can do it on their own. It is the way our culture works. You have to be able to persevere, and be encouraged as you persevere. They can get frustrated but they have to be able to work it through in their own mind and not give up. That is what is important.

This teacher's comments emphasize the importance of student's persevering to end and being affirmed as they work to end, not simply being judged for their performance removed from the actual process of working to end. As well, students are not only working on tasks that are attainable in terms of completion, but also have a degree of open-endedness in terms of the end result. Students are not simply following a set of steps to all arrive at the same conclusion or end. Instead they are required to show some initiative and perseverance and independent thinking to arrive at an end result. What was evident overall from students and teachers is that end results that focus on assigning achievement scores based on knowledge and understanding "correctness" are much less important than the actual completion of task. It is suggested by the authors that students' sense of success is culturally situated; that is, within their culture success is also defined in terms of working to end. This is affirmed by comments in *Inuuqatigiit: The Curriculum from the Inuit Perspective* (GNWT, 1996) where it is emphasized that "doing of things", task completion and developing a sense of accomplishment from task completion is an

integral component of the Inuit learning process. Accompanying this process, it is imperative that children see a positive attitude and hear positive feedback as they progress.

Often in subjects like science the focus for teachers is on developing student understanding of a conceptual area or having right answers, whereas for students their sense of accomplishment is likely to come from completion of the activities that provide students with the foundational experiences that support their learning of science ideas. Within a subject such as science, the Middle-Years curriculum begins to shift focus from initial first-hand experiences to the understanding of science ideas. Associated with this is the likelihood that many teachers will want to emphasize knowledge development at the expense of first-hand experiences. Since students greatest sense of satisfaction apparently comes from working to end, teachers must be aware of the significance of providing learners with attainable opportunities promoting first-hand experience that require students to persevere to end. As well, since success is nearly always recognized by students themselves and their peers by persevering to completion, teachers need to give consideration to assessment practices and what emphasis they place on marks and scores for evaluating students performance as opposed to performance evaluation of working to end. Students are unlikely to hold a view that 'a mark' has much value or should have more value than their personal perceptions of having worked through something to end.

As Bishop and colleagues (2003) suggest, success for Aboriginal students is typically defined by the dominant culture. In Nunavut schools it is possible, even likely that success is defined differently by teachers from the south. Terms of reference need to be challenged since the very pedagogic process will hold these definitions as a central value. If the terms of success are to be culturally determined, there needs to be repositioning of how teachers see and evaluate success. The comments from students would suggest that achievement by students is

acknowledged primarily through their evaluation of their ability to work to end and their sense of satisfaction reinforced through the acknowledgement of others that they have worked to end in a satisfactory manner.

Student Identification of Interactive Processes Influencing Their Success

Students were able to identify a variety of classroom interaction patterns primarily influenced by the classroom teacher that contributed to a positive learning environment. It is not surprising that since the majority of responses came from students themselves, the interactive processes influencing students perceptions were those that teachers contributed to either directly or indirectly. Similarly teachers suggested that they themselves were primarily responsible for contributing over time to a positive learning environment. Bishop and colleagues (2003) suggest that many teachers of Maori identify that someone outside the teacher's area of influence such as the school administration, the community or the students themselves are responsible for the development of a positive learning environment. That is, where teachers perceive their classroom environment to be a negative environment for fostering learning they attribute the cause of this to elements other than themselves. Such beliefs typically manifest themselves in a 'me and them' frustration mentality. Although such a shifting blame mentality may have some grounds, teachers who position themselves and accept their part in the relationship are likely to make more progress in establishing positive learning environments. That is, teachers who have a personal understanding that they can bring about change and are responsible for bringing about change in terms of interaction patterns in classrooms are likely to have much more success. As two southern teachers leaving the north suggested:

> You have this idea that things are going to be quite utopic [here in the north] and that isn't what I faced half way through the year [when I arrived]. I had in my

> mind the way things should be, and I was going to move towards that end. It took me that whole year [to work towards this and I didn't achieve it], and if I [had] achieved this end it wouldn't necessarily have been the best result. I guess I just wanted a well-managed classroom where everything went my way, or at least the way I thought was best. Paul

> When I look back [over my time here] what has changed most is me; just how I see the purpose and goal of education. For students it's mainly about what we are doing, and for me it was always the end result- learning this, reciting that- I just had to become much more focused on the *way* we did things – not just the end result. Seeing them [the students] as individuals and their interests and abilities – that made the biggest difference – not just a whole class with me as a teacher. Esther

Both of these teachers were able to talk at length about how they as teachers had worked towards establishing more positive ends primarily through their changed relationships and interactions with students, especially in regard to the processes that underpinned the development of positive learning environments. In contrast, one teacher who saw the problem as inherent within the nature of her students and the culture of community asserts:

> It never seemed to get to the place where I wanted it to. Just for students to work independently and co-operatively – at least for even a short period – they [the students] were just unable to. Unless I was in charge and very structured it wouldn't work. Pamela

Students, themselves were able to identify teacher behaviors that supported the development of positive learning environments.

> I didn't know which one [of the teachers in Grade 6] I wanted this year. Everyone knows they are very nice to you. They make you work, but they are nice. They care. Wayne.

> She [my teacher this year] doesn't just have to have things her way. Last year [the teacher] was strict but that doesn't mean I enjoy it or learn more. Elisapee

> She tells us she cares about that we learn and we <u>want</u> to learn. That's her job and our job is to try hard to help us to learn. She says that all the time and it's true. I know sometimes she's mad at us and that's ok. We try hard. Jacob

> She can bother me, and it is because she cares. We think that she cares about everyone the same way. [A student] doesn't come to school and she cares about

> that. It doesn't matter what it is. We know the [whole] class is important. I hope next year [at the high school] that's what we get. Joeli

Consistently students made distinctions between classrooms that were very structured and teacher-directed and those classrooms where the classroom environment was co-constructed and reflected students' perceptions of a positive learning environment. As one teacher said:

> I don't know how well I'll do teaching down south again. Here I have had to work with my students to make it work. It's about reflecting their needs and interests and I think I'm used to it being pretty much on my terms. It's what I want to have in my classroom [down south] but I'm concerned that this might not be the attitude of the teachers I'll work with [and will prevent me from responding to my students]. Esther

Teachers and students did not negate the role of a teacher as authority, but all emphasized the role of the teacher of working with students towards facilitating a common vision for the learning conditions of the classroom. As one teacher who has lived in the north for several years suggests:

> Students may know you and of you out of the classroom and the school, but until they are in your class they don't really know what you are all about. That can make the start of the year difficult. But, I focus on them telling me what they think my responsibilities are and them telling me what their responsibilities are. We write these on a wall poster. We always return to these. We try to live by these. Sharon

Sharon's comments are reflected in the comments of nearly all students. She works towards establishing an open dialogue amongst her students to identify what each person's expectations are and how these expectations become the foundation for defining what a positive learning environment might look like. Both she and her students are demonstrating their high expectations for a secure, well-managed learning setting. There is a focus on two-way communication and an open dialogue that speaks truthfully of expectation, disappointment and successes for teachers and students. Sharon's comments are strongly embedded within the IQ principles of *tunnganarniq* (respecting others and relationships), *aajiiqatigijnniq* (ensuring all aspects of

community development are fostered through decision making through collaboration and consensus), *pilimmaksarniq* (development through practice and action ensuring members of the communities are full and meaningful partners community and social development activities) and *piliriqatigiinniq* (working together for a common cause) (Arnakak, 2001). Again, these principles may be quite foreign to teachers who see their role from a much more teacher dominated and directed stance. In contrast to this, these students and teachers see positive learning environments as learning communities in which there is a negotiated community where expectations are clear and both teachers and students are accountable. As many students and teachers in one school suggest:

> We all know what is expected of the other. If an individual student doesn't comply, even the other students will try to bring them on board. As a last resort we will seek administrative support. Note I said WE – it starts with us as a class and then it'll go outside the class if necessary. Greg (teacher)
>
> I like it that we do [the decisions together]. I don't like it when one student gets it [singled out and disciplined by the teacher]. I like it better when we work on it together. We all know what we are supposed to do [including our behavior]. Elisapee (student)

Again, these teachers' comments are affirmed by the Inuit educators in *Inuugatigiit: The Curriculum from the Inuit Perspective* (GNWT, 1996) where they assert that children need to be treated with respect and included as contributing individuals as part of a partnership to the overall success of classrooms. Parents and children want a positive atmosphere for their children where students can feel good about their progress.

The primary focus of the conversations was to try to elucidate the pedagogical practices that influenced students learning. In this analysis the researchers attempted to identify through consensus in low-inference teacher behaviors that influenced student engagement and learning, that is, specific and observable teacher behaviors that help students to learn. The following

behaviors were consistently identified by students and teachers. They are not presented in a priority list.

The Importance of First Language Use and Effective Oral Communication

It is not surprising that since most students and teachers were in classrooms where student first language is Inuktitut, but teachers are not of the majority language and are unable to communicate in students' first language, effective oral communication was deemed a major factor influencing student learning. Similar to Kanu's findings (2002), effective teachers are able to communicate clearly to students or use strategies to explain, even if it requires other's assistance.

> He speaks fast. He is kind of mumbling (sic) too. I don't know why he doesn't speak so we can listen and learn. Wally
>
> It's like he tries to make us not learn. I want to learn but I can't learn because I can't listen to what he says. Joeli
>
> She tries to read to us in Inuktitut and uses our words [from the CCL resource material]. That makes me listen and I can hear to learn. Thomas

Clear communication typically was considered to be manifest in simple, uncomplicated expectations that were often accompanied by visual representations or modeling. Within the context of science, two comments were specific to this characteristic.

> She shows us what to do rather than just telling us. The words are there but when the words are with the thing we do it makes sense. She doesn't go on and on. Esther
>
> I can follow the books we use in science. I like the pictures because you can see what it looks like. Then the words she says make sense. Thomas

And, as their teacher suggests:

> We use [name of a science series]. The language is appropriate and it is supported by wonderful visual images that support their carrying out the activities. It's visually sequenced so even if I speak clearly and slowly they can see what I am saying. Even gesturing and pointing [at pictures] becomes a means of talking. Chad

Teachers often referred to the frustration they experienced in communication science ideas and the difficulty in communicating to students whose first language is Inuktitut. As well, they suggested strategies used to communicate effectively.

> You try to get across an idea, like the other day with the idea of a vibration. They need to experience it first and then you try to show the meaning of the word. This worked well when I use my hand to show a vibration or drawing it on the board. But, Jeff [a teaching assistant and bilingual Inuk] was in the room and he explained it to the students and you knew that they understood it right away. Chad.

> You become thankful pretty quickly that some students are bilingual and can assist you in communicating ideas. We [the class] just need to accept that I can't talk to them in their language but we can use others in the class to get across ideas. Joel

Similarly students were able to recognize the influence of this language barrier as a frustration in their learning.

> I can learn but when there' no Inuktitut I don't learn well. [Another student in the class] will help us to learn our way [in Inuktitut] so you don't feel like you are not smart. Sometimes you learn by seeing [the teacher do it]. Sometimes you have to hear it to learn. Freda

Freda's comments were not uncommon. She recognizes that her learning is sometimes impeded because her first language is not the medium of instruction. But, where it is used mainly through a bilingual conduit her learning is not impeded.

> I learned lots last year (in a bilingual classroom). This year I don't learn as much. I find it more hard because there is no Inuktitut. Wayne.

Wayne's comments similarly expose the challenge for students in classrooms where they have to make the transition to another language of instruction.

Multiple Instructional Strategies

Associated with the previous point is the importance of teachers using multiple instructional strategies to support student learning. It is probable that the most common statement by teachers and students was associated with how they tried to communicate ideas, especially when the learning was associated with abstract ideas. Students commonly referred to learning through an instructional sequence that involved the teacher first modeling, often repeatedly ensuring students visualized what was required to be learned. This finding is similar to Kanu's (2002) who suggests that there is a strong link between learning by observation and then imitation. The classroom observations of effective teachers often revealed this modeling was done in silence and then, second time around, with a limited verbal account of the procedure or explanation. Following this, teachers would then provide opportunity for students to independently provide an explanation or carry out a task and if necessary, seek teacher help or the help of a peer. As examples two students made comment of how a string telephone worked:

> We had done it [made the telephone] but didn't know how it worked. She showed the picture of the things moving [vibration] and how the sound travels. We did the acting [role play] and you could see how the sound goes through [the string]. She made us draw this our own way and I could explain it to [another student in Inuktitut]. Simon

> Sometimes it's hard to understand [in English] and we might have [learning support teacher] in the classroom and that helps but together with the pictures and other things [role plays] we can get it. She wants us to get it. Joelie

It is quite evident that tangible visual representations through modeling that support abstract ideas are valuable as is the opportunity for students to hear and provide explanations in their first-language. Most importantly multiple approaches to assist students in their learning were most commonly cited as ingredients for fostering learning. Again, these comments are endorsed by *Inuugatigiit: The Curriculum from the Inuit Perspective* (GNWT, 1996) which emphasizes the importance of observation and imitation and ultimately through repetition, practice and progression becoming confident enough o do something independently.

Allowing Time and Initial Support for Completion and Mastery

Since students perceive success to be commonly associated with accomplishing a task through to end, students commonly cited that an effective teacher commonly provides repeated opportunity and the time necessary for students to work through to end. Where students faced difficulty teachers were able to provide initial support in order alleviate possible frustration and instead boost initial confidence.

As one Inuit teacher suggests:

> You can't do it for them, but they must have some initial success and persevere. We worry about students that are too depending on us, but that can't change overnight. Once they see more success in themselves they are willing to do more on their own. It's like blooming – if we feed them encouragement through their little successes it gets better. Tuqqassie.

This comment was affirmed by several students. For example:

> She'll [non-Inuit teacher] show us how to do it. Many times she'll show us. Then we try. She'll help us or we help each other. It will take time. She makes us do it on our own but first she will show us how. She can explain but showing me is [more] better. She can go away then. Tanner

Tanner's comments reiterate the comments made by *Inuuqatigiit: The Curriculum from the Inuit Perspective* (GNWT, 1996). Provide short verbal instructions in a calm, positive, respectful voice and model tasks ensuring you provide time for students to learn. Eventually children are expected to do the whole task from beginning to end, but must have a sense of achieving progress as they work towards the end (p. 14)

Individual Attention to Support Learning

Building upon previous comments, students repeatedly made mention of the importance of someone, usually teachers being near students and observing them completing tasks with repeated assurance of them doing something properly. These comments were typically associated with mathematics where students were asked to complete something on their own. When asked about their most recent examples of success students often referred to completing numeracy or literacy-related tasks. As identified by Kanu (2002) students often required some form of temporary framework or scaffolding, at least until they were able to develop the skills to learn independently. Repeatedly classroom observations showed that these effective teachers or peers were supportive of other's learning through provision of direct guidance and assurance.

> In math we mainly work alone or groups after she has shown us how to do it. I like it when she shows us first and then helps us as I need help. You can get mad when it doesn't work, or you just want to stop but she can be there to help. Wayne

Local Contexts and Resources

Consistent with the community's aspirations for science education, students repeatedly responded positively to teachers and their inclusion of the local context as examples in their teaching. The underpinning mandate for the CRYSTAL initiative is to honour community

aspirations for a two-way learning experience that advocates Inuit cultural knowledge and processes as thoughtful and purposeful (McKinley, 2000). The development of CRYSTAL resources is based upon the premises of culture-based education and the legitimization of local language, knowledge and processes (Bishop & Glynn, 1999) detailed previously in this paper and a foundation of education in Nunavut. Of particular importance to students was hearing the stories from elders or members of their community, especially in their first language.

As two teachers suggest:

> Hearing about people they know immediately evokes response from them. They can relate to the stories and their experiences. There is a significant sense of pride associated with hearing of stories most relevant to their lives. Elaine

> My experiences in this community are limited. But, every experience I have seems to translate into a story and students respond so well to this. Especially when it has to do with someone they know or a place they have been. Susan

Strongly embedded with these comments is the imperative importance of seeing the use of local context in supporting student learning. The underlying premise of culture-based education is similar to what is advocated in place-based education. Place-based education is rooted in place; that is, the organizing focus of the school is on the local socio-cultural, ecological setting. In place-based and culture-based education the role of schooling is to provide a secure, nurturing environment that reflects the culture of the community and promotes the participation of educational staff, students, families and the community in making decisions about learning. Teaching is grounded in what students are familiar with; actualities rather than abstractions. It emerges from the particular characteristics of place. It draws from the unique characteristics and strengths of the community and, thus, does not lend itself to duplication or replication. It promotes the use of community resource people and is inherently experiential drawing upon the opportunities provided by the local context and its people. As one non-Inuit teacher suggested:

> I had taught in a northern setting before, but here we have culture specialists available in the school to augment our teaching. I'll be teaching a topic and realize that there are points of view that can be addressed by the elder, so they come in. I get them to talk about a specific thing and it goes so well. [The District Authority Director] said he heard his son [who is my class] being taught about the weather from both me and the elder and thought that this way of having us both contributing was the ideal for his son. I tend to agree. It means both of us contribute to the learning. Ian

Ian himself could see the benefit of students experiencing 'two-way' learning. As well, as a teacher he is seen to be effective by the school community in that he draws upon the local community as a resource in a variety of ways, in particular in the inclusion of community members and their knowledge and skills in contributing to student learning. He also was able to address the tension that many teachers experience in drawing upon community members.

> Unfortunately using the Culture Specialists is not seen by everyone as a positive move. Some people have trouble believing the [elder's visits] are worthwhile and so they don't make the effort. Some people believe the money could be better spent elsewhere. I believe having them here [in the school] shows we respect that [traditional] knowledge and think it's important.

Inuugatigiit: The Curriculum from the Inuit Perspective (GNWT, 1996) asserts the importance of learning being embedded within the experience base of students. Inuit want learning to be just as meaningful today for today as it was in the past. It does not mean that learning only deals with the traditional and historical, but it must begin with the life of the child and their community (p. 14).

Reciprocal Learning

Several teachers reported that they found that making provision for students to share of their skills, experiences and knowledge in contributing to the classes learning was a significant strategy in promoting learning and a positive learning environment. Teachers, especially those

non-Inuit, emphasized that they quickly realized that encouraging students to help each other was an important and positive vehicle for promoting learning.

> You learn pretty quickly that you don't have to be everywhere at one time. The students need individual support and they're quick to call upon their friends to help them. Chad

> It seems somewhere this year I realized that each student had something to contribute. Without expecting it, you'd be doing something and then, suddenly, they [referring to a quiet student or students] would have something to say and you would just sit and listen. I'd think if only I knew each of them really well I'd be able to draw upon that more. (Paul)

> He [our teacher] knows we can all do things [some better than others] and he'll get us to show the others or help each other. [A student's name] helps me in math and I help him with the words. We know we can help each other. He'll get us to help and we don't just need to use him. Wayne

Novel Opportunities

An interesting theme recognized by students was a sense of the unexpected and less orthodox experiences students might be introduced to as a result of their teachers' efforts. This comment was mentioned repeatedly in one schools' conversations and clarified through conversations in a further school.

> We work hard in her class and we don't expect anything. But she does these things that she doesn't need to do for us. I know she cares. Elisapee

> We sometimes wonder if she's planning something. She always lets us know when she's proud of us but then she brought a cake. We felt proud. Rebekah

As is mentioned in *Inuugatigiit: The Curriculum from the Inuit Perspective* (GNWT, 1996), students want a positive learning environment where there is fun, laughter and a sense of anticipation. Embedded within these comments are suggestions that students see a teacher that these novel and unexpected opportunities provided by teachers for students provides evidence to

students that a teacher cares about their progress and is willing to tangibly honor their collective successes.

Effective Teaching Profile for Inuit Students

As stated earlier, the data collected from these multiple sources provides evidence of some prevalent themes associated with student perceptions of success and teacher specific and culturally determined classroom characteristics that influence student learning. In all cases, ideas presented are limited to those comments held consistently by teachers and students. These preliminary themes assist teachers in giving consideration to their own teaching practices and environments, primarily as a starting point for reflection upon whether their own classroom practices are responsive to the voice of their own students. As mentioned previously a culturally responsive teacher should be able to "problematize" their teaching and question the nature of the student-teacher relationship, the curriculum and schooling in general. At the focus of this consideration are teacher perceptions of the source of problems if they are evident within their classrooms. Are problems located within the nature of students and their culture or are problems manifest in their own interactions and relationships as teachers with students? If they are located within their interactions and practices within classrooms, are they willing to respond so they are able to work towards the establishment of a positive learning environment?

Similar to the work of Bishop and colleagues, based on the comments made by students and the information collected from teachers and Inuit educators (GNWT, 1996) an effective teaching profile for teachers of Middle Years Inuit students is presented herewith.

1. *Effective teachers give consideration to how their students define educational success.* They consider what their students perceive as success based upon recognition of where students themselves are proud of their achievements. Accordingly, they reposition their efforts to acknowledge success from students'

terms, especially in giving regard to perseverance and working through to end as opposed to simply evaluating product and placing greater regard on the evaluation outcome. Accompanying this attribute is ensuring that the experiences provided for students have 'working to end' opportunities based upon practical, first-hand experiences.

2. *Effective teachers re-consider what they believe to be the attributes of a positive learning environment in response to what their students identify as a positive learning environment*. They re-position themselves in their role and interactions with students in developing a more co-operative, co-generated learning environment. They are caring, consistent, interested and connected teachers.

3. *Effective teachers communicate to their students that they care about students' educational success and that students can succeed*. They do not see deficits in their students. They communicate that they work to foster that success and that they want to succeed and are committed to fostering students' success. They are willing to enter into conversations about what they can do to foster their students' learning. As Noddings (1996) suggests, caring is manifest in actions: it delights, challenges, responds and affirms.

4. *Effective teachers allow room for the use of students' first language in the classroom.* They respond to how students seek to understand their instructions and develop new strategies and protocols such as using the human resources available to them, including other students and support workers in the classroom to communicate in students' first language.

5. *Effective teachers communicate clearly and concisely with their students*. Their communication in English is abbreviated and direct. It simplifies rather than complicates.

6. *Effective teachers foster learning by using multiple instructional strategies such as direct instruction and modeling*. They re-consider and change their pedagogical practice in light of how students respond to their teaching.

7. *Effective teachers allow time and provide individual support to promote student learning*. They develop an awareness of the pace at which their students work and need to complete work satisfactorily and the amount of individual attention they require in their learning.

8. *Effective teachers establish reciprocal learning opportunities within their classroom*. They recognize that others can contribute to the overall learning and will promote students to both seek out and provide support in learning as the need arises.

> 9. *Effective teachers use local contexts and resource materials in their teaching*. They do not believe that they are the central figure able to contribute to their students' learning. They attempt to use the local community and the resources within it to support students and their learning. They legitimize the knowledge and practices of the community by endorsing it within the classroom, especially through narratives about local people.
>
> 10. *Effective teachers recognize that they can and must change their teaching to help students learn.* They don't believe that students must learn the teacher's way and that the student-teacher and student-student interactions need to be controlled or defined by the teacher, but, instead, see the processes influencing student learning as opportunities to change their teaching to better suit their students. They make adjustments and even transformations to the orthodoxy of their practice to provide for the inclusion of practices reflective of the home culture (Harker, 1979).

What is noteworthy in this list of characteristics of effective teachers is the relative importance of culture-based resource materials, especially those in students' first-language. From this study it is evident that although place-based teaching resources are important supportive factors for effective teaching, the use of such resources is only part of the amalgam of an effective teacher profile. Stairs (1995) identifies in her culture-based model for teaching in Aboriginal settings a variety of processes that need to be considered. It is noteworthy that the use of place-based content material is but one consideration. Stairs places even higher emphasis on the use of the ecological context (human resource and environment) and social and cognitive processes as essential elements for successful teaching in Aboriginal settings. This study would similarly support that the use of place-based resources similar to those developed and implemented through this project are only one dimension of contributors to fostering student learning. Students in this study assert that many of the factors influencing their learning are primarily associated with the social and interactive processes occurring within their classroom.

Summary Comments for Student Outcomes

This portion of this paper has its origins in identifying through the voices of Middle Years Inuit students what they perceive as educational success. Further, it gives consideration to what primarily students identify as the teacher specific and classroom characteristics that contribute to this success. It becomes quite evident that as much as the voices of the respondents contribute to an understanding of student success and contributors to success, the narratives paint quite vivid descriptions of teachers who have responded to their students and their backgrounds to create pedagogically preferred practices for creating positive learning environments. Central to prompting these changes and successes are teachers who have deeply considered what they can do to best support the development of classrooms to foster student success. As two teachers suggest:

> You come north to teach and you want the experience to be different, not just in the community but in the classroom. Somewhere along the way I realized that the real [positive] experience here was to be gained by not living my southern life in the north, but instead responding to the opportunities [this community] offered. It was the same in my classroom. I wanted it to be different, but I had to be the one to respond. I knew the education would be different. I wanted it to be more reflective of this community and the students and their lives. I made some progress, but it needs to be the focus of all [the schools' teachers] of our conversations. How can we respond better to what our students are telling us about their schooling and learning? I know we don't ask that enough. If we did we would be making much more progress. (Esther non-Inuk teacher).

> If I look back at my first year here and compare it to how I teach after four years, I can see that my students haven't changed from year to year but I have. I want them to know I care about them, but also really care about their learning. I want them to do well and to do it well. I'm not easy on them but I also show I care. My approaches have changed. I try to give each student care and concern and let the class know we need to work together in our learning and that learning is really important. I'm more focused on them, not just what they do. I think they know that and that's why it works. (Sharon non-Inuk teacher).

At the heart of these changes is a regard by teachers accepting that *they* are the central player in fostering change, first in themselves in shifting power relationships and working collaboratively towards an environment where practices reflect the culture in which students are situated. Second, by changing their teaching practices so they assist students in their learning. For Middle Years students in the northern Qikiqtani, this study suggests that students *are* very aware of what *can* contribute to their learning. Culture-based education *should* and *must* reflect, validate and promote the culture and language of the Inuit of Nunavut. These experiences must be reflected not only in the management and operation of the school but also in the curricula and programs implemented and *pedagogies* utilized. Such is the nature of culturally responsive teaching; using the cultural knowledge, prior experiences, frames of reference, and performance styles of students to make learning encounters more relevant to and effective for them. Such is the challenge the outcomes of this study place on the educators of Inuit Middle Years' students.

Summary and Implications

This paper has reported on several phases of a multiphase science education development project in three Inuit communities in the northern Qikiqtani Region of Nunavut, Canada. The project in its entirety has focused on (1) establishing the current situation in Kindergarten to Grade 7 science education in the Qikiqtani communities, (2) identifying developmental aspirations for stakeholders within the communities and potential contributors and constraints to these aspirations, (3) implementing mechanisms for achieving identified aspirations, (4) evaluating the effectiveness of such mechanisms and (5) providing suggestions for further development projects established to assist Aboriginal, especially Inuit communities in achieving their goals for curriculum, in particular, science delivery.

The outcomes of this study provide considerable input into understanding the processes that impede and contribute to the realisation of education programs in Indigenous settings that endeavour to combine the views of "both worlds". In this summation, it is important to emphasize that although this project attempted to "combine the views of both worlds" in science education, it also attempted to combine the views of both worlds in achieving these goals through two process development models, Bronfenbrenner's bio-ecological model and *Inuit Qaujimajatuqangit.* As CRYSTAL has worked over the past four years with these school communities, we have developed a deeper and broader awareness of the factors influencing programs that honour school community aspirations and the consequence of such programs on Nunavut students. We have also become more acutely aware of the inherent value of these two perspectives in understanding and assisting in the development process. Bronfenbrenner's bio-ecological view allows an encompassing overview which shows all the various influences both internal and external to the individual teacher that can add to or impede on her development. In regards to science education in Inuit settings, this model provides stakeholders a way of seeing the multitude of factors at all levels of society that may be preventing their educational aspirations to be reached. Although it assists in identifying these factors, it is does not provide insight into the relative magnitude of these factors nor the interrelationship among these factors and their influence on the realization of project goals. It does not suggest means by which progress can be made towards upsetting existing colonialist structures and progressing towards new means of strategizing. While it is important for all in society to be aware of the parameters through which systems operate, a Bronfenbrenner perspective potentially further perpetuates and reinforces beliefs of subordination as marginalised people exist and operate under a more dominant system. Whereas *Inuit Qaujimajatuqangit* clearly advocates for autonomy and freedom

and to be in charge of one's own well-being and destiny, Bronfenbrenner's model, when used solely as a lens of identifying system factors influencing development, does not appear to advocate in any way for this autonomy and freedom. This model appears to show that one will always be at the mercy of such parameters of control. It illuminates but, potentially, provides no vehicle for resolving issues of domination and marginalization. We believe this highlights the strength of *Inuit Qaujimajatuqangit* because it is continuously seeking for ways to remove those parameters of control by placing development in the hands of collaboratively operating school communities. In order to avoid the future disappointment of what occurs in Nunavut classrooms, *Inuit Qaujimajatuqangit* seeks to ensure that as a people, school communities are continuously pro-active, assertive and if necessary creative to ensure they are putting the controlling what goes into a package-a package of our own making, in this case curriculum materials and the outcomes of such curriculum implementation. Although IQ is a body of knowledge and a synthesis of the unique cultural insights of Inuit into the workings of nature, its application goes beyond content inclusion of Nunavut science classrooms. More importantly *Inuit Qaujimajatuqangit* denotes traditional principles that are to be incorporated into all aspects of or used in the development of Nunavut policy and practice, including school governance and curricula and, possibly most importantly classroom interactions and pedagogy.

Despite these limitations, the value of Bronfenbrenner's bio-ecological model is seen in how it provides a convenient lens to systematically identify potential multi-system factors impacting on science program delivery. It provides a foundation for developing mechanisms that accentuate the protective factors and mitigates the risk factors. Unlike *Inuit Qaujimajatuqangit,* it does not provide practical examples of processes or mechanisms that can guide development but instead assists in the identification of constraints and contributors to achieving success. It would

appear that "both-ways" are very valuable for understanding and fostering school and classroom development, and not just in science education.

When both Bronfenbrenner's bio-ecological model and *Inuit Qaujimajatuqangit* are applied to the understanding of what has been realized from this project, a variety of conclusions can be made. Most importantly, it is evident that a broad amalgam of factors influences a school community's ability to accomplish its goals for curriculum enactment. The results indicate that although teachers may be the critical agents in the curriculum implementation process, teacher professional adequacy, knowledge, and interest are but one dimension in the complex matrix of factors that influence primary science delivery that combines the views of both world. This matrix is not limited to some of the more salient features (resource adequacy, time, professional support) that are commonly cited as impediments to effective science program delivery (Harlen, 1997). Figure 4 illustrates the factors seen to contributing to or impeding such aspirations within the communities involved in this study. It is noteworthy that some factors may be contributors in one community and impediments in the next. As an example, a critically important factor is whether educational leadership within the school is committed to working toward this priority. As well, school teacher-leaders or individuals that can support the development process are exceptionally important contributor to culture-based education realization at the school level.

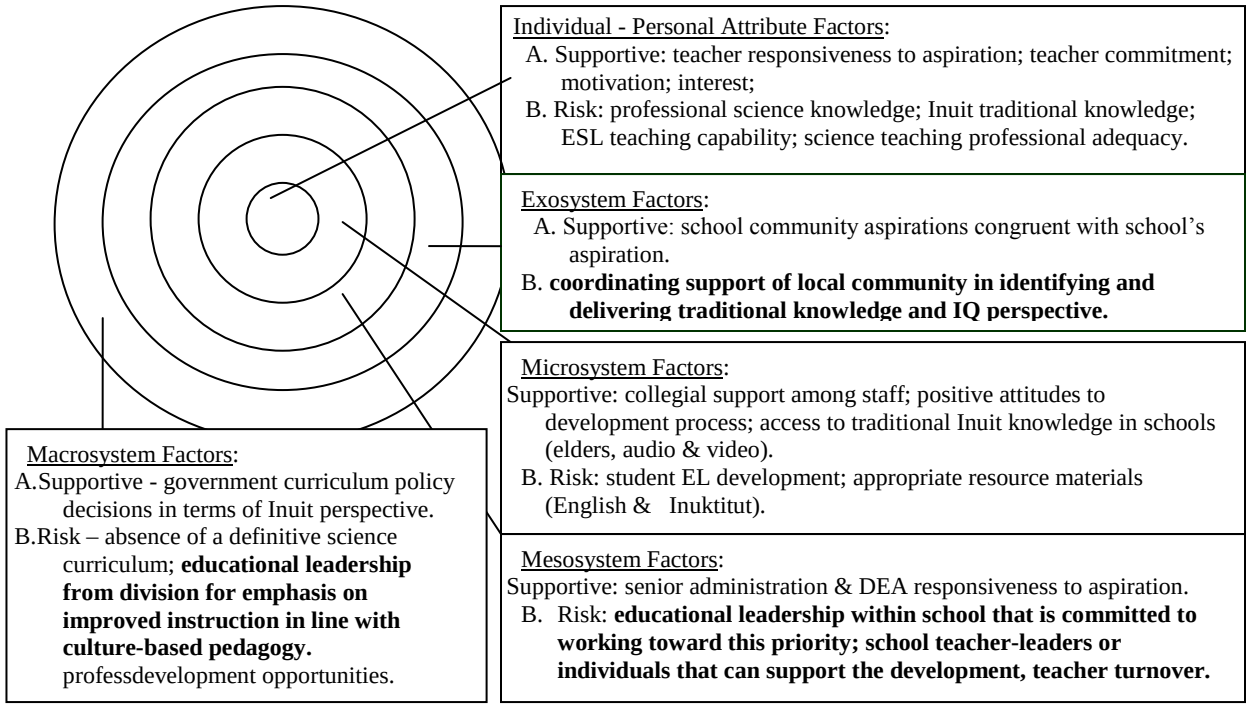

Figure 4: Factors influencing two-way science implementation in Qikiqtani

The illustration identifies a few critical factors (which are bolded) that are typically impediments to the achievement of culture-based education aspirations, especially factors largely ignored resident with the meso, macro and microsystems. In very practical terms, of particular significance was the perceived role of school community leadership provided by the principal or teacher leaders within the school who were willing to work with the District Education Authority's aspirations in influencing science curriculum implementation and program delivery. The project continues to assist the school communities in achieving their goals but is more aware of the critical role played by senior administrators and lead-teachers in working collaboratively to ensure the achievement of project's goals. Of particular importance is ensuring that newly appointed principals understand their role and responsibility in assisting District Education Authorities achieve project goals. As suggested by Goddard and Foster (2002) northern [Aboriginal] schools are commonly characterized by conflicting understandings between

imported educators and indigenous parents reflected in the significant linguistic, cultural and world-view differences between the dominant national society and the minority society of the community. Within the context of this ongoing study, of particular significance is the importance of the principal in working with the local District Education Authority in influencing science curriculum implementation and program delivery consistent with community aspirations and place-based policy requirement; and not simply serving the administrative responsibilities expected by the education hierarchy. Curriculum focused leadership and a school culture that advocates collaborative curriculum development in science in conjunction with the support of family and community members, especially elders, to enhance educational opportunities for students are clearly strongly influential in positively influencing the attainment of these goals. The extent to which place-based educational opportunities for each school's children are realized will largely be based on the degree to which the principles of *pilimmaksarniq* and *piliriqatigiinniq* are enacted and stakeholders work collaboratively towards commonly identified aspirations.

Although the degree to which culture-based educational opportunities are enacted at the classroom level is largely dependent on teacher personal attribute factors such as interest, capability and knowledge, the actual experiences that foster student learning and engagement go beyond the use of place-based materials. More importantly are likely to be the social and pedagogical practices teachers adopt in their classrooms. At the heart of these changes is regard by classroom teachers accepting that *they* are the central player in fostering change, first in themselves in shifting power relationships and working collaboratively towards an environment where practices reflect the culture in which students are situated. By changing their teaching practices so they assist students in their learning. Northern Qikiqtani schools and their students

are very aware of what *can* contribute to their learning. Culture-based education *should* and *must* reflect, validate and promote the culture and language of the Inuit of Nunavut. These experiences must be reflected not only in the management and operation of the school but also in the curricula and programs implemented and *pedagogies* utilized. Such is the nature of culturally responsive teaching; using the cultural knowledge, prior experiences, frames of reference, and performance styles of students to make learning encounters more relevant to and effective for them. As Stairs (1995) suggests, although culture-based resources contribute to a teacher's ability to provide meaningful learning experiences for Inuit students, there is much more to being an effective teacher in Inuit settings than the use of relevant place-based resources. Teachers, and the principals who are required to provide leadership to foster such actions, must consider the orthodoxy of their practice and modify their practice to allow for the social and interactive practices of their classrooms to be more reflective of the home culture their students represent.

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Appendix

Science Evaluation Questionnaire for Nunavut Schools

School Name: _____ Grade Level(s): _____

There are 28 questions in this questionnaire. Although you are encouraged to answer it on your own, you can decide to answer it (1) with a few other teachers or (2) as a whole school staff.

The sentences in this questionnaire all have to do with the teaching of science from the Inuit perspective. Students in Nunavut are encouraged to learn contemporary science within the context of Inuit history, values, traditions, beliefs, and, where appropriate, language (Department of Education, 2005). Students are encouraged to develop their understanding of both traditional and contemporary science knowledge. Learning of one and not the other limits the richness of the science learning experience provided for students in Nunavut schools. Instead science should be a blend of contemporary and traditional science knowledge built within the context of Inuit Qaujimajatuqangit (IQ).

Answer each question by circling the answer that you feel best describes your school in its ability to teach science that integrates both contemporary and traditional Inuit knowledge within the context of IQ. Be honest in your response. By answering them honestly you will help the school to identify how it might improve in its development to assist in improving the science experience it provides for its students.

Circle:
SD if you *strongly disagree* with the statement.
D if you *disagree* with the statement.
N if you *neither agree nor disagree* with the statement
A if you *agree* with the statement.
SA if you *strongly agree* with the statement.

1. I feel prepared to teach science from the perspective of Inuit values, beliefs and knowledge.	SD D N A SA
2. I am supported in my effort to teach science from the perspective of Inuit culture and values.	SD D N A SA
3. I have a good knowledge of the both the contemporary science and traditional knowledge we want students to learn.	SD D N A SA
4. I have a good understanding of the science ideas we are to teach our students.	SD D N A SA

5. I have the time to teach science from the perspective of Inuit culture and values.	SD D N A SA
6. The school community places a strong emphasis on learning science from the perspective of Inuit culture and values.	SD D N A SA
7. The school has a formalized plan for what science topics are to be taught at each grade level.	SD D N A SA
8. I have a good knowledge of ways to teach science that integrate contemporary science with an Inuit perspective.	SD D N A SA
9. The school community supports me in teaching of science in a way that integrates science with an Inuit perspective.	SD D N A SA
10. I have a good knowledge of the science ideas I am to teach from the perspective of Inuit culture and values.	SD D N A SA
11. I have a good knowledge of the science content we are to teach.	SD D N A SA
12. I have a positive attitude to teaching science from the perspective of Inuit values, beliefs and knowledge.	SD D N A SA
13. There is leadership from the school administration for the teaching of curricula such science from an Inuit perspective.	SD D N A SA
14. I have a good knowledge of the strategies that are beneficial for helping students learn science.	SD D N A SA
15. I have a good knowledge of local culture as it relates to the teaching of science.	SD D N A SA
16. Our school administration supports the teaching of science from the perspective of Inuit culture and values.	SD D N A SA
17. I have good background knowledge for teaching science from the perspective of Inuit culture and values.	SD D N A SA
18. I am a confident science teacher.	SD D N A SA
19. My students are interested in learning science from the perspective of Inuit culture and values.	SD D N A SA
20. There is leadership from the divisional administration for the teaching of curricula like science from an Inuit perspective.	SD D N A SA

21. The equipment I need to teach science is readily available.	SD D N A SA
22. I have the skills to teach science from the perspective of Inuit culture and values.	SD D N A SA
23. School community members help me to teach science from the perspective of Inuit culture and values.	SD D N A SA
24. I am adequately prepared to teach science from the perspective of Inuit culture and values.	SD D N A SA
25. I have a good understanding of the contemporary science knowledge that students are to learn.	SD D N A SA
26. I am committed to teaching science from the perspective of Inuit culture and values.	SD D N A SA
27. I have the resources and materials I need to teach science from the perspective of Inuit culture and values.	SD D N A SA
28. I get the opportunity for science professional development as a teacher.	SD D N A SA

Thank-you for answering this questionnaire!