Mathematical Views within a Lakota Community:

Towards a Mathematics for Tribal Self-Determination

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Mathematical Views Within a Lakota Community: Towards a Mathematics for Tribal Self-Determination

Thesis directed by Associate Professor Jeffrey Frykholm

Abstract

In this dissertation, I examined the impact of Indian educational self-determination on the teaching of mathematics at the local level in a Lakota community. I drew upon a framework created by Bishop (1991) which described mathematical activities found in all cultures to develop a Lakota mathematical framework from which to compare activities and content found within the middle-school and elementary mathematics classrooms to mathematical activities found in Lakota culture. These six universal mathematical activities included counting, measuring, locating, designing, playing and explaining. I also constructed a framework (also for comparison) around self-determination principles that have been formulated and implemented in curriculum in Indian Country over the last forty years. I used this to inform the language used in the descriptions of self-determination in this Lakota community as well as the implementation of these principles in the structure and curriculum at the local K-8 school. I argue that self-determination, as an educational philosophy in this Lakota community had no impact on the teaching of mathematics. I also argue that, self-determination, at the curriculum level, has much potential, not only in integrating Lakota culture and language into the teaching of mathematics but also integrating mathematics into the teaching of the Lakota language and culture.

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Chapter 1: The American Indian Pledge

The Indian Self-Determination and Education Act

In 1975, with the passing of the Indian Self-Determination and Education Act (PL-93-638), local control of the education of Indian children became a reality. It states,

> The Congress further finds that (1) true self-determination in any society of people is dependent upon an educational process which will insure the development of qualified people to fulfill meaningful leadership roles; (2) the Federal responsibility for and assistance to education of Indian children has not effected the desired level of educational achievement or created the diverse opportunities and personal satisfaction which education can and should provide; and (3) parental and community control of the educational process is of crucial importance to the Indian people.

The key emphasis in PL-93-638 is that the United States government is now committed to supporting and assisting Indian tribes in the development of strong and stable tribal governments. These governments can administer quality programs and develop the economies of local Indian communities. Also acknowledged in PL-93-638 is the function of parents and the local community in shaping the educational system that can produce these outcomes. What PL-93-638 meant in practice was that Indian communities could now contract with the Bureau of Indian Affairs in constructing the direction and implementation of education systems designed to produce educational outcomes they deemed important. As a result of this legislation Indian educational self-determination has been the cornerstone philosophy in Indian education over the last thirty-five years.

A little about me

I grew up on the Pine Ridge Reservation in the small rural community of Oglala, South Dakota in the backdrop of all that was happening there in the 1970's. I was an elementary student at Loneman Day School at that time (later, a student at Red Cloud Indian School in the

early 1980's). As a young student I noticed an influx of local Lakota culture and language at Loneman. I recall, for example, a local Lakota community member speaking to my class about the mythical Lakota trickster, *Iktomi*. I can still recall his question asking if we knew who/what *Iktomi* was. Later, when I was a student at Red Cloud Indian School, I remember viewing the trailer house that served as the classroom for the Lakota language and culture class. On the first day of school that year I walked into this classroom and was greeted by my uncle and aunt who would be teaching us Lakota langauge and crafts. It seems these courses, with an emphasis on Lakota culture and language, impressed my young mind because they were different - they were from the community and they were taught by Indian people. Lakota langauge and culture would become content fixtures in Pine Ridge Reservation schools thereafter.

Currently, as an educational researcher in mathematics education, I can see that I was part of the first generation of Indian students whose education was impacted directly by the push for local control of education on the Pine Ridge Reservation. In my studies as a doctoral student I have had the opportunity to analyze mathematics content, pedagogy, policies and movements that have impacted the teaching and learning of mathematics in our country. What I have not been able to see is how the teaching of mathematics was impacted by the push for local control within the local Oglala Lakota context. This study is designed to describe this impact within the scope of Indian educational self-determination. This study follows the course set forth some forty years ago in a small Navajo Reservation school called Rough Rock Demonstration School located within the Rough Rock community of Arizona. It was there that a glimpse of local control of schooling by Indian people was first seen. Innovative curriculum development, inclusion of local community member input, and the infusion of culture and language into the

school all became part of the education of Navajo students at Rough Rock. Soon other Indian communities followed suit, including the Oglala community in South Dakota.

This study will describe the history of self-determination in Oglala, its genesis, its implementation and its current structural integration. It will answer the question (this among many) How does the local school, Loneman Day School (now *Isna-Wica Owayawa*), the school of my youth, pay heed to Indian educational self-determination? Once this description is completed then our main focus comes to the fore - a description of the space that lies between the intersection of Indian education and mathematics education within the Oglala Lakota context at *Isna-Wica Owayawa*.

Definition of Self-Determination

Before looking into the development of self-determination and the push for local control in Oglala and *Isna-Wica Owayawa* I would like to answer the question, What is self-determination? Self-determination seems to be a phrase that needs no definition. It presumes to mean that an individual has the right to choose the direction and course of his or her life. From a tribal stand-point it seems to mean that the tribe has an inherent right to institute laws and programs to guide the life-ways of its people, for its own survival and benefit. But is this all there is to the term self-determination?

From a philosophical standpoint self-determination is rooted in personal freedom and personal responsibility. Wojtyla, (1974) explores a conception of self-determination, one he called, the "personal structure of self-determination" which, though not necessarily in the realm of Indian education, brings into the Indian educational context notions that strengthen the concept of self-determination at the individual and tribal levels. According to Wojytla (1974) self-determination implies action; in taking action an effort is made towards an intended

outcome. "The first definition of self-determination in the experience of human action involves a sense of efficacy on the part of the personal self: "I act" means "I am the efficient cause" of my action...connected with a sense of responsibility for that activity" (p.2). Thus self-determination "takes place through acts of will" (p. 2) and through the action "I become the "creator of myself" (p.3). Self-determination points to "self-possession and self-governance as the structure proper to a person. If I determine myself, I must possess myself and govern myself "(p.4). So the first important characteristics of self-determination is that it involves action and self-governance each of which are informed and guided by the will of the individual. In doing the individual creates himself.

Not only does the individual create himsef but through his actions he makes known to others his right to act and assert, "...that I posses myself and govern myself. In this way, my acts give me a unique insight into myself as a person" (p. 4). All of this, of course, assumes a basis in real autonomy and freedom and puts a special emphasis on the right of the individual (and the tribe). For the purposes of this study then self-determination is an approach to asserting self, both at the tribal level and the individual level. It is also the process found in the actions put forth stemming from in the inherent right of a community, tribe, or individual to provide the direction for their lives as they see fit, for the purposes they define. Through these actions we come to know the community. Self-determination is not just a right to assert and act, but a right to know oneself through one's actions.

As we shall see, the impact of the philosophy of Indian educational self-determination was the push for local control of the educational process. This in turn impacted the purpose of schooling of Indian children (as we shall see a direction desribed as bi-cultural) and also the shaping of curriculum. As I look for the impact of self-determination in the teaching of

mathematics at *Isna-Wica Owayawa* I am looking for the inclusion of Lakota language and cultural contexts in the mathematics classroom which in turn stemmed from the community asserting it's inherent right to act and become.

The development of Self-Determination

The development of Indian self-determination did not occur overnight. It had a long history in Indian communities. Rather than look at the historical roots of self-determination in the rhetoric found in the Marshall Trilogy (Johnson v. M'intosh (1823), Cherokee Nation v. Georgia (1831), and Worcester v. Georgia (1832)) court cases where the political relationship between the US government and Indian tribes was set (with tribes being defined as "domestic dependent nations") I wanted to start with a little known conference that happened in Chicago in 1961. This conference came to be known as the American Indian Chicago Conference (AICC). It is important to start here because a new era was beginning, one that turned emphatically away from past legislation to a hopeful eye to the future. It was at this conference that a unified shift in attitude began to take place among Indian people nationally. During this conference Indian people from all walks of life came together for the purpose of denouncing past Termination Policy (that had been enacted over the previous twenty years) and, more importantly to assert their political rights as Indian people to craft a document that they hoped would influence the incoming Kennedy administration. I argue here that self-determination as an educational philosophy had its roots in this conference. This assertion is in part justified because notions of tribal sovereignty become part of the conversation at this conference. The rhetoric of self-determination that followed can be found in the push for greater tribal assertions of rights which surfaced in the decade of the 1970's as a way to approach Indian federal government policy.

Although the rhetoric of self-determination was scant at the time of the AICC, following the course of articles printed in the *Journal of American Indian Education* we see that not more than two years after the conference the seeds of self-determination in Indian education began to germinate. Calls for local control, Indian participation in school boards and adult education surfaced. Changes in curriculum geared to help Indians come to value the influence of Native Americans on American culture, along with a push to assist Indians in valuing their own identity, emerged. The language of PL-98-638 reflects these desired changes.

Found in the early development of self-determination rhetoric are ideas about what Indian schools run by Indian communities might look like. In 1964 the Rough Rock Demonstration School (RRDS) on the Navajo Reservation opened as a way to test the educational waters for Indian run schools. After what seemed like enthusiastic support for RRDS from various groups Indian communities all over the country began taking note; some formed schools like RRDS in their own communities.

Soon to follow was the development of Navajo Community College (NCC) founded in 1968 to help meet the educational needs of the Navajo people at the post-secondary level. These educational purposes of Indian tribal colleges mirrored the needs expressed at the primary and secondary levels. They encompassed adult education, Indian tribal-specific culture and language, vocational/technical training and academic preparation for post-secondary institutions.

In the 1970s, a time designated as the age of self-determination for Indian tribes, a whole slew of tribal colleges were formed (Stein, 1992). Sinte Gleska College on the Rosebud Sioux Reservation in South Dakota, Deganawidh-Quetzlcoatl University (D-Q University) in Davis, California and the Lakota Higher Education Center (now Oglala Lakota College) on the Pine Ridge Indian Reservation in South Dakota soon followed NCC, opening their doors in 1968,

1970 and 1971 respectively. By the time the decade of the 1970's was over there were twenty-one tribal colleges in operation. Each tribal college had its own focus but invariably included curriculum not only designed to help develop important employable skills but also to educate tribal members with tribal-specific culture and language courses. The dual purposes of these schools emphasized educating a student grounded in their tribal culture and history while at the same time educating them for employment. (Currently there are thirty tribal colleges in operation and numerous locally Indian run primary and secondary schools. Also of note is the rise in Indian run charter schools across Indian country geared to promoting the same kinds of goals for Indian education found in the original rhetoric of self-determination (Bielenberg, 2000).)

Although there have been many articles written about Indian education and the impact of self-determination, there is a paucity of articles dealing with how mathematics curriculum and teaching might have been impacted by self-determination. Clearly, as seen in the literature, room was made in the curriculum at both the tribal college level and the primary/secondary schooling level for native languages, culture, tribal history and government as well as literature. There is, however, little, outside of what has been occurring in Alaska with Jerry Lipka and the Yup'ik people, illustrating how specific tribes might incorporate culture in the mathematics classroom. No mention is present that mathematics might be used to shape notions of Indian self-determination at the tribal level. The question thus remains two-fold: How has self-determination impacted mathematics at the local Indian schooling level and how can mathematics be used to help express tribal self-determination and tribal sovereignty?

While the rise in self-determination in Indian education provides the bedrock for this study, it is important to note that the history of self-determination per se lies outside the focus of this project. Rather, in the framing of this project, one central objective is to highlight the

metamorphosis that took place in Indian self-determination over time and to try to flush out the impact of these ideas (once Indian people gained control of local schools and founded tribal colleges) on curriculum. In the chapters that follow, I characterize main principles of Indian self-determination and show how it has historically impacted (or not) the learning and teaching of mathematics in Indian education in a meaningful manner. It is upon this foundation that this research has been conceptualized, and it is this foundation that allows for a comparison between this historical perspective and contemporary curriculum and teaching practices within mathematics education at a local Oglala Lakota K-8 school.

In trying to judge whether or not Indian self-determination has impacted local Indian mathematics curriculum it is important to see how it has impacted other subject curriculum. As mentioned previously there has been an infusion of local tribal culture into typically non-Indian subject matter. Thus history became tribal specific history, literature became Native American Literature, English was taught alongside the teaching of the native language, etc. We can see, for instance, in a place like Rock Point Community School, located on the Navajo Reservation in Rock Point, Arizona, that much has been given to Navajo students by way of curriculum changes. These included Navajo language, Navajo history, Navajo myths and ecological and environmental issues (Evers,1982). However, in looking through these same curriculum materials little to no thought has been given to either a Navajo form of mathematics or how the purpose of teaching mathematics to Navajo students at Rock Point Community school might contribute to the strengthening of the Navajo tribe or local community. Can mathematics be used to help students gain a greater understanding of Navajo culture? Can mathematics be used to foster Navajo tribal self-determination? To these two questions there has yet to emerge a clear or compelling answer.

Self-determination, Indian Culture and the Mathematics Classroom

How might I recognize the impact of self-determination at the local K-8 mathematics classroom setting? It seems reasonable to think that if I could find evidence of Indian language and culture in the mathematics classroom I will have found the impact of local control. As far as math content goes it seems that Indian culture can offer a context for the teaching of mathematical concepts. Mathematics impacted by local Indian culture might mean using local tribal crafts such as beadwork, pottery making or weaving, depending on local tribal cultural activities, as contexts for developing algebraic algorithms. It might mean incorporating traditional tribal designs used in art or dress to introduce and study geometric patterns and shapes. The construction of a tipi might offer a chance to study conic sections or raise questions concerning the relationship between the area of the tipi canvas and the length of tipi poles. The Montana Office of Public Instruction offers an illustration of the use of Indian culture in the mathematics classroom where pan-Indian powwow topics are used as the main Indian cultural activity in some primary and elementary grade-level curriculum. Finally, we can also take a look at traditional games, like hand games, to tie cultural concepts to probability concepts taught in the classroom. The presence of cultural activities is easily observable in the classroom and can be apparent in the curriculum.

A second way of evaluating whether or not local tribal culture is present in the mathematics classroom is to determine the extent to which language and traditional reasoning is used in teaching and learning contexts. A close look at curriculum may give glimpses of this impact, but it is unlikely to be sufficient. Rather, the influence of language and traditional reasoning is likely to be discerned primarily through observations in the classroom. Indications of this form of cultural influence in the classroom could be evident in the amount of time tribal

language is used to discuss and explain terms and concepts in the local native language. Lipka (1991) addresses some of these ideas when reporting on observations of culturally relevant curriculum and pedagogy witnessed in the classroom lesson given by a Yup'ik teacher to Yup'ik students. In the instructor's presentation of material we see explanations of art concepts as they are related to aspects of Yup'ik cultural subsistence and survival. Lipka (1991) felt that this was an effective way of teaching art concepts to Yup'ik children as it related formal classroom content to deeper Yup'ik cultural values. This is something that should be part of the teaching of formal mathematics as well, that is, if we are to assume an influence of local Indian culture into the classroom as suggested by ideals in self-determination. For instance, is there present a comparison between the way traditional Indian people measured time and distance versus the use of standard measurement units? Are there other lessons to be gleaned from mathematical concepts pertaining to Lakota culture where, on the surface, no connection appears? Can we look at the spiritual quality of numbers for instance, when looking at number systems? How do the Lakota envision a mathematical concept like infinity, or fractions?

Another indicator of Indian culture in the mathematics classroom is the degree to which the local area is used as a way to incorporate indigenous notions of place. Deloria & Wildcat (2001) speak to this characteristic of the native worldview and see 'place,' the local geographical area of Indian people, as an important educational entity necessary in developing the Indian notion of personality. The authors state that Indian personality is equal to the sum of power and place. Power is described as being the spiritual characteristic attached to all living things and place being the physical location of an individual. Thus, in order to develop the Indian personality (hence identity) to its fullest capacity the need to raise a person capable of respecting relationships between themselves and the place (and the entities it contains) is paramount.

Important questions arise: Is there a way we can use mathematics to highlight relationships that have occurred between Indian people and the land in which they lived? Can this be used to show the current relationship between an Indian student and his 'place?' What mathematical tools and constructs could populate the math curriculum such that they may be used to describe these types of relationships?

Thus there seems to be at least three ways in which to form a judgment as to whether or not Indian notions of self-determination are present in the local classroom: (1) The presence of Indian cultural activities, (2) the use of language and Indian mathematics and reasoning and (3) an inclusion of the local physical context which adds an emphasis of the Indian notion of 'place.' I posit that the presence of any or all of these will signify a local incorporation of Indian self-determination principles. In all cases, an illustration of local culture is necessary to provide a platform from which to gather these forms of crafts and aspects of local Indian thinking. For this reason it is important to look at what constitutes Indian self-determination and also what is available in the local Indian culture that could lend itself as a context for the local Indian classroom.

The Usefulness of Ethnomathematics

If a characteristic for the push for self-determination was to help Indian children come to appreciate their culture and who they are as Indian people then the field of ethnomathematics can be of aid. Ubiratan D'Ambrosio (2007) who coined the term 'ethnomathematics' did so as he was beginning the formulation of the study of what he called "mathematics non-Western." Part of the reason for his look at non-Western mathematics was to help restore "cultural dignity" to marginalized groups. He gives two main reasons for the study of ethnomathematics: one, "to demystify a form of knowledge [mathematics] as being final, permanent, absolute, unique...and

two, to illustrate achievement of various civilizations, cultures, peoples, professions, gender..." (pp.33-34). Through this study he (and many that followed this course of study, such as Gerdes (1988a, 1988b), Nunes et. al. (1993), Ascher (1991) and Closs (1986)) were able to bring forth the notion that we all have mathematics embedded in our daily lives, regardless of our culture, economic situation or physical location. This doesn't necessarily mean that all cultures formulated abstract notions of proof and mathematical rigor. What it does mean is that in looking at all cultures through a formal mathematical lens we can see that all cultures count, all cultures reason systematically and that all cultures measure time and distances, etc. The importance of the emphasis in this area by those studying ethnomathematics is that it shows that as humans we have a firm basis within all our cultures in which mathematical thinking both rests and is cultivated to meet the needs of each culture. In looking at the development of formal mathematics we can see that it was an endeavor that included many cultures through time (Kline, 1964). Thus, contributions to the growth of mathematics came from Babylonians, the Egyptians, the Greeks, Arabs, and also Western European countries. Since ethnomathematics considers mathematics at a cultural level it necessarily must consider the roots of mathematics, its impact on the world, and its uses in modern times, both political and practical.

Ethnomathematics and Lakota Culture

Ethnomathematics offers something useful here - that the recognition that aspects of mathematics are an inherent part of all cultural thinking. As such we can look at how the local Oglala Lakota culture uses and reasons mathematically; we can tease out forms of mathematics within the Lakota culture to form a body of mathematical knowledge distinctly Lakota. This in turn can be used as a basis for comparison between formal mathematics taught at the local K-8 school and "Lakota mathematics." The development of a Lakota mathematical framework will

help in providing a lens to see if local cultural mathematical activities and reasoning is included in the formal mathematics classroom. In searching common features of mathematics in all cultures, with the assumption that all cultures 'do' mathematics, Bishop (1991) describes six universal mathematical activities common to all cultures. They are: counting, locating, measuring, designing, playing, and explaining. In identifying and naming these six activities he states:

> All these activities are motivated by, and in their turn, help to motivate, some environmental need. All of them stimulate, and are stimulated by, various cognitive processes, and I shall argue that all of them are significant, both separately and in interaction, for the development of mathematical ideas in any culture. Moreover all of them involve special kinds of language and representation. They all help to develop the symbolic technology which we call mathematics. (p.23)

Barta et. al. (2001) and Barta & Shockey (2006) illustrated the use of these ethnomathematical principles to illustrate the mathematics in indigenous cultures. These two studies conducted with the Shoshoni of Wyoming and the Northern Ute people of Nevada built on the framework of mathematical activity in all cultures offered by Bishop (1991). Barta et. al. (2001) and Barta & Shockey (2006) offered specific ways in which this information could be incorporated into the schooling of Indian children who are members of those tribes studied. This framework provides a structure for a similar investigation into this study, one used to describe a form of mathematics inherent in the practices of the Oglala Lakota people of Oglala, South Dakota. Following the format offered by Barta et. al. (2001) and Barta & Shockey (2006) and synthesizing the knowledge shared by the Oglala Lakota elders interviewed in this study, one purpose of this research will be to pursue the idea of whether or not both mathematical activity and Oglala Lakota mathematical reasoning can be combined into a Lakota mathematical framework.

The study

This study was based on three theoretical propositions. The first fundamental tenet was ethnomathematical in nature. It proposed to use the aforementioned framework described as "the six universal mathematical behaviors" by Bishop (1991) to build a Lakota mathematical framework. This was accomplished by asking questions to Lakota elders on the topics of counting, locating, measuring, designing, playing, and explaining. The second area of study looked at how self-determination has been instituted in the formal educational realm and how its principles might have been interwoven into the thinking of local educators in the community. Those who control the formal aspects of education offered this study a way to frame ideas of self-determination. Just as working with elders helps to develop a "Lakota mathematics" working with local Indian educators helped form a local Oglala Lakota version of self-determination. Using these two frameworks, Lakota mathematics and Lakota ideas of self-determination, I could determine whether aspects of these are present in the mathematics classroom. This comparison constitutes the third area of study. In the classroom I observed the content itself as well as how it was implemented, taught and received. Are local Lakota cultural activities present in the classroom? How much of the Lakota language is used either by the teacher or students in doing mathematics? Is the Indian notion of 'place' used as a context for the study of mathematics? The presence of these aspects of Lakota culture gave an indication to ideas expressed in principles of Indian self-determination set forth by local Lakota educators.

The goal in intertwining these three areas into one study is to ultimately be able to describe the impact of self-determination on the local mathematics classroom in the hopes of developing a final framework in which to analyze the mathematical education of Indian children in this prolonged age of self-determination.

A note on terminology

Throughout this study I have used the term "Indian". The choice of this word is strictly personal. Although I could have easily used the term American Indian or Native American, as many authors do to try to avoid issues that come with any term used to categorize indigenous peoples of the Americas, there is really none that exists which would not cause consternation among a few. I grew up in an era on the reservation when the term "Indian" was used by many within the Oglala community, including myself (I argue here that many still do use this term since I hear it used all the time when I am back home). I have used it in this study more as a norm I acquired within the context of the Oglala community than anything else.

Summary

The three theoretical principles described above will be used to answer the following three research questions. The use of ethnomathematics and Bishop's (1991) framework will help answer research question 1: What does Lakota mathematics look like? The framework built from an examination of characteristics of Indian educational self determination, having been a fixture in Indian education for the past forty years, will help answer research question 2: How do local educators express self-determination in the educational process of their students? Finally, once a Lakota mathematics is described and once self-determination at the local level is grasped we can see how both impact the local K-8 classroom and answer research question 3: What aspects of Lakota culture and self-determination principles are present in the middle-school mathematics classroom?

Answers to each research question are dependent on three groups of people within the local community. Elders and Lakota language speakers will help express and illustrate Lakota mathematics. Lakota teachers and educators will express ideas of self-determination/local

control. Finally, students and teachers (along with classroom observations) will help bring about a description of the impact of these ideas in the local classroom.

Studies of the intersection of mathematics and Indian education are rare. Even less available is how local control might impact the teaching of mathematics in Indian communities. This study proposes to highlight the impact (or lack thereof) of Indian educational self-determination on the local Indian mathematics classroom. The long-term goal of which is to describe a framework (whose result is dependent on the three research questions above) that might be useful in creating a mathematics that is geared toward strengthening self-determination at the tribal level.

Chapter 2: Lit Review and Conceptual Framework

THE AMERICAN INDIAN PLEDGE

> 1. We are steadfast, as all other true Americans, in our absolute faith in the wisdom and justice of our American form of Government.
>
> 2. We join with all other loyal citizens of our beloved country in offering our lives, our property and our sacred honor in the defense of this country and of its institutions.
>
> 3. We denounce in emphatic terms the efforts of the promoters of any alien form of government to plant upon our shores or within any of our institutions the ideology or way of life which inflicts slavery, trial and punishment without the sanction of a jury, denies free speech, abhors free choice of religious worship, or through force and fear threatens the peace and safety of mankind.
>
> 4. At this critical hour of human history the American Indians arise as one in pledging to the President of the United States and to our fellow citizens our assurance that upon these principles we and our children shall forever stand. (Declaration of Indian Purpose, American Indian Chicago Conference, 1961)

The American Indian Chicago Conference

In the summer of 1961, from June 13th to June 20th, a gathering of some 460 Indian people representing 90 tribes and bands from across the United States gathered at the University of Chicago campus. It was the hope of the organizers of this conference that it would provide a space for Indian people, on a national scale, to have discussions about current issues affecting Indian tribes and agree upon the direction future Indian policy should take. The goal of the discussions and agreements would be to produce a document that could be presented to the incoming Kennedy Administration. This conference was known as the American Indian Chicago Conference (AICC) and the document pushing the direction of future federal Indian policy came to be known as the *Declaration of Indian Purpose*.

The person spearheading the organization of the AICC was Sol Tax, an anthropologist from the University of Chicago. During the previous fall, in November of 1960, he approached the National Congress of American Indians (NCAI) at their annual conference to present his idea for the conference and to ask for their blessing and support. NCAI was a national political intertribal organization founded in 1944 "to assist tribes in availing themselves of the provisions of the IRA (Indian Reorganization Act) when people returned from military service and defense industries" (Lurie, 1999, p. 109). During the time of Sol's request federal policy towards Indians was not favorable for Indian tribes. Federal policy was geared towards terminating its treaty responsibility to certain Indian tribes. House Current Resolution 108, which came to be known as the Termination Act, was passed on August 1, 1953. It stated:

> Whereas it is the policy of Congress, as rapidly as possible, to make the Indians within the territorial limits of the United States subject to the same laws and entitle to the same privileges and responsibilities as are applicable to other citizens of the Unties States, to end their status as wards of the United States, and to grant them all of the rights and prerogatives to American citizenship...That it is declared to be the sense of Congress that, at the earliest possible time, all of the Indians tribes and the individual members thereof located within the States of California, Florida, New York, and Texas, and all of the following named Indian tribes and individual members thereof, should be freed from Federal supervision and control and from all disabilities and limitations specially applicable to Indians: The Flathead Tribe...the Klamath Tribe...the Menominee...the Potowatamie Tribe...Chippewa Tribe...(*Declaration of Indian Purpose,*1961*,* p.32)

As a result of this legislation some tribes lost federal recognition. The Rancherias in California were terminated in 1958, the Catawba in 1959, and the Klamath and Menominee were terminated in 1961. This federal legislation, which was viewed by tribes as a threat to their very existence, coupled with the promise of a new administration, made it seem like it was the right time for such a conference to occur.

> The time indeed is particularly strategic because a new administration in Washington will appreciate new information on the basis of which to act. From

> this last point of view, what is to be done should be done this Spring and the development of the report itself should be educational and "public" to all leaders involved (a letter from one of the participants in initial gathering of thoughts). (Lurie, 1961, p. 482)

Once the NCAI blessing was received Tax began piecing the conference together. He set about putting together the agenda and issues up for discussion. Part of Sol's genius was that he made sure all Indians, (meaning Indians from every region, tribe, and location-both urban and reservation as well as members of federally and non-federally recognized tribes) were involved in the planning of the conference. In doing so he set the tone for a national Indian voice to be spoken and heard at the conference. The presence of such a unified voice in the document would show the future administration the issues facing all Indian people. Correspondence between Sol Tax and Indians interested in giving him feedback was used to help draft what eventually became known as the *Declaration of Indian Purpose* (to be discussed shortly).

In anticipation of the conference on the University of Chicago campus Sol Tax wrote an article in the *Chicago Sun-Times* (two days prior to the conference). The article was titled, "What the Indians Want" (as seen in Lurie, 1961, p. 492). In the article he speaks to the general public about what it is, from his perspective, Indians were asking for and might be pushing for in the upcoming conference. He states:

> RESPECTING THE IDENTITY of Indians means recognizing the continuing existence and identity of Indian communities...RECOGNIZING THE IDENTITY of the Indian communities and their right to persist...When Indian communities were independent and sovereign, they were able to adapt readily to changing conditions and avail themselves intelligently and efficiently of new ideas, techniques and material objects.
>
> In our management of Indian affairs we have made two serious miscalculations. First, we, rather than the Indians, have decided what their goals could be. Second, we have tried to see to it that these goals are reached by our own rather than the Indians' methods.

The opening speech offered at the AICC by Edward Dozier, an American Indian as well as an anthropologist, summed up the motive and spirit of the meeting:

> One of the important characteristics of us as American Indians is our enormous diversity. One has merely to look over this congregation to realize the fact, and when we examine the groups from which we come, the diversity is compounded. Yet, despite this variation, Indians have and continue to share a common situation. The very fact that there was an enthusiastic response to this general meeting of Indians is indicative of this commonality.
>
> Our purpose at this conference is to compile a series of suggestions and recommendations. Here we must unite for it is the commonness of purpose that brings us together. While we differ as groups and individuals our problems have a commonality. Pooling our efforts toward policies of greater benefits for ourselves is our goal. (Lurie, 1961, p. 490)

As the week of the AICC progressed, ideas were discussed and suggestions were turned into agreements from which a formal document could be created. What follows here is a short analysis of the educational section of this document couched within the language of the *Declaration of Indian Purpose*. The reasons I want to spend time discussing this conference and specifically the creation of this document is the understanding that it *did* have a national impact on federal attitude and policy towards Indian people and also because it became the impetus for the push from tribes towards tribal sovereignty. Also of importance is the recognition that Indian tribes began pushing for self-determination in Indian education soon thereafter.

The Declaration of Indian Purpose

The *Declaration of Indian Purpose* starts immediately with an American Indian Pledge (seen at the beginning of this document). This pledge seemed to want to qualm any fears that what was about to take place at this conference was not an anti-American ploy but an effort by Indian people to take hold of current problems, identify them for the larger society, claim responsibility for them and move forward in finding ways of bettering the lives of Indian people. Following the American Indian Pledge came the Creed, seen here in its entirety:

CREED

> WE BELIEVE in the inherent right of all people to retain spiritual and cultural values, and that the free exercise of these values is necessary to the normal development of any people. Indians exercised this inherent right to live their own lives for thousands of years before the white man came and took their lands. It is a more complex world in which Indians live today, but the Indian people who first settled the New World and built the great civilizations which only now are being dug out of the past, long ago demonstrated that they could master complexity.
>
> WE BELIEVE that the history and development of America shows that the Indian has been subjected to duress, undue influence, unwarranted pressures, and policies which have produced uncertainty, frustration, and despair. Only when the public understands these conditions and is moved to take action toward the formulation and adoption of sound and consistent policies and programs will these destroying factors be removed and the Indian resumes his normal growth and make his maximum contribution to modern society.
>
> WE BELIEVE in the future of a greater America, an America which we were first to love, where life, liberty, and the pursuit of happiness will be a reality. In such a future, with Indians and all other American cooperating, a cultural climate will be created in which the Indian people will grow and develop as members of a free society. (*Declaration of Indian Purpose*, 1961, p. 5)

The *Declaration of Indian Purpose* (DIP) identifies six areas of major concerns affecting the lives of Indian people. These six areas of importance and concern are: Resource and Economic Development, Health, Welfare, Housing, Education and Law and Jurisdiction. These six are listed as subcategories under the umbrella of Legislative and Regulatory purposes. Each section of concern starts with an explanation of who is responsible for the subcategory, for education it is noted that the Bureau of Indian Affairs was responsible. Then it identifies current problems and offers recommendations on how to solve those problems. (Because I am concerned with the document's view of education I will focus on it exclusively while ignoring the other five areas of concern.) Education is expressed in the following way:

> We conceive education not only in terms of classroom teaching, but a process which begins at birth and continues through a life span. Of all the studies, surveys, and research made of Indians, the inevitable conclusions and recommendations are that education is the key to salvation of whatever ills may be, wherever Indians reside. (p.11)

The sub-category of education is sub-divided still into six major areas of concern: federal and public schools, vocational training, adult education, on-the-job-training, school lunch programs and special classrooms. Given that federal and public schools housed the vast numbers of Indian students at the time it is fitting that this area of concern was given the biggest "air-play" under education. Nash (1964) states that "The total enrollment in the Federal Indian schools was nearly 42,000 with about 26,000 in boarding schools and the balance in day schools...In addition there were nearly 70,000 Indian youngsters of school age attending local public schools" (p.1). Problems encompassed a lack of opportunity to attend these schools, dropout rates, attendance, transferring from federal to public schools and admissions to federal schools and staffing with good teachers and adequate counselors were mentioned. Inserted as one of the solutions to inadequate education for Indian students that harkens to the culture and local Indian community is the following: "In order that good student-teacher and community relationships be promoted, personnel employed to teach in government schools should be selected on a basis of their interest in Indian students, their knowledge of Indian culture, and their willingness to live and participate in local community life" (DIP, p.12).

The document suggested that vocational training be available to all Indians and that the government should help those in vocational schools with subsistence payments to ease the burden of living expenses while in school. Adult education needed to be more readily available and better equipped to handle the "needs and interests of the people involved. (DIP, p. 13). On-the-job training should be available to both "adults and youth." to counter juvenile delinquency and also to give young people jobs to "keep them occupied" and to offer them "skills that could be useful on their home reservation or elsewhere" (DIP, p. 13). The document also advocated for

school lunches and classrooms designed to meet the needs of both "exceptional and retarded children on reservations" (DIP, p.13).

In analyzing what was deemed important in the realm of education clearly access to adequate education was important. Also important was additional funding not only for lunch programs but to also assist students while they learned. Access to educational opportunity was important, however so too was access to the fruits of education. Since education was viewed as a step to individual economic independence it was paramount that Indians should receive it. Through education whether it was academic, vocational or on-the-job, Indian students and adults could gain necessary skills for employment. Education was seen as an important tool to help students gain skills in trades either in vocational education or as trainees getting experience on-the-job or on-the-farm. It is assumed that employment would then impact local Indian social life for the better. The end purpose of education was employment.

The AICC ended and was viewed as a resounding success. Indians now had a united front and purpose. They had accomplished the goal of creating a document that they felt would impact future federal legislation. The document changed form from its initial tone and format as the conference drew near to something entirely different by the end of the conference.

> It began as an expression of the belief that Indians can manage their own affairs, easily mistaken for the idea that Indians should progress themselves out of their "Indianness." In final form, the language strongly decries policies which have been harmful to Indians and stresses the right to a decent life with holding to Indian identity and concepts (Lurie, 1961, p. 483).

Its concluding statement reads:

Declaration of Indian Purpose - Concluding Statement

> To complete our Declaration, we point out that in the beginning the people of the New World, called Indians by accident of geography, were possessed of a continent and a way of life. In the course of many lifetimes, our people had adjusted to every climate and condition from the Arctic to the torrid zones. In

their livelihood and family relationships, their ceremonial observances, they reflected the diversity of the physical world they occupied.

The conditions in which Indians live today reflect a world in which every basic aspect of life has been transformed. Even the physical world is no longer the controlling factor in determining where and under what conditions men may live. In region after region, Indian groups found their means for existence either totally destroyed or materially modified. Newly introduced diseases swept away or reduced regional populations. These changes were followed by major shifts in the internal life of tribe and family.

The time came when the Indian people were no longer the masters of their situation. Their life ways survived subject to the will of a dominant sovereign power. This is said, not in a spirit of complaint; we understand that in the lives of all nations of people, there are times of plenty and times of famine. But we do speak out in a plea for understanding.

When we go before the American people, as we in this Declaration, and ask for material assistance in developing our resources and developing our opportunities, we pose a moral problem which cannot be left unanswered. For the problem we raise affects the standing which our nation sustains before world opinion.

Our situation cannot be relieved by appropriated funds alone, though it is equally obvious that without capital investment and funded services, solutions will be delayed. Nor will the passage of time lessen the complexities which beset a people moving toward new meaning and purpose.

The answers we seek are not commodities to be purchased, neither are they evolved automatically through the passing of time.

The effort to place social adjustment on a money-time interval scale which has characterized Indian administration, has resulted in unwanted pressure and frustration.

When Indians speak of the continent they yielded, they are not referring only to the loss of some millions of acres in real estate. They have in mind that the land supported a universe of things they knew, valued, and loved.

With that continent gone, except for the few poor parcels they still retain, the basis of life is precariously held, but they mean to hold the scraps and parcels as earnestly as any small nation or ethnic group was ever determined to hold to identity and survival.

What we ask of America is not charity, not paternalism, even when benevolent. We ask only the nature of our situation be recognized and made the basis of policy and action.

In short, the Indians ask for assistance, technical and financial, for the time needed, however long that may be, to regain in the America of the space age some measure of the adjustment they enjoyed as the original possessors of their native land. (pp. 19-20)

Indian people were not going away. They were not going to assimilate into American society and disappear. This much was reaffirmed. The conference only brought to the fore that

it was time for America to take a look at Indian people, to acknowledge their existence and right to life. It was time to allow them to make informed decisions on their own. Indians knew they would need aid to do what they had set forth. They also understood that it was time for Indians to take Indian matters into their own hands, as they had done for millennia, and be given the space to figure out solutions to problems that ailed them.

Results of AICC

The immediate aftermath of the AICC is important to note. What types of feelings were expressed and what kinds of hopes did Indian people have once the conference ended? Ablon (1962) suggested that Indians now understood that they had common goals and solutions to common problems shared by all tribes. "Reservation people, rural and urban dwellers alike, were able to see the whole range of problems of their Indian brothers, and it appeared that each Indian voted in the interests of all Indians" (p. 22). Indians of all tribes could pool their ideas and resources and could rely on each other to confront national legislation that could hurt Indian tribes. Also, they had the realization that they had the power to affect change in policy en masse. Another major result of the conference was an understanding of how to operate with and against the federal government: "As the conference drew to a close, most of the participants embraced the NCAI position that, despite grievances against the government and harsh criticism voiced in the declaration, the only feasible and realistic course was to work within the existing system and try to bring about reforms" (Lurie, 1999, p. 112).

If these were the feelings soon after the conference ended what was its long-term impact? There were four long term effects, according to Lurie (1999) that resulted from the AICC: 1). It helped tribes agree on new directions for federal Indian policy. 2). It provided inspiration for the formation of the National Indian Youth and the Great Lakes Intertribal Council. 3). It helped

spur the creation of a branch of the Bureau of Indian Affairs (BIA) to assist tribes in applying for federal Indian recognition and (4) It helped increase funding for the BIA in the 1970s leading to the passage of the Indian Self-Determination Act of 1972. The AICC is worth noting because it set in place a solid platform in which to develop tribal rights along Indian Sovereignty lines. This impacted the development of tribal self-determination, which in turn impacted Indian education.

Not considered an immediate affect at the time, but was seen as such later, was the development of the idea of using tribal sovereignty as a way to affect federal legislation. The right to govern oneself is listed by Lurie (1999) as perhaps the biggest impact AICC had on the way Indian people worked to strengthen Indian policy. Lurie (1999) argues the idea that tribal sovereignty, as it is known today in Indian Country, was a term and concept mostly ignored at the AICC; it was done so because a logical consequence of the philosophy was a denunciation of U.S. citizenship. Such a stance was viewed as counterproductive by the vast majority of Indians present at the conference who had already suggested the best way to impact federal policy would be to work within the system. Sovereignty as a concept was present only as an underlying current in the creation of the *Declaration of Indian Purpose* and was only given brief mention. Lurie (1999) argues that it really was an underlying thread that did not have political voice until a decade or so later. In the decades that followed the AICC, tribal sovereignty has proven to be a cornerstone in the push for tribal rights.

Impact on self-determination philosophy

In trying to glean the impact of AICC and its subsequent document the *Declaration of Indian Purpose* on the psyche of Indian people and tribal government we find that there are a few characteristics we can attach to the formulation of self-determination principles. First, tribes

have an inherent right to govern themselves. This is a notion that should be obvious. The U.S. Supreme Court stated as much when Chief Justice Marshall recognized tribes as distinct political entities powerful enough for the federal government to form binding treaties with in Cherokee Nation v. Georgia (1831). This was re-emphasized in the Indian Reorganization Act of 1934. Secondly, tribes could govern and make important policy decisions on their own without the aid of outside "experts" and their "ready-made" solutions. Thirdly, there are two basic elements that surface in Lurie (1961) and Tax's article in the Chicago Sun-Times, for which Indian people are willing to fight vehemently for - their land, and their Indian identity. Indian land and Indian identity, as we shall see, were echoed in educational realm for many years to come. They will surface time and again in reasons for Indian people pushing for local control of their own schools.

The Journal of Indian Education, 1962 - 1969

Indian Control and Indian-Centered

The *Journal of Indian Education* (JAIE) was founded in 1961. "It is a professional journal that publishes papers directly related to the education of American Indian/Alaska Natives" (*Journal of American Indian Education,* n.d.). Its publishing coincided in many ways with the rise of self-determination. It has been able to publish scholarship and educational innovations found in the push for Indian educational self-determination. As such it provides an interesting view of the rise of self-determination in Indian education through time. It gives voice to many Indian educators (and others) who were involved with leadership not just in the educational realm but also in tribal politics at the local and national level. In addition, it provides a voice for Indians concerned with the education of Indian children and serves as a source for current trends in Indian education. It has published in conjunction with the National Indian

Education Association since 1970, by reporting on many of the issues given voice at NIEA's annual national conference. In looking at articles presented in JAIE on self-determination I hope to bring forth the qualities embodied in Indian self-determination. It is the intention of the author to parse through the journal for the first eighteen years of its existence to see how it viewed what was happening in Indian education during the time later denoted as the age of Indian self-determination. By the end of this look characteristics of self-determination will have been found and can then be applied to this study.

In 1962 an article written by Nelson Lose, then governor of the Gila River-Pima Tribes, appeared in the May issue of the *Journal of American Indian Education*. Among a quick look at grim educational statistics was the conclusion that if things continue their current course Indian people would have a more difficult time becoming employed. Suggestions Lose (1962) made were to use the education of Indian people to help them develop "skills" both at the primary and secondary levels as well as at the adult education level to help facilitate the development of education for employable skills. The need for tribal government to take the lead in informing its members of the importance of education was suggested. Tribes also should find funds to build classrooms and schools and also to give financial assistance to students who chose the path of education. After looking at the purpose of education Lose (1962) mentioned several ideas that are part of the crux for the impending push found in Indian educational self-determination-local control and student view of self and Indian heritage and culture:

> Local control of schools is desirable. Indians must take an active part in the support and control of schools. It is heartening to see them serve on school boards. I am sure where Indians show a willingness to serve and demonstrate the ability to make a contribution they will find themselves in places of leadership...Perhaps one of the greatest needs of Indian people is a feeling of pride in many contributions Indians have made to our American society...There should be a place in our school programs for the teaching of such understandings. (p.24)

Finally, Lose (1962) addresses the young Indian students as if to bring home the point about being proud of their Indian heritage, "I would like to say to our Indian youth today that you are human beings, each with an individual personality. You are citizens of the United States and you are the descendants of a distinguished heritage of which you can be proud" (p. 25).

Philleo Nash, commissioner of the BIA from 1961-1966, wrote a piece in the JAIE in 1964 stating the education mission of the BIA.

> ...we have the responsibility of providing students with basic grounding in the three R's and other academic subjects and equipping them as fully as possible for effective adult lives, but our problem is greatly complicated by the fact that a very high percentage of our students come from homes where English is not the everyday household language and where the whole cultural background is quite different from that of a typical non-Indian...In a sense, our schools function as a bridge between the two cultures and have the responsibility of giving the youngster an understanding of the world outside the reservation boundaries so that he will be at no disadvantage in dealing with it as an adult whether he decides to live on or off the reservation. (p. 1)

He later mentions a possible shift from the vocational to the academic, "It does not mean, of course, that every youngster will have to graduate form a college or university and enter a professional career. But it does mean that the first 12 years of schooling should be devoted as fully as possible to academic subjects and that vocational education should come only after the completion of this basic preparation" (p.2). He lists four areas that have given special emphasis by the BIA: developing English language fluency among students, strengthening guidance and student counseling, the development of summer programs to "make more productive use of the vacation months" (p.3), the education and training of adult vocational programs and finally adult education courses where some of the main courses were "the development of reservation resources, making a living, home and family life, social understanding, health and safety, civic participation and the education of Indian children" (p.4).

In 1966 we see the first call for a special post-secondary school for Native Americans. Jack Forbes, an associate professor at the University of Nevada, sent out the call giving reasons for such an institution of higher learning. "It is clear that although some Indian students now attend public and private colleges and universities, a problem in higher education still exists. No institution is designed to really meet the fundamental needs of the Indian community, which needs an institution of higher learning *both Indian-controlled and Indian-centered*" (p.1). (His emphasis) Forbes (1966) goes on to list reasons why such a school was necessary, "to preserve identity both as "Indians" and as members of specific tribes" (p. 2). to also educate "Large number of Indians in an environment suitable for the development of self-confidence, both individual and collective" (p.2) to educate Indians in a "post-high school institution thoroughly oriented towards tribal needs...to train large number of Indians, both old and young, for leadership within the context of the tribal community" (p.2). His proposed inter-tribal university would meet the following needs of Indian communities: teacher training, law training, arts training, social work, ethnic background training, agricultural development, general training, pre-college training, student orientation, cultural-intellectual center, literacy, spreading knowledge of Indian culture, vocational training, tribal research, inter-American Indian affairs and overseas program. He ends the article by alluding to the purpose of education as a way to cure the poverty that ails Indian communities, "the time appears ripe for Indians and interested non-Indians to gather to discuss the wisdom of establishing an inter-tribal university. It could be the major effort in the "war on poverty" in so far as tribal groups are concerned. It also could signal the dawn of a new age in which tribes take their place as worthy members of a modern world community" (p.7).

What we see with these first three articles will continue to serve those concerned with Indian education. First and foremost is a call for Indian controlled and Indian-centered schools that could meet the needs of Indian students. It is viewed by the authors that the education received in such schools would better serve Indian students because it could reinforce their view of self and help them better understand and appreciate who they are as members of specific tribes. Thus self-esteem and self-worth is inherently tied into this form of education. Faith in the educational system to give access to future employment as a way to cure issues stemming from poverty in Indian communities is assumed a fruit of receiving such an education. A push for academics both rigorous and centered on the American Indian community should also be a part of this education. And finally, as if to reinforce what was said in the AICC, counseling, adult education programs must continue to be a part of the education equation.

Rough Rock Demonstration School (RRDS)

In 1966 a demonstration school opened its doors in Lukachukai, Arizona after receiving funding for one year from the Economic Opportunity Act of 1964. Its purpose was to show how a school run by Indian people might function. After the first year it received additional funding and moved to Rough Rock, Arizona to continue the experiment. Rough Rock Demonstration School opened its doors on July 1, 1966. Soon RRDS received national acclaim as a model for how an Indian school should be run. It was innovative. It had an all-Navajo school board, it employed many local Navajo people who were deemed uneducated at the time, and it began to push the boundaries of what an Indian education should look like. Curricular changes included use of the Navajo language, Navajo myths and history and highlighted accomplishments of Navajo people. There were many articles written in the JAIE about this demonstration school and its impact on the psyche of Indian education.

Thomas R. Reno, then a graduate student at Arizona State University, and Robert A. Roessel, Jr., the director of RRDS, both wrote articles in JAIE during the initial years of RRDS (Reno, 1967; Roessel Jan, 1968, May, 1968). Their articles Reno (1967) and Roessel (May, 1968) laid out the areas in which the demonstration school was to focus to satisfy the extension grant from the Office of Economic Opportunity (OEO). These areas included: school and community relations and parental involvement, cultural identification programs, home and school visitation, in-service training and staff orientation, Navaho[1] language learning, adult education, dormitory living, guidance and counseling, and auxiliary services (evaluation, recreation, art, finances, social work and a school library).

One of the first things done at RRDS after the selection of local Navajos to the school board, was that children were allowed to go home during the weekends. This was a very symbolic gesture as most boarding schools had kept children for months at a time. "The newly elected local school board said emphatically, "*the child belongs to the family and parents, and not to the schools*" (Roessel, 1968, p. 3). (His emphasis). This gesture helped the school gain the trust of Navajo parents, who were seen as an important key in the course of educating Navajo children. They were heavily involved in many ways in the school. For example, parents had free access to the school at any time and oftentimes sat in the classes alongside their children. The school also developed dormitory parents. By doing so they brought the family to the school. As a consequence Navajo language, culture, "etiquette, belief and lore" (Reno, 1967, p.3) was at hand for the student both in the classroom and in the dorms. Since parents were present they could share Navajo culture and stories with the children. Reno (1967) points out the fact that the Navaho language was used quite extensively in the classroom and in the dormitories. Roessel

[1] Navajo was spelled Navaho in these articles and will be used synonymously in this literature review.

(1968) commented on the role of the dorm parents, "They (dorm parents) come into the dormitory and spend five weeks with the girls and boys, sleeping with and talking to the children, helping them, just as parents do" (p.3). Salaries were cut in the school budget so that more local Navahos could work in the school. Thus, parents were included in the education of their children in very creative and logical ways. This seems to have been the first time they were looked upon by local schools as valuable educational resources.

In terms of curriculum, Navaho language and culture was everywhere present. Cultural identification was considered a place where the Navaho school board was "blazing trails". Roessel (Jan, 1968) called it "the "both-and" approach to Indian Education. A place where students received the best of both the white world and the Indian world:

> Taking the best of dominant culture and the best of the Indian culture and putting these together in the classroom so the child grows up with a positive sense of well-being, a positive self-image, with pride in his heritage....so our board said that they wanted the Indian people to be included in a positive way in our curriculum, and gave an outline of what they wished...they wanted biographies and history. They wanted to learn about the Navahos today, their problems and opportunities. They want the Navaho child to be proud of being a Navaho as well as being proud of being an American. They want the Navaho language taught in the classroom. (p.5)

The school also served as a community centered education institution offering adult education to local Navajo adults who could take high school or extension college courses. English was taught to adults in the community as well as auto mechanics, home economics, woodworking and sewing. All school equipment was available to the community including laundry and shower facilities as well as the library. The school also used community members skilled in various crafts such as weaving, jewelry-making to teach both students and other adults. The effect of such a school on the community could not be underestimated:

> In the past there have been three kinds of schools operating on the Navaho Reservation: (1) Bureau of Indian Affairs schools, (2) public schools and (3) mission schools. Navaho call BIA schools "Wa'a'shin-doon bi'olt'a or "Washington's school." They call public schools "Bilaga'ana Yazzie bi'olt'a" or "little whiteman's school." Mission schools are "Eenishoodi bi'olt'a or the school of "those who drag their clothes," a name stemming from the first Catholic priests who came to the reservation.
>
> A fourth kind of school has now appeared. It's a tribal school, controlled and operated by the local Navaho community...Its English name is Rough Rock Demonstration School. Navahos call it "Dine' bi'olt'a or the "Navaho's school." There are nearly one hundred schools located on the Navajo Reservation but only one is so honored. These words express more eloquently than anything the significance and sense of identification the Navajos attach to the Rough Rock Demonstration School. (Roessel, May, 1968, p.5)

Local control was the key element in this school and it follows some of what Forbes (1966) had pushed at the post-secondary level, namely being Indian-controlled and Indian-centered. "At Rough Rock the School Board and the community now enjoy a right long enjoyed by other Americans…This is the right to be *wrong*..."(Roessel, May, 1968, p.13) (His emphasis) Roessel (May, 1968) identifies two elements that make the experience at RRDS special - local control and cultural identification.

> On the other hand, if the BIA and public school systems finally recognize the problems affecting Indians in schools demand not more of the same, but a radical new departure and new approach, then Rough Rock stands vindicated and its significance will never be lost. In a very real way, the significance of Rough Rock is based on two factors: First, control of Indian education by Indian people, and second, the incorporation into the school curriculum of positive elements of Indian life and culture. (p. 11)

RRDS and the Navajo of Rough Rock added many important facets and programs to strengthen the notion of self-determination in Indian education. It showed "what is possible when Indian people, with limited or no formal education, are given an opportunity to direct and control their own education." It showed innovation, it showed how to involve the community, it showed how to involve parents and how to educate using the native language. In addition, it

showed how to meet the emotional and psychological needs of the students through innovations in curriculum. It showed how to raise student self-esteem, which was seen, at the time, as a crucial piece for educational success. Infuse the culture and language into the school, use tribal history and stories and include modern stories of successful Navajos and, it seemed, educational success would follow.

The curricular innovations that came from the school are important to note. These changes were deemed necessary to help students become aware of who they are as Navajo people and also to appreciate their Navajo culture and heritage. Pfieffer (1968), then the Assistant Director for Educational Services and Gary Witherspoon, the Assistant Director of the Navaho Curriculum Center, provide some insight into the development of curriculum at RRDS. Three reasons are given by Witherspoon (1968) for the teaching and learning of Navajo language and culture in the formal classroom: (1) so the school is not seen as a foreign institution by the community designed to "undermine the foundations of Navajo culture and social order; (2) to help ease student transition from the family and community life to the school itself with the purpose of achieving enthusiasm and purpose in their academic work; and (3) to help Navaho children develop a positive self-image. It was viewed by the author that "Indians are happy, secure and well-adjusted when they feel pride in their Indian identity" (p.36). The curriculum also had an academic purpose, to get students to function in two worlds, the world of the Navajo and the world of the white man.

> Students should be prepared to function in a bicultural setting., if this should be their choice in the future. Education must enable our Navajo students to acquire positive feelings about themselves and to establish a pride in their own culture and heritage. This can be accomplished by incorporating (into the curriculum) the reading and writing of the Navaho language and studies in Navajo social living. Primarily, each child must be seen as a total and uniquely integrated personality - a child who is constantly developing according to his own individual pattern. (Pfieffer, 1968, p. 25)

Parents gave reasons for including Navajo culture and language in the classroom at RRDS. These reasons included the importance of understanding and appreciating their heritage, strengthening and preserving their culture, respecting their own people and parents, feeling more secure and not forgetting who they are, and respecting and understanding themselves (Witherspoon, 1968, p. 37). To meet these demands various curricular materials had to be developed. The creation of the Navajo Curriculum Center was created to meet these needs. This center initially prepared seven books: *Black Mountain Boy*, *Denetsosie*, *Coyote Stories*, *Rough Rock History*, *Grandfather Stories*, *Navajo Biographies*, and *Navajo History*. At the time the article was written a second series of books were in the works. They included twelve textbooks dealing with Navajo history and culture: biographies highlighting successful Navaho people, Navaho history, Navaho legends and myths, primary readers and Navaho social order, tribal government, sacred places and Navaho science and ethnobotany (Witherspoon, 1968).

Unfortunately there is no discussion about possible drawbacks to the inclusion of Navajo language and culture into the formal education process. A key point with this influx of Navajo curriculum was a shift in focus of the school itself. Rather than a push for academic mastery of the three R's, which was seen earlier as a major point of emphasis in the education of Indian children, the new purpose of such a school seemed to be cultural maintenance and language preservation. The purpose of RRDS was for students to better understand their Navajo culture. "More than academic mastery, the Rough Rock faculty wants its children to become proud of their heritage as Navahos, confident, independent, forthright, with a positive sense of identity, eager to participate in Navaho and Anglo culture" (Pfieffer, 1968, p. 28).

The voice of Roessel comes to the surface in analyzing what was offered to Navajo students. The "both-and" philosophy, i.e., the best of both the white world and the Navajo world

seems to have held true in the design of the curriculum at RRDS and is reflected in the following comment about the ESL program at RRDS: "The major objective of this ESL program is to give students the ability in language necessary to function in, not necessarily to convert to, the dominant American culture. The objective states, "There will be no attempt to persuade the student to prefer English over Navaho nor Navaho over English, but rather to see both as useful tools" (Pfieffer, 1968, p. 31).

What were the drawbacks to such a curriculum? Was it effective? How was success of this type of schooling measured? Could it be measured? Surely success had to be both academic and cultural. Ideally a student taught at RRDS could "walk in both worlds" comfortably and with relative ease. Were students able to succeed academically at a better rate than students at neighboring federal and public schools that served mainly Navajo students in the traditional formal educational setting at the time? Unfortunately, to my knowledge, this type of data had not been collected. It would have been interesting to see whether the stated goals for the push for Indian-controlled schools that focused on Indian curriculum were in actuality better schools, not just for cultural reasons, but for purely academic reasons. Did Navajo students who eventually went through RRDS more fit for life in both the Navajo and dominant society or did they eventually chose one over the other?

Bayne (1969) seemed to be the lone voice of dissent in JAIE regarding RRDS. He wondered of the effectiveness of bringing in cultural activities to the classroom given that the context of formal education was at odds with Indian cultural values. His voice provides not just dissent against the push for Indian culture in the classroom but also a sincere appreciation of the damage that might occur to Indian culture if it was to be cut into ready-made curricular boxes. He gives two reasons for his pessimism regarding culture materials in schools:

> (1) The *form* of an education system as well as the content is a vehicle for perpetuating the values of the culture operating the system. Mere inclusion of Indian culture materials in the *content* of curricula for American Indian children without radical alteration of the form of the education process seriously perverts the meaning of the materials from their meaning within the native culture. Specifically, education in our schools is compartmentalized and formal, whereas the form of education in the native American cultures was neither (p.1).
>
> (2) Myths, legends, arts and crafts, and language are only a small part of a people's culture. Unfortunately, most Americans hold the romantic notion that these aspects of American Indian culture are synonymous with the totality of Indian culture. These are the parts of culture referred to when educators speak of "the best of Indian life." Thus the most colorful and easily identifiable aspects of the native American cultures are taught in the schools, rather than any deeper foundations. (p.3)

The greatest teacher of culture to Indian children could not be found in the schools but in the context of their community and family. It was really the kinship fabric woven into the cloth of daily life that separated Indian culture from the rest of American culture. Since this kinship system cannot be replicated in the classroom it would have minimal effect in regards to preserving Indian cultures. The family and extended family inherently found in Indian communities should be charged with giving Indian children an appreciation and preservation of their own cultures, not the schools. "Thus the source of a child's Indian identity will always rest in his *community* and will be destroyed when that community ceases to function…When the kin communities die, then Indian culture as a unique, living alternative to the American mainstream will die no matter how many legends are learned in school by children of Indian descent" (pp. 3-4).

The schools could however, as purveyors of dominant culture, include cultural materials for three reasons: (1) to help students gain some sense of self worth, this in turn might help them cope better with dominant society. (2) cultural materials might help facilitate a better appreciation of Indian culture for teachers. These materials might help the teacher become more effective because then they could understand the community in which they teach and (3) the

inclusion of curriculum materials helps educators understand that you should not separate the school entirely from the community in which it is situated (Bayne, 1968). These cultural materials would alleviate some of that disparity between school and community. In spite of his seeming agreement that cultural materials in the classroom could have a positive effect by breaching the gap between school and community and the gap between student and curriculum, Bayne (1968) still held the contention that "It is still the purpose of the school to teach and perpetuate the culture of modern, technological America, and it is the grave responsibility of the school to do it well. Anything less is a crime against the next generation, a crime for which schools for Indians have long borne guilt" (p.5).

With the criticism from Bayne comes the end of the sixties and the first attempts to formulate ideas about what local control of schools by Indian people meant. These ideas later become wrapped in the category of self-determination. Self-determination in Indian education caught fire in the 1970's in many Indian communities culminating in the rapid growth of Tribal colleges and local control of schools. With the passage of the Indian Self-Determination and Education Act of 1975 schools would be able to circumvent BIA control and get direct funding. At the same time the inclusion of Indian culture and language into formal education in many local Indian communities occurred. The ideas brought forth from the work of the Navajos and many others in the sixties, which I will call "principles of self-determination," include local control and curriculum designed to raise the appreciation and awareness in Indian students of their own culture - to increase self-esteem amongst Indian students. The curriculum changes proposed include the teaching of tribal history, government, myth, tribal stories, and include biographies of tribal members and ecological sciences and natural resources. These principles will continue to be forged in the decade of the 1970's but really do not change much over the

course of time. Of note, there is no mention of the change in mathematics to suit the needs of the community or how it might have been impacted by the infusion of local Indian culture in the formal educational setting.

Curricular Innovations Part I

A "Bi-Cultural" Education

Indian educational self-determination, i.e., local control and Indian-centered ideals, has been the impetus of curriculum changes found within Indian community schools since the late sixties. Very early on, as I have shown, it was decided that the education of Indian children should have two purposes. The first purpose was to teach Indian students about their culture. This included teaching them about their tribal history, government, mythology, language, kinship relations/obligations, and philosophy/worldview. The point of doing this, it was thought, was to help students raise their self-esteem by developing a greater appreciation of their cultural heritage. The second purpose of educating Indian students was to prepare them for life off the reservation. This meant teaching them important skills and values needed for functioning in dominant society, i.e. being employed and making a living. Thus, the Indian purpose of schooling took on almost immediately a bi-cultural approach to educating its students. This dual purpose is reflected throughout the curricular innovations found in the development of curriculum materials in Indian-run schools.

Churchman et al. (1975) speak to this duality when looking at a pre-school program for Indian students. They suggest that two assumptions should guide the curriculum: The first is that a child "will learn best in a culturally relevant context" (p.7). These materials should "demonstrate the richness of tribal values, history and culture." and also be "consistent with the traditional pattern of Indian communal interaction wherein individuals work cooperatively to

achieve what all can share" (p.7). The second "is that preschools should prepare the Indian child for public school" (p.8). Sharpes (1978) puts it this way, "The problem in curriculum development, then, is two-fold: to identify with and be distinctly American Indian, and to become educated to cope with the modern world. To be educated without addressing the question of background and ancestry is insufficient" (p.25). Lebrasseur & Freark (1982) suggests that it is the "moral and legal" responsibility of Indian tribes, and federal and state governments to "provide Indian youngsters with an education which nurtures and fosters the right of those children to achieve a sense of self-realization as members of their own cultural community and as members of the larger society" (Roger Buffalohead as seen in Lebrasseur & Freark, 1982, p. 38).

The presence of many “Bi’s” in the literature attests to the duality Indian education assumed in the push for local control. A cursory glance at the titles of many of the articles in JAIE gives a clear indication of the direction this education would take. Churchman et al. (1975) is entitled “To Know Both Worlds,” Conn (1973) proffers a “Bilingual Legal Education,” whereas Davis & Pyatskowit (1976) discuss a “Bicognitive Education,” and Smith (1980) looks at archeology in “Cross-Cultural Science Education,”

Time and time again we see this push for understanding of content with culture as a way of promoting a healthy view of self. "Such materials should facilitate success in developing skills which, in turn, enhance self-concept" (Churchman et al., 1975, p.8). Almost all content areas changed in ways to meet the dual purposes of Indian education. English and literacy, Science, social studies and music were all infused with Indian cultural materials and ideas.

Language/Bilingual Programs

Rough Rock Demonstration School set the stage for what was to follow in the realm of Indian school curriculum. Pfieffer (1968) mentions the result of children not being able to speak their language in boarding schools prior to RRDS. She also discusses the lack of connection between the family and the child when the child was in boarding school. RRDS was going to be different in many ways.

> Students should be prepared to function in a bicultural setting, if this should be their choice in the future. Education must enable our Navaho students to acquire positive feelings about themselves and to establish a pride in their own culture and heritage. This can be accomplished by incorporating (into the curriculum) the reading and writing of the Navaho language and studies in Navaho social living. (p.25)

From day one at RRDS enthusiasm and joy came from parents when they realized the education their children received at RRDS was going to include the Navajo language, "Last year, in a community survey, the parents of Rough Rock were asked if they wished their children to learn to read and write their own language. All but one parent so desired and the children were thrilled to know they would be allowed to do so (Pfieffer, 1968, p. 29)." The preservation of Indian languages is vital to the maintenance of Indian cultures. Efforts to implement native language programs were deemed very important and had community support.

> The loss of language is closely tied to a loss of culture. As Jon Reyhner points out: "Our languages contain a significant part of the world's wisdom. When a language is lost, much of the knowledge that language represents is lost (1996, p. 4)." Joshua Fishman concurs: "Take it away from the culture, and you take away its greetings, its curses, its praises, its laws, its literature, its songs, its riddles, its proverbs, its cures, its wisdom, its prayers. The culture could not be expressed and handed on in any other way...(Batchelder, 2000, p.11)

Once the language dies, so too the culture. Dearmin (1977) speaks to the importance of maintaining the language in Indian communities. "For many Indian people…preservation of

language means preservation of a world view and a philosophical center which secures their identity apart from the Anglo society and apart from other Indian tribes which are frequently treated collectively as a group under the umbrella title "Indian"" (p.6).

An example of a bilingual program is found in Reyhner (1990) who describes the use of the Navajo language at Rough Rock from the early years of schooling through high school. In the primary years the Navajo language used the majority of time in teaching students in the following subject areas: Reading Readiness, Math, Science, Social Studies are taught in Navajo and English. The amount of Navajo language used diminishes as the number of years in school increases. Navajo students learn how to read and write in Navajo and also print the school newspaper in Navajo.

Goodluck et al. (2000) describes another bilingual program from a teacher perspective at Chinle Primary School (the Dual Language Project). Teachers, who for the most part, have spoken Navajo since they were young, were trained in this program to teach younger Navajo students how to read and write in the Navajo language. They found great satisfaction in teaching Navajo students how to read and write in the language. They became empowered and were extremely proud and appreciative of their role in passing on the language to the next generation of Navajos. They used the local community in fairly innovative ways to teach students not just the language but also other content areas:

> The thematic unit "Dibe' lima At'e: Sheep is Life" integrates the world of Chinle Primary students with the teaching of mathematics...teachers discuss the use of visual models for measurement. Traditionally Navajos did not use cups, yardsticks, or any type of measuring tools. They used a hand to measure flour for frybread and estimated a day's travel not in miles or kilometers but in the length of a day on horseback or in a wagon. (pp. 20-21)

Dick et al. (1994) see some obstacles but have reason to hope for a successful bilingual program based on three areas of focus in teaching the Navajo language:

> Nonetheless, at the elementary school, positive change has occurred through restructuring: (1) the content of instruction or what is taught and learned; (2) the organization of instruction or the structures for classroom participation; and (3) the larger school context in which teachers and their students are able to take risks and to grow. Addressing all three areas has helped establish learning environments that are academically rich, intellectually engaging, and relevant to Navajo students' lives. (p. 44)

Bilingual programs are now staples in Indian-run schools. Language was and is a key issue in the move for local control. Bilingualism was inherent in the philosophy of a bi-cultural education. At first bilingualism was implemented to help students learn the English language more fluently. Life in dominant society required it. As the years have gone by bilingualism gravitated towards the preservation of the native languages. With the understanding that once a language dies so too does the culture from which it sprang educators in Indian communities have included teaching native languages in the formal educational setting.

Social Studies

Social studies was a fruitful subject area for the inclusion of Indian culture in the classroom. As we have seen in the initial push for curriculum development at RRDS, with the guidance of local Navajo people, seven books were created: 1. *Black Mountain Boy*; 2. *Denetsosie*; 3. *Coyote Stories*; 4. *Rough Rock History*; 5. *Grandfather Stories*; 6. *Navajo Biographies*, and 7. *Navaho History*. All of these dealt with various forms of history (I consider Coyote Stories and Grandfather stories and biographies forms of history). This tradition is followed throughout the years on the Navajo Reservation. The monumental work called *Between Sacred Mountains* provides an extensive look at Navajo stories and ties them into a coherent view of the land. It shows how communities can use their immediate surroundings both

in terms of culture and natural resources, to create a curriculum that pays homage to local community knowledge (Evers, 1986). Ray Yazzie, a member of the Rock Point Parent Committee, commented about the curriculum materials:

> This book is only part of a community effort to provide Rock Point children with relevant high-quality education. Rock Point School is a community-controlled "contract" school...Children at Rock Point learn to read and write in both Navajo and English...The three Rs are taught entirely in Navajo until third grade, although an intensive English as a Second language program prepares student for transition to largely English instruction after that. Science and social studies, however, continue in Navajo through junior high school, and much of high school social studies in Navajo as well. The traditional Navajo clan relationship system is taught in classrooms...Ideas for chapters come in many ways. Members of a parent committee submitted suggestions, listened to tapes of stories already collected, and offered feedback at regular intervals...Other grandparents showed similar interest in sharing with young people...Interviews are not limited to oral histories from Rock Point, and contributors to this book, both young and old, come from communities throughout the Navajo Reservation...Their viewpoints are not always the same, but their focus is always on the land and the lessons learned from it. (pp. ix-x)

The land is a teacher. Whether you are a scientist or a story-teller the land you inhabit quite naturally shapes your viewpoint. Deloria & Wildcat (2001) speak to this notion in *Power and Place: Indian Education in America*. Deloria & Wildcat (2001) assert that the personality of an Indian person can be equated to the sum of power and place. Power being the spiritual nature of all living and physical objects and place being the physical space in which one grows. In essence the 'Place' one lives can be viewed as a teacher and as such provides a relationship to individuals as they grow. The authors of the stories included in *Between Sacred Mountains* understood this well:

> This book tells about a piece of land, *Dine' Bike'yah*, Navajo Country. It tells how the land supported life, of the invasions and wars that have passed over it, and the economic, legal, and cultural questions touching Navajo land today.
>
> From hunting and plant gathering, to Anasazi history, to coal mining and the legal battles of the Navajo-Hopi Land Dispute, stories of the land are told by people from all over Navajo Country, or are put together for historical records. In

> each chapter, notes giving technical and historical background follow the stories...As the forces of ecology, economics, and politics have changed this land down the centuries, the people of *Dine Bik'eyah*, the *Dine'* themselves, have met the challenge of every age, and still do. (p. xi)

In the design of social studies curriculum on the Menominee Reservation the creation of vast amount of curriculum materials covering many topics including artwork, crafts, music, medicine, social living, legends and names of important waterways on the reservation occurred (Antes & Boseker, 1983). The belief is that these cultural materials can add to the cultural understanding of students studying them. In the long run this will help students come to appreciate their language and culture and be able to use them as sources of comparing and contrasting with Western forms of knowledge. Formal classroom subjects find context in the local community.

Curriculum under the umbrella heading "Social Studies"" is very broad. Government, geography, kinship, history, and family are tied together in this area of study. It is no wonder that this was a fruitful area for the inclusion of many aspects of Indian cultures into the formal classroom setting. This area was heavily dependent on local knowledge and as such was highly valued.

Science

In Many Farms, a science program called, Ethno-science was created. This form of science allowed aspects of the local cultural landscape to be used for scientific investigation and also for illustrating scientific principles (Snow, 1972). Snow (1972) describes and illustrates an infusion of Navajo culture materials as a vehicle for learning science at Many Farms high school. A Many Farms science teacher at the time incorporated local cultural materials found in the Many Farms community on the Navajo Reservation into his classroom. The author recognizes

the Navajo way of looking at the world in terms of how to live in the world as “being one in harmony with his environment" (p. 5) which in turn "makes his culture philosophically naturalistic" (p.5). Ethno-science is defined as using "American Indian technology blended with myth and the past and present life experience of the American Indian" (p.6). Essentially it is the use of traditional Navajo story in the teaching of scientific concepts, "Whatever the science taught, Navajo materials and attitudes will be used both in the lab and in class discussion" (p.10). Snow (1972) illustrated the learning of science in this fashion for the development of a "healthy self-concept for the Indian since he sees himself and his culture in a useful, beautiful and important perspective" (p. 8). This harkens to the already discussed idea that a healthy self-concept/high self-esteem are important in the education of the Indian student. The creator of Ethno-Science, Carl Hime at Many Farms states the long-term goal of Ethno-Science is to "fit the needs of the community by giving a better understanding of the environment of the reservation, to contribute to the ongoing development of Navajos both economically and socially and finally to contribute to the Navajo's self-concept and image" (pp. 8-9).

Karla (1975) looked at how the teaching of science to Indian students might be affected if there was an incorporation of not just the methods of science but also its history and philosophy and how it impacted Western culture. Kalra (1975) felt that science should be taught on three levels : "the fact, the concept, and the values level" (p. 22). This method of teaching was to be done so that Indian students could began to understand science as a cultural construct and thus, perhaps begin to see it as a part of their everyday lives "to develop pride in their scientifically rich heritage (technology) and in understanding the world in which they live" (p. 24).

Smith (1982) felt that since science is applied to a vast numbers of bodies of knowledge, it could be applied within the sphere of Indian cultures. Thus situating the teaching of science in

a student's cultural knowledge base could make the science more relevant and more interesting to students. This could help in highlighting the science within the student's culture. The author provides three examples of how this might work: In the classification of animals, Indian mythology and stories - to contrast with Greek and western stories, and in relation to astronomy and star-constellations (as he showed later in Smith (1984)). Indian people had ways of classifying animals. They also have creation stories and myths and used the stars as a way of keeping track of seasons. Northern Plains Indians used medicine wheels to do this (Smith, 1984).

The Difficulty With Developing Curriculum Materials

Developing specific tribal curriculum is not an easy task. At RRDS the process of creating Navajo cultural books required the hard work of local Navajo people:

> The Navaho people themselves are involved in the book project in six ways: First, Navaho adults tell the stories into a tape recorder; second, Navahos themselves select the areas in which the books are to be written; third, Navahos select the stories to be used in the book; fourth, Navahos translate the tapes from Navaho into English; fifth, Navaho artists illustrate each book, and finally, a Navaho evaluation committee determines their distribution and effectiveness. (Witherspoon, 1968, p.38)

The literature shows us the complexity and difficulty found in trying to bridge the Indian world and into the classroom (Johnston, 1974; Dearmin, 1977; Goodluck et al., 2000, Evers, 1982). In order to handle such a task, local Indian people have to take it upon themselves to create a way to compile and transform a mostly verbal body of knowledge into a form usable in the formal classroom. That is, stories have to be documented from traditional elders and tribal people; creation and personal stories have to be shared. In the case of creating an Indian music curriculum a vast array of people have to be aligned in order to make the curriculum both authentic and effective (Johnston, 1974). Not only do experts in culture and music need to be

available to guide the process but so too tribal music artifacts and music accessories and technology.

> We have dealt so far with eight essential steps of the program, namely, the provisions of: (1) historical information on Alaskan Indian musical performance; (2) tangible musical accessories via the use of authentic musical artifacts as models; (3) craft-instructors and craft-shops to produce these accessories; (4) taped sound materials old and new, together with relevant information concerning each item; (5) quality playback and recording equipment together with the training necessary to operate it; (6) printed musical transcriptions, together with explanatory booklets; (7) Kodaly classroom musical sightreading charts, and the scheduling of clinics to instruct in their use; and (8) the in-field training of Indian musicologists by University personnel. (pp.22-23)

Developing Native language programs, bilingual programs and science programs that have a cultural emphasis all run into the same issues when trying to get off the ground. They essentially have to take aspects found in oral traditions and change them into a written form capable of teaching young Indian students something of the culture and the specific content. Changing it from one form of knowledge that is oral to a written form comes with consequences akin to translating from one language to another. Something is bound to be lost in translation. It is easy to see that a tribal member with cultural knowledge and history, one who is versed in Indian tradition is by far a greater teacher of these cultural materials than a certified teacher unversed in the culture, who might wish to use the materials in his/her classroom. Without the cultural understanding and nuance in storytelling (and by extension in other ways of communicating cultural knowledge) much can be lost when relaying the information in a formal educational setting.

The school also has to pay heed to local customs in terms of what can be shared and when these things can be shared. Some types of stories for instance, among the Navajo cannot be shared except when there is snow on the ground. Certain songs cannot be sung in the

classroom and only certain people within the tribe can sing those songs. There also has to be a willingness from the community to allow schools to teach these types of cultural materials. Community members have to decide whether or not school is the place for some of this knowledge to be shared. Consensus on such a matter is not guaranteed. Thus what is appropriate for the classroom, who should teach it and how it should be taught are all important questions that need to be answered by the community before the materials actually find a place within the classroom. Some of these issues were discussed in Batchelder (2000) when surveying Navajo people about what aspects and to what degree of fluency Navajo language and culture should be taught in schools. She found that answers were a function of both age grouping and living situation on the reservation. Although both language and culture were thought by the vast majority of Navajo people to be appropriate areas of study in Navajo schools, there was not much consensus in terms of how this should be done and to what degree and by whom it should be taught. She found more agreement on these issues in pockets of local community members, that is, local community members agreed more in terms of the content and the functioning of schools in regards to teaching Navajo language and culture versus Navajo people across the tribe.

Conclusion

We begin to see curriculum described as "culturally relevant" (Churchman et al., 1975) when looking at how curriculum changed in Indian schools to meet the needs of teaching students about their culture and teaching them skills and values necessary for successful living in the modern age. It was the hope of teachers and educators implementing this curriculum that by doing this, students would come to understand the complexity of their own tribal knowledge and thus could feel proud about their heritage. It also offered students and educators the opportunity

to compare and contrast the Western worldview with specific tribal knowledge. Changes in curriculum included the infusion of cultural knowledge. This came in various forms. Sometimes this manifested itself in a direct one-to-one substitution of trivial "culturally appropriate" words for English words. For example, "A" is for "Apple," became "A" is for "Arrow" in a preschool classroom (Churchman et al.,1975, p. 10). In another instance, *Sally, Dick and Jane*, was viewed as a context too foreign for Navajo students to learn to read. The values these three unfortunate children reflected, white, urban and middle-class, did not sit well with Indian students who were poor, nonwhite, and rural, or so it was thought (Evyard & Mitchell, 1966). Sometimes it was a substitution of cultural events where typical American/Christian holidays were substituted with potlatches (Churchman et al.,1975).

As time progressed ideas about what to include in the dual purpose of education became more complex. Indian designs and art were seen in the design of the building or perhaps schools changed names to reflect this shift. We begin to see more complex ideas about the Indian worldview, his relationship to the land and stories about tribal history, myths and biographies taken into the classroom. Inclusion of the Native language was prominent and helped create bilingual programs in many schools. The progression continued as students began to read and write and think in their own languages in some communities (Goodluck et al., 2000).

Much of the early years of self-determination and its philosophy impacted local education a great deal. One need only walk into a current educational setting on most reservation/Indian community schools to see that the principles I have mentioned, which were discussed and implemented in Indian schools as early as 1968, are still present. The vast majority of Indian schools have culture and native language courses present. There is no question that these views impacted the curriculum offered to Indian students in these schools to try to meet the

philosophical needs of a "bi-cultural" education. We have seen the infusion of culture in various content areas. What was not readily a part of the discussion, in terms of curriculum, was how the mathematics classroom might include Indian culture. How and when was mathematics brought into this discussion? When it finally was included how might it have been impacted by these curricular ideas? Before setting out to answer these questions let's first focus on organizing what we have seen thus far in this literature review into a framework that I will call "principles of self-determination, which can be used to inform this current study on aspects of self-determination at the local Lakota community level.

Part I of Theoretical Framework: Self-Determination

We have seen in this literature review regarding the development of Indian educational self-determination and local control of education that soon after the AICC in 1961 calls for local control of education occurred. The subsequent push for local control that followed changed the direction of Indian schools. They would become Indian-run and Indian-centered. They would be designed to help students “live in both worlds” which stemmed from a “both-and” educational philosophy. To meet these goals, students would be educated in their own culture (knowledgeable and appreciative of tribal customs) and also educated to be successful in dominant society. This education would raise the self-esteem of Indian students – which was viewed as a major factor in educational success of the Indian student at the time.

This “bi-cultural” educational philosophy sparked the creation of a bi-cultural curriculum which included the use of the local community to create cultural curriculum materials. These materials included tribal history, art, government, myths, legends and aspects of the local ecology. Soon to follow the development and inclusion of these tribal specific cultural

curriculum materials was the infusion of the local Indian culture into content areas like the sciences, law, and music.

This development of self-determination over the years is important to this study because it provides a framework that can be used to investigate the development of self-determination at the local Lakota community context. All the factors seen in this literature review thus far will aid in answering one of the research questions mentioned in the previous chapter: How do local educators express self-determination in the educational process of their students? From the literature we can see that the following questions also need to be answered in order to get a good understanding of the overall impact of self-determination at the local Lakota community level: When did the push for local control occur? What was the effect of PL-93-638 have on the operation of the local K-8 school? How did local community members participate and influence the direction and purpose of the local school? Does the local K-8 school have a Lakota language program? Are expressions like "bi-cultural education" present? Finally, are local community members, seen as resources in the push for self-determination, involved in the functioning of the school?

For the first portion of my theoretical framework attention must be paid to all the important "principles of self-determination" that we have seen come to characterize the push for local control. These principles I will organize with the intent of using them in the overall theoretical framework (parts two and three to come later) to help answer the research question: How do local educators express self-determination in the educational process of their students? These "Principles of Self-Determination" include: 1). Schools are Indian run; 2). Schools are Indian-centered; 3). Schools employ a bi-cultural educational philosophy which includes, bi-lingual programs, an infusion of local culture in school structure and curriculum and attention

given to develop skills necessary for success in dominant culture; 4). Elders and community provide direction and purpose of school; 5). Elders and community members are involved in the creation of curriculum materials; 6). Students are knowledgeable and appreciative of local Indian culture (evidence of language geared to self-esteem/self-perception of students and 7). Local control of schooling (as seen in PL-93-638) meant to strengthen tribal governments by developing "qualified people for leadership roles."

Curricular Innovations II: Mathematics in Indian Education

As we have seen, changes to curriculum followed the rise of local control in Indian communities during the era of self-determination. Noted was the more culturally-specific context infused into content areas that were typically Indian-free. Also noted was the development of tribal-specific curriculum and the time and effort needed to make such materials. Examples of this form of curriculum emerged in the content areas of the social sciences, art, music, science and of course the inclusion of space within the schools for Native languages and cultural activities. Reasons for the inclusion of such curriculum material and content included the perceived need for Indian children to come to know and appreciate their culture. This understanding, it was thought, would help their self-perception, which in turn, would lead to greater academic success. It was also thought that this form of education would also lead to greater employment opportunities for the Indian.

The look at these content areas over time was necessary because it clarified the overall impact of self-determination and local control on curriculum used in the schooling of Indian children. It also provides a framework from which we can analyze the current educational philosophy and implementation of self-determination at the local level. This framework informs us that if self-determination were to impact the teaching and learning of mathematics in Indian

communities at the local level then both culture and language should be present in the math classroom. It will be seen in the next part of this literature review, which centers on the development of mathematics in Indian education, that some of the same reasons given for the creation and movement of culturally based curriculum in other content areas in Indian schools forms a basis for the changing of mathematics teaching and learning at the local Indian level. What also will come to light is that this may not have occurred at all if it wasn't for the outside influence embodied in the research field of ethnomathematics. The reason for this has to do with the way in which ethnomathematics, which is concerned with the cultural influences impacting mathematics and mathematics in cultural activities, changes the perception of mathematics in general. As a result mathematics is fluid, living and as D'Ambrosio (2007) states, "demystifies" mathematics.

Mathematics in Indian Education: Late to the Game

In the literature describing the intersection of mathematics education and Indian education we see that mathematics in Indian education was the Johnnie-come-lately to curricular innovations. Mathematics as a content area was not given much thought during the formative years of curriculum development during the initial push for self-determination. Articles on mathematics and Indian education in the 1960s were non-existent. In the seventies they were passing thoughts. Scott (1983) is the first article that dealt with any topic in the realm of mathematics published in the *Journal of American Indian Education* (JAIE). This article appeared a full twenty-two years after the creation of JAIE. Prior to the 1980s there are very few records that chronicle any, much less, heavy, discussion around mathematics and Indian education.

In the 1980s, with the development of ethnomathematics as a field of study, growing interest in the intersection of mathematics and Indian cultures surfaced. It wasn't until the late 1980s, with an educational foray lead by Jerry Lipka and Yup'ik educators into Yup'ik Eskimo culture, that we begin to see a process by which mathematics as a content area could change with the influence of a local Indian community. Lipka's work eventually settles on learning mathematics through Yup'ik Eskimo survival/subsistence practices and remains one of the only, if not *the* only, look at the continual development of mathematics teaching and learning within a specific Native community. Incorporated throughout the course of Lipka's work is an integration of self-determination principles (local control, the local Native language, purpose of education, local context for curriculum, the use of elders as sources for curriculum development, culturally relevant pedagogy) and ethnomathematics over time.

Rather than give an historical account of the development of math in Indian education I want to continue the focus of the impact of self-determination on mathematics at the curriculum level. This means that I will look for evidence of the inclusion of the local Native language and pay attention to how the local context influenced the direction of mathematics education in Indian country. What were the reasons given for the perceived need in the change in direction and who was involved in this process? What the reader will notice as we progress through this portion of the literature review is that we are essentially retelling the story of the push for local control that occurred in the 1960s and 1970s in other Indian communities. The big difference now is that math as a content area, since it was so late to the game, has taken center stage in the push to redefine education for the purposes of the local community. What also will come to the surface is that this story we are telling about the development of mathematics in the local Native context is really the story of defining a purpose for the teaching mathematics coupled with the

development of mathematics curriculum in the local Yup'ik Eskimo community. Thus the content and context has shifted from the early years of Indian educational self-determination from content non-Mathematical to mathematics. The content changed but the essence of the story is the same.

The Early Mathematical Language in Indian Education

The earliest language concerning mathematics and Indian education dealt with difficulties Indian students had in math achievement. "The underachievement of students in mathematics, however, is a problem common to most Native-American tribes" (Cheek, 1984a). Scott (1983) compared mathematics test scores in arithmetic between Anglo students and Pueblo students in New Mexico and Trent & Gilman (1985) followed with reasons that could have explained low mathematics test scores among Indian students living in Nevada. Other early articles pointed to possible ways in which to improve success in learning mathematics among Indian students. In response to low math achievement Cheek (1984a) looked ahead at the type of research that she thought was necessary to help students do better on standardized tests and Bradley (1984) centered on three areas that might help students perform better mathematically: Instructional strategies, curriculum and evaluation, and teacher centers in schools. Cheek (1984b) approached ways to get students interested in math and science related fields. Schindler & Davison (1985) pointed at the possible benefit of teaching Indian students cross-culturally and really is one of the first articles dealing with the possibility of using the local Native language in teaching mathematics to Indian students, "Research suggests that any classroom that may contain children whose dominant language is not English, needs to have a teacher who can analyze the dominant language of these children..."(p.27).

Thus, mathematics became part of the discussion in Indian education during the first half of the decade of the 1980's because of concern regarding student achievement. Once the problem was expressed solutions for countering this lack of achievement in mathematics began to surface. Part of these solutions pointed to the integration of language and culture (Schindler & Davison, 1985). Culturally based programs in mathematics and pedagogical practices are among the suggestions for future research to meet these lack of achievement in mathematics for Indian student.

> Researchers need to examine the process of developing a culturally based mathematics curriculum. Approaches should be identified that have proved successful when tribe and school have worked together on similar projects in other disciples. Questions that should be explored include: How much formal mathematics education do community members need to work successfully with the school? Must teachers also be tribal members?...What attributes of the school and the community are most important in developing a successful program? (Cheek, 1984a, p. 109)

Ethnomathematics

Culturally based mathematics programs and mathematics defined by local Indian contexts were non-existent prior to the mid-1980s. The rise in discussion of the teaching of mathematics in Indian communities helped push research into this area but it wasn't until the formulation of developing ideas within the field of Ethnomathematics that what this might entail crystalized. This developing field was a significant impetus for the mathematics research that would develop later in Indian communities. Ubiratan D'Ambrosio, a Brazilian mathematician, began the discussion around non-Western mathematics in the late 1970s. D'Ambrosio classified ethnomathematics as a field of study that lay in the intersection between anthropology and mathematics: "Making a bridge between anthropologists and historians of culture and mathematicians is an important step towards recognizing that different modes of thought may lead to different forms of mathematics; this is the field which we may call 'ethnomathematics'"

(D'Ambrosio, Feb, 1985, p.44). With the development of ethnomathematics as a field of study, and with the intent of "...collecting examples and data on the practices of culturally differentiated groups..."(D'Ambrosio, Feb, 1985, p.47) a foray of research into indigenous cultures across the globe occurred. The purpose for this effort was to seek various forms of mathematics embedded in cultural activities and contexts - the effect of which broadened the notions of what mathematics constitutes.

Before continuing the look at the development of mathematics influenced by the local Indian context we must describe ethnomathematics briefly since it has a heavy influence on what mathematics in Indian cultures comes to embody. What we find is that ethnomathematics helped change the perception of mathematics from one that was centered on certain processes (algorithm, proof, and structure) to one that is embedded in all cultures and as such is present in cultural activities the world over. These are important to note since mathematics has had the perception of being "above culture" and therefore accessible only in certain ways - this we will seems to be a major reason why mathematics continues to be the least impacted content area in Indian education.

In a discussion on ethnomathematics Ascher and D'Ambrosio (1994), both considered pioneers in the field of ethnomathematics, spoke about the impact of this field on the perception of mathematics. "Through the work with the quipas and your further work in other cultures you were able to generate a new conception of mathematics" (D'Ambrosio, p. 37). This came on the heels of the understanding that mathematics itself is not definitively defined even by mathematicians.

> I (Ascher) concern myself with mathematical ideas. That focus on, and talks to, what people have in common. Those ideas have to do with number, loci, and spatial configuration and, very important, the combination or organization of those into systems and structures (p. 37).

In essence this view of mathematics, broadly defined allowed for an inclusion of mathematical activity and thought found in other cultures and also showed that mathematics "is more than technique" (D'Ambrosio, p. 37). What this did was to allow the bridge between activity and what most people consider mathematics - abstract, rigid and done a certain way and in certain places. "The carpenter is definitely dealing with mathematical idea; the mathematician who set those strictures on the problem was dealing with an idea. They are *both* important, but they are *different*. And, they are *linked*"(Ascher, p. 38). (Her emphasis)

The next thing to realize is that ethnomathematics brings back into the mathematical equation the notion of context and culture. Mathematics did not develop in a vacuum. It was created, revised, redone, reshaped and added onto for more than three millennia by many cultures including the Greeks, the Babylonians, the Egyptians, the Arabs and Western Europeans. So when we think about mathematics, how it is taught and perceived, especially in relation to culture we realize it permeates everything; it is everywhere and as such everyone engages in mathematical activity. "Ethnomathematics relates to life in all its aspects. Indeed, it is a description of the evolution of mankind through diverse ramifications - that is, the civilizations, communities, families and individual. This calls for deeper recognition than is found in most anthropologies" (D'Ambrosio, 1994, p. 39). Barton (1996), in highlighting the development and changes within the field of ethnomathematics, especially in the efforts of Ascher and D'Ambrosio, and including the efforts of Paulus Gerdes, a Mozambican mathematician, speaks to the importance of giving mathematics cultural connections/contexts, "Acknowledging the cultural component of mathematics will enhance our appreciation of its scope and of its potential to provide an interesting, artistic and useful view of the world" (p. 229).

With the field of ethnomathematics now defined (though its scope has changed and been redefined over the years to impact mathematics education and the politics that surround education (Barton, 1996)) many mathematicians and educational researchers began the study of mathematical cultural practices the world over. Knight (1984) looked at the geometry in Maori art. Gerdes studied mathematical concepts in Angolan designs (Gerdes, 1988a) and geometrical thinking in African cultures (Gerdes, 1988b, 2005). Graham (1988) looked at mathematics education of Aboriginal children and Ezeife (2003) saw the context of the land around the aboriginal peoples in Australia as a key context for the teaching of science and mathematics. In the context of locating Turnbull (1991) looked at the practices of Micronesian navigators. Selin (2000), provides a compilation of research on mathematics in non-Western cultures across history and Ascher (2002) looks at mathematics found in small "traditional" cultures. Finally, When ethnomathematical thought turned to mathematics not just in non-Western cultures but situated outside of the math classroom the focus centered on non-formal uses of mathematics such as study of "street mathematics" (Nunes et al., 1993). This literature provides, if nothing else, more proof to the notion that we all, the world-over, engage in mathematical activity.

Categorization of cultural mathematical activities

Now that mathematics was resituated in culture (and as such found in all cultures) and the realization that we all do mathematical activates on a daily basis in various contexts it became important to decide what activities constituted mathematical behavior. The categorization of cultural mathematical activities from which to analyze non-Western mathematical contexts was described in D'Ambrosio (1985). He had classified the following activities as ethnomathematical in nature: "counting, measuring, classifying, ordering, inferring, modeling..."(p.46) and in doing so presented a framework from which to analyze mathematical activities in non-Western

cultures. Bishop (1991) proffered a slightly different categorization of mathematical activities used to help develop mathematical thinking. These were termed the 'six universal mathematical activities.' These activities included counting, locating, measuring, designing, playing and explaining. Bishop (1991) spoke of the importance of these activities in developing various aspects involved in mathematical thinking:

> ...counting develops number language, number imagery and number systems, locating develops spatial language, images and coordinate systems, measuring develops the language of quantifiers, units and measurement systems, designing develops images, shapes and geometrical ideas. Playing seems to develop the idea of 'game.' (p.44)

Ethnomathematics and Native American cultures.

These classification systems are important because they give researchers frameworks useful in analyzing the mathematics embedded in non-Western cultures. These classification systems have provided researchers studying Indian cultures a bridge by which the discussion of tribal-specific mathematics can begin. Two examples come to light - Bishop's (1991) categorization was used by Barta et al. (2001) and Barta & Shockey (2006) to analyze mathematics in the Shoshoni and Northern Ute cultures, respectively. In a study in Africa the same categorization of mathematical activities (Bishop, 1991) was used by Sternstein (2008) in looking at mathematical activities in the Dan culture in Africa. We also see evidence of these ethnomathematical frameworks in the work of Lipka. In Lipka (1994a) we see descriptions of the Yup'ik Eskimo counting system, the geometry in the designing of Parkas and the importance of abstract symbols in 'story knifing'. It is Bishop's (1991) framework from which I will analyze the Lakota culture in this study to develop a description of Lakota mathematics.

The mid-1980s marks the formal marriage of mathematics and Indian cultures as defined by ethnomathematics. Closs (1986) provides the first work describing this intersection. In his

seminal work he analyzes counting systems, calendars and geometry used by indigenous peoples of the Americas. In other research concerning mathematics and Indian cultures we see many other cultural practices from various tribes emerging over the years. Pixten et al. (1987) investigated geometry in Navajo cultural activities, thought and spatial representation for the purpose of instituting a bi-cultural education on the Navajo reservation. Some of the contexts in this work included looking at the rodeo, the hooghan, herding sheep and weaving rugs. From other Southwest contexts comes a look at petroglyphs (Moore, 1988a) and string figures (Moore, 1988b). Lipka (1989) began his work with the Yup'ik about this time searching for a context for which to situate the purpose of his work in Alaska. He found the context for mathematical content in Yup'ik culture.

Before moving into the later years of the development of ethnomathematics and Indian cultures it is important to note the relative sparseness of material up to this point concerning Native American cultures and mathematics in the literature, even though a few studies in the 1980s were conducted. It seems that the development of this area was relatively slow but eventually came to include more and more research on mathematics in Indian communities.

From the 1990s onward more studies developed and more thought was given to mathematics in Indian education. The topics researched were widespread and not wholly tribally specific. Hankes (1998) looked at two Native languages, the Lakota and the Oneida languages, while looking at place value and multi-digit numeration. From the Plains Indian tribes we see two articles analyzing the structures and mathematical properties of tipi's, Souhrada (2001) and Orey (2000). Also seen from Plains Indian cultures was the use of beadwork (Barkley & Cruz, 2001) and star quilts (Nueman, 2003) to teach geometrical concepts. Indigenous art is used to help classify Frieze designs (McDonald & Weston, n.d.)

More recently Engblom-Bradley (2006) looked at one Yup'ik Eskimo's navigational practices to show connections to the mathematical activities of measuring time, position and direction to help document a very basic survival skill necessary for travel across the Alaskan tundra. Eglash (2009) investigated Native-American designs and saw aspects of the Cartesian coordinate system and (Rauff, 2009) analyzed dice games from some Native American cultures as contexts to study probability. Finally, the use of some of these Plains cultural contexts, especially seen in aspects of the powwow is found in the curriculum offered by the Montana Office of Instruction (Montana Office of Instruction, n.d.).

The analysis of Native American cultural practices and activities are a trend that has gathered much steam late in the age of self-determination and are becoming more and more prevalent in the literature concerning Indian education. It is evident that Indian cultures and their educational practices and cultural activities have gained the attention of mathematics educators since the mid-1980s and they continue to be contexts for inclusion in the field of ethnomathematics.

Native Languages and ethnomathematics

Since one of the important facets of self-determination and local control is the maintenance of culture and language what purpose or role might Native languages play in looking at mathematics in Indian cultures (since we have already seen how aspects of culture have been included)? For the most part the research is quiet on this topic. Hankes (1998) did look at the ways in which the Oneida and Lakota expressed numbers in the language, and its inclusion in the teaching of Yup'ik students is discussed in depth in Lipka (1994b) and among his constituents (Lipka & Mohatt,1998). Barta et al. (2001) and Barta & Shockey (2006) each looked at the use of the language to classify objects, numbers, etc. but did not mention the

importance of the using the language to teach mathematical concepts. Lipka (1994b) looked at the power struggle and politics involved in using the Yup'ik language to teach mathematics. In his work we see that the teaching of mathematics in the language comes with some logistical issues, for instance not all teachers who teach in the mostly rural areas of tribes in America are from the tribe and therefore not typically able to speak the language let alone teach mathematics in the language. Also there is a struggle within the Yup'ik community as to whether or not the Native language should be used in the formal classroom in the first place (Lipka, 1994b). As we continue to see the push for self-determination aspects of local control into the mathematics classroom, of which the inclusion of the native language is deemed important, one cannot help but note the absence of mathematics curriculum material written and made available in the local Native language.

Jerry Lipka and the Yup'ik Community

Our focus now centers on Jerry Lipka, Yup'ik educators, and the Yup'ik people in the development of the *Math In a Cultural Context* curriculum. The attention given to this culturally based mathematics developed from the collaboration of researchers educators and community members is justified on two counts: First, since the late 1980s it is really only Lipka that has documented widely the issues, struggles, successes and the voice of a local Indian people in the push for the inclusion of culture by way of mathematics. Thus we see the many principles of self-denervation, which I classified earlier, included in this movement. Secondly, there is not much else in the literature dating from the late 1980's that deals with the intersection of mathematics in Indian education (outside the few ethnomathematical studies done in various tribal contexts mentioned earlier), especially as we move through the decade of the 2000's. From a sheer numbers perspective, Lipka, the people he has worked with and studies that center on the

effectiveness of his *Math in a Cultural Context* (*MCC)* curriculum encompass the vast majority of articles since 1989 that deal with Mathematics and Indian cultures.

Lipka's early work and the genesis of his ideas

Lipka began working with the Yup'ik in 1981 while a tutor in the Native teacher education program called the Cross-Cultural Educational Development Program (X-CED), a program designed to increase the number of indigenous teachers in Alaska. It was during this time he cultivated relationships with the Yup'ik community and Yup'ik educators who would help him much in his future work. In Lipka (1989) a framework for "culturally relevant curriculum" development was sought and soon found in the political and economic needs of the village, which at the time was trying to come to a consensus on how best to set up a form of government. Lipka wrote:

> ...more important than any expressed concern was the overriding sense of a people attempting to determine their own political agenda. Although schooling was not at the forefront of these political concerns, it was obvious that the same principles of self-determination would best work in the process of schooling. (p. 225)

In a case study Lipka (1991) illustrates a Yup'ik form of culturally based pedagogy by way of observing the teaching practices of a Yup'ik Eskimo teacher. A theme throughout Lipka's later work was developed here which centered on the importance of curriculum and pedagogy. If culturally relevant curriculum is to be produced, then perhaps a culturally relevant pedagogy would best be suited to teach such a curriculum. In this article a Yup'ik teacher is highlighted using teaching methods not generally seen in the teaching practices of the general public, "...a combination of demonstrating and modeling while speaking and supporting group cohesiveness and student self-reliance" (p. 207) occurs. This teacher "expected the children to follow the demonstrations (instead of depending on verbal instruction) (pp. 213-214)." Even though the

article was about one Yup'ik Eskimo teacher's way of teaching to Yup'ik children it is here that Lipka begins to see a real basis for curriculum development: "the cultural values of survival, knowledge of the land, and subsistence clearly emerge" (p. 215) and "However, the hidden curriculum in this lesson is about survival, patience, care, and doing things properly…the teacher is using shared cognitive knowledge related to subsistence and survival, …is conveying knowledge in a culturally appropriate manner through modeling and parallel work" (p. 218). This theme emerges over and over in his work and is really the impetus for *Math in a Cultural Context*. Not only is the theme for later curriculum development found, but also a theme for a pedagogical manner. This form of pedagogy would be classified as an "expert-apprentice model" (Lipka, 1994b).

In Lipka (1994) there is not consensus in the community that teaching in a "Yup'ik way" or including the Yup'ik culture and language in the curriculum is the correct way to educate their youth. The community is divided on the topic:

> In addition, it furthered a growing schism between Yup'ik teachers and some Yup'ik regional board members who are increasingly supportive of English as the language of instruction. The power of English and Western culture is not lost on board members...The board members did not see the relevance of using Yup'ik culture and language in the process of schooling. (p. 275)

Despite the increasing chasm within the community on the issue of curriculum and language Lipka remained optimistic. His optimism can be attributed to the rise in elder participation in the research he and his constituents are conducting. Elders prove to be a valuable source of information and really provide deeper cultural understanding to contexts for school curriculum. "In short order, the group, now strengthened by elders, became a community inquiring into there own cultural practices and the ways those practices could form a basis for schooling" (p. 276). Having elders aboard provides credibility to the effort and their backing of

the research cannot be underestimated for it is really their understanding of the culture that is legitimate. Their talks with the elders help frame future contexts for the development of curriculum.

In Lipka & McCarty (1994) the beginnings of the use of subsistence and survival activities and methods as contexts for mathematics are described. Included in this activities are Fish Camps (which ultimately becomes one of the units in the *MCC* curriculum) and weather patterns, and the Yup'ik number system where song and dance were used to help teach children how to count to 20 in the Yup'ik language. Elders also inform children on not only how to survive and be self-reliant but also how children are to be concerning themselves with the "right behavior" in various cultural contexts. The die is cast as far as his future work with the Yup'ik is concerned: "We believe the potential exists for recreating an entire elementary mathematics curriculum based within Yup'ik cultural knowledge and ways of knowing..." (Lipka & McCarty, 1994, p. 276).

The influence of and attention given to Yup'ik elders as cultural resources for curriculum development is illustrated again in Lipka (1994a). Elders continue to be the generators of ideas for the "*Ciulistet*" group (a group of Yup'ik teachers). Fish camps, forecasting weather, making parkas, understanding the base-twenty, sub-five Yup'ik number system, basket making, and story-knifing all become cultural contexts from which Lipka's mathematics curriculum continues to evolve. Parka deigns and basket weaving form a geometrical context, the Yup'ik number system is seen to have been based off of the human body and provides a natural coordinate system from which to measure. It also shows the influence of outside cultures on the Yup'ik since this number system only goes to the number 400 within the language and struggles onward in the Russian language.

The reasons for this form of curriculum development and the push to have the local culture included in the schooling of Yup'ik children were "(1) to show students that mathematics is socially constructed; (2) to engage students in the process of constructing a system of mathematics based on their cultural knowledge and (3) to connect students' knowledge of "their mathematics" through comparisons and bridges to other aboriginal and Western systems" (p.25). These reasons and indeed these contexts used for the development of a bridge between Yup'ik culture and Western mathematics are reflective of the thoughts we saw earlier with the work of D'Ambrosio and also parallel self-determination principles we have seen in the development of other curriculum content, especially the need to know and appreciate one's own culture and the allusion to a bi-cultural understanding - in this case of mathematics.

Lipka (1994b) again tackles the issue of language, specifically looking at the following questions: What language should be used to teach Yup'ik children? and When should the language be used as the primary language of instruction? Also presented are the politics and division in the community surrounding the use of Yup'ik language in the instruction of Yup'ik children. The discussion comes with a heightened sense of urgency given the fact that as the years go by fewer children are able to speak the Yup'ik language. Is it the schools responsibility to preserve the language in the community or is it the parents' or is it both? "Our language is part of our identity: [It is] a part of ourselves. We can work out ways to keep the language and be successful in the Western world (p. 82)." Here again, is an allusion to a bi-cultural education, one in which the students are knowledgeable about their culture and language and are also able to live and prosper in the White man's world. Obviously language is a key ingredient in understanding one's culture and if the preservation of that culture commences then it only follows that the continuation of the language should be a part of that push.

Deeply embedded in the structure of the school is the purpose of the school. In Indian educational self-determination, culture and language take center stage, providing the purpose for the schooling of children. In the Yup'ik Eskimo communities it was deemed the time to get language and culture into the "formal" education of students. This decision did not come without controversy: "The part of the dialogue opened a deeper internal conflict within Manokotak concerning the future of being a Yup'ik, and this conflict centered on the issue of language and instruction" (Lipka, 1994b, p. 90).

The voice of the Yup'ik and the connection to culture/community

Lipka & Mohatt (1998) provide an in-depth look at the issues that had emerged in the first seventeen years worth of work and collaboration between Lipka and Yup'ik educators. In a sense it is a rehashing of the articles we have seen thus far from Lipka in that it revisits the purpose of the *Ciulistet* group - the Yup'ik educators with whom Lipka worked. In this book two Yup'ik educators write about their experiences in trying to bridge Yup'ik culture and language and the schooling of Yup'ik children. Rifts within the community are presented and first-hand experiences show the difficult task that invariably follows from the implementation of Indian culture into the classroom. The book gives a deeper look at the process of creating culturally based curriculum and the impact of collaboration with the community. It shows that once elders buy into the idea of including culture in the schools the movement gains validity. Along with these struggles, successes and efforts is the continual development of the *MCC* curriculum.

The important facets of Lipka & Mohatt (1998) are the push for local control and the impact this had on the community as well as the obstacles and sources that come along with the development of local curriculum. It documents also, through the voice of teachers in the *Ciulistet* group, issues and obstacles that arose in their own personal push to get the inclusion of

their culture into the school. It also documents the perceptions of the community that these teachers were something less than a true teacher because of their furthered education. "By going to college, some of the people would comment that I was becoming a *Kass'aq* (white person). That was hard to take" (p. 51). In addition it documents issues of language again and the struggle to have it implemented as a subject in the schools and also to become a part of the way in which school content is taught.

Sharp, a Yup'ik teacher at the center of the push, lists many reasons why the Yup'ik language should be included: "I appreciate my language more now because I am proud to see the confidence in my students' learning. They know when to switch language and types of speaking in terms of to whom they are speaking" (p. 58). In response to a Yup'ik skeptic Sharp replied, "But you did not listen to how it is taught and how it can be helpful to the students...But to teach the old ways - if something happens to them in the wilderness they will not know how not to be hungry. That is why we are teaching" (p. 57). Finally, Teachers can now use their mother tongue with pride to teach the highest concepts and for the benefit of the tribe and the survival of their students.

In this short look at Lipka's early work a few things must be noted. First, Lipka showed how the local culture and the wishes of the local community impacted the direction his work would take. These influences impacted both the direction of the school, the types of curriculum that would be developed and the inclusion (or not) of the local Yup'ik language. All of these community influences are part and parcel to the movements we have seen in local control in other contexts (The Rough Rock Community, for instance) - in essence they are natural consequences of the push for local control. The next thing to note is the use of elders as educational resources. Lipka and the *Ciulistet* group learned and were guided by the directions

found in the topics shared by Yup'ik elders. "The elders were naturalists and they wanted to help because their children would become teachers" (Agroborealis, 2009, p. 4). The elders had an inherent understanding of the language we saw in PL-93-638, that is this form of education, locally crafted, would impact the future of the tribe, as such attention needed to be paid to producing children who would one day become leaders of the tribe. Finally, because of local influence, it was decided that curriculum would reflect a theme that came up over and over in the community - survival, both cultural and individual. Lipka's efforts began to take shape in the form of mathematics embedded in the Yup'ik cultural subsistence activities, seen next in a look at the culmination of all this effort, *Math in a Cultural Context* curriculum.

Math in a Cultural Context

The work done by Lipka in his early involvement with the Yup'ik Eskimo in Alaska pointed towards the creation of culturally based curriculum in mathematics. It centered at first on issues of self-determination, tribal government and the local economy. In the early stages it dealt with issues of language and teaching the Yup'ik way of life in the formal educational settings. It was deemed necessary as Lipka looked for contexts for culturally relevant curriculum that a culturally relevant pedagogy be created. Yup'ik elders became involved during this time. In the work with Yup'ik elders various contexts arose (story-knifing, designing patterns, navigating etc.) as possible cultural contexts for curriculum development. Survival and subsistence activities surfaced as the major theme for curriculum development. All of these factors - local context, influence of elders, the push for culturally relevant curriculum and pedagogy culminated in the creation of *Math in a Cultural Context* (*MCC*). Currently *MCC* is being tested and is used in classrooms in local Native Alaskan classrooms as well as in urban settings (Kagle, 2007; Rickard, 2005).

Survival as the Key

Survival as a mathematical context for curriculum development would not seem a logical choice. When one thinks about survival one does not typically think of mathematics. However, when thought about through an ethnomathematical lens one begins to see the possibilities. Isn't there present many mathematical activities in the process of surviving? For instance is not the geography of a certain area important in locating - knowing where you are situated, what types of resources are available and what is in that location that can help one find direction? In moving from place to place, especially in the wintertime, paying attention to distance and time, rates and seasons becomes important. These factors imply paying attention to the sun during the day and the moon and stars at night - all important facets in the very serious game of survival. Teaching the younger generations to read the signs found in nature, from the direction the grass lays under the snow to the rippling effect of the small waves on top of the snow, to finding the cardinal directions as a function of time and stellar positions can point one back home if he knows they exist.

> In my community, we have cultural values that are passed down, and we use these values in learning survival skills in our community. For example, we are taught how to work in groups. One of the skills that we do in groups is hunting. It is very unusual for one person to go hunting alone because a lot of things can happen to him…Whereas if that hunter went with a couple of other men, they would help each other in trying to survive. (Lipka & Mohatt, 1998, p. 124)

Use of Elders

Lipka and his constituents, once they understood that the overriding cultural theme in the work they were doing with the Yup'ik to be centered on survival practices, looked no further than the group of people in the Yup'ik community who had deep knowledge of these activities - the elders. The reliance on the elders for the development of curriculum materials is a phenomenon

that has been mentioned a few times in the literature regarding the building of curriculum materials for other content as well.

> From the elders it has become increasingly clear that Yup'ik "mathematics and science" or ethnomathematics originate from the knowledge required to survive and to live a long life in the harsh and unforgiving subarctic. Under these circumstances, elders have passed along a tradition in which empirical observation of minute changes in the physical and biological environment can mean the difference between life and death…the elders shared their way of seeing the world, which provides us with another set of tools to understand the world around us. (Lipka & Mohatt, 1998, p.145).

So it was that elders were mined for their cultural knowledge. The process of gathering information included meetings between elders and Lipka and Yup'ik educators. In these meetings elders explained and demonstrated survival activities. Lipka and the Yup'ik educators involved observed and then took part in the demonstrations.

> Through demonstrations and explanations, this group of elders conveyed cultural knowledge around topics as diverse as how to build a kayak, how to design and sew a border pattern, and how to navigate using the stars. From approximately 1995 to 2002, we had two to three meetings a year with Yup'ik teachers and elders...fewer meetings with elders from 2003 to the present. We joined the elders and teachers in building fish rack and making model smokehouse. (Lipka et al., 2009, p. 264)

Finally in the work with the elders and mathematicians and local educators the connections to mathematics from a cultural perspective is made explicit.

> ...through this process of revealing, elders taught those of us involved in the project, and we began to appreciate the mathematics embedded in everyday activities that included: ways of measuring, numerating, estimating, designing, patterning, locating, and navigating (Bishop, 1988) as well as way of communicating and instructing. (Lipka et al., 2009, p. 265)

It was through this process, gathered from the people then analyzed and woven with mathematics, that the MCC curriculum came about. As a result the culture of the Yup'ik Eskimo

found its way into the teaching and learning of mathematics in the formal classroom. Lipka et al. (2005b) described their curriculum in the following way.

> MCC is also a direct response to the top-down authoritarian ways of teaching mathematics, in which there is one right answer and usually only one way to find it. Associated with the one right answer is a classroom discourse style of the teacher initiating questions about known facts, students respond and the teacher evaluating student's responses. Through the development of MCC and work with elders and reform-oriented math educators and mathematicians, we have developed math as problem-solving...They "discover" mathematical principles and properties because the curriculum design, mathematical tools, and familiarity with the activities are structured so that students of different abilities and inclinations can learn in different meaningful ways and at different levels. (p.3)

Goals of MCC

The goals of MCC are posted in the MCC website (Math in a Cultural Context, n.d.): (1) To improve the math performance of elementary school students, especially Alaska native students; (2) to provide professional development to Alaska school districts; (3) for school districts to adapt and adopt MCC modules; (4) to research the effectiveness of the modules in improving students' math performance and (5) to study contextual factors that contribute to the effectiveness of implementing MCC. What is most interesting here is that this curriculum, which at first was concerned with the local Yup'ik context now is considered a curriculum which can benefit the teaching of all students in the state of Alaska. It is also open, as stated, in the professional development of all teachers across the state, providing a platform to help teachers come to understand the Native Alaskan cultures as well as how to approach mathematics from a different lens. All students and all teachers are welcome to use the *MCC* materials in various settings, rural or urban, Native Alaskan or not.

These goals, centering on the inclusion of the non-Native Alaskan community were not the original intent of the development of mathematical curriculum in local Native Alaskan

communities; at least they were not present in the early developmental stages. So it is interesting to note the expansion of the influence these curriculum materials have undergone. With this change in scope one begins to wonder about the reasoning behind the move out of the local context. These materials may be of value to educators in that they not only help bridge the historical divide seen between Native students and the learning of mathematics, by providing the local culture and context, but also can be a bridge between non-Native teachers and the Native community/culture. This harkens back to Bayne's (1968) thoughts on why the inclusion of local Indian cultural artifacts would be beneficial in some regards.

Lastly this form of mathematics is not something most teachers of math would consider mathematics - it requires, as we have seen as a consequence in the development of ethnomathematics, a change in the perception of what constitutes mathematics. Kagle (2007) speaks to some of these ideas as she describes the professional development component that comes with using MCC curriculum materials, "A primary goal of the professional development was to expose teachers to mathematics as embedded in its social context" (p.15). Later she states, "Elementary teachers of mathematics are often in need of support in learning mathematical content, especially given the open-ended and problem-solving approach of reform mathematics" (p.16). She also ponders the teachers' experience with Native communities and cultures.

> The teachers had a positive response to this approach and we experienced none of the resistance by teachers to the culture cited in the literature...I believe this enthusiasm was due to the fact that these teachers...live and work in isolated Native villages where they are in the minority with little contact with their own culture. Given these circumstances, they have a compelling need to understand the culture around them. (p.16)

The impact of *MCC,* seen now as not just a local phenomena but one that can bring the larger community together across the state of Alaska provides credence to D'Ambrosio's thoughts concerning one of the reasons for developing the field of ethnomathematics, "Ethnomathematics is increasingly recognized as systems of knowledge, which offer the possibility of a more favorable and harmonious relation in human behavior and between humans and nature" (D'Ambrosio, 1999, p.35). The goals of MCC are now broad and universal even though it was locally built from the Yup'ik Eskimo community.

Description of MCC

We have seen the inspiration for and the development of MCC curriculum but what constitute*s Math in a Cultural Context*? Derived from the Yup'ik community, especially from elders in the community, MCC is a ″series of modules that are intended to supplement a complete K-6 mathematics curriculum and explicitly connect important mathematics with the culture and knowledge of the Yup'ik people" (Rickard, 2005, p. 81). They consist of various units, each taking approximately six weeks to complete. All units "have accompanying stories that connect cultural context and the specific cultural activity...such as berry picking, pattern making…to specific mathematics topics such as data collection and analysis, geometric patterns, and numeration" (Lipka et al., 2007, p. 101).

As time has gone on new units have been added to the curriculum. Currently there are ten supplemental MCC curriculum units consisting of the following titles, subjects and grade levels: (1) "*Picking Berries: Connections Between Data Collection, Graphing and Measuring*, (2nd-3rd Grades), (2) *Going to Egg Island: Adventures in Grouping and Place Values* (1st- 2nd grades), (3) *Patterns and Parkas: Investigating Geometric Principles, Shapes, Patterns and Measurement*, (2nd Grade), (4) *Designing Pattern: Exploring Shapes and Area* (3rd, 4th and 5th

grades), (5) *Building a Fish Rack: Investigations into Proofs, Properties, Perimeter and Area* (6th Grade), (6) *Building a Smokehouse: The Geometry of Prisms* (6th, 7th grades) (7) *Star Navigation: Explorations into Angles and Measurement* (5th, 6th and 7th grades), (8) *Salmon Fishing: Investigations into Probability,* (6th, 7th grades), (9) *Drying Salmon: Journeys into Proportional and Pre-Algebraic Thinking*, (6th-7th grades) and finally *Kayak Design: Scientific Analysis and Statistical Analysis.*

On the MCC website a description of the curriculum materials is made available:

> *Math in a Cultural Context* (MCC) is a long-term and ongoing set of interrelated federally funded projects. Central to MCC is its long-term collaboration with Yup'ik elders, teachers, and Alaskan school districts to develop culturally based curricular materials, especially supplemental math curriculum for elementary school students. At this time, MCC has published ten different supplemental math modules: three at the second grade, one for grade 3-5, and six at the sixth grade (most of these are applicable to 7th grade students). The modules also include supporting materials such as DVD clips of teachers' implementing exemplary lessons, written case studies, a *Guide to Implementing MCC*, literacy activities and stories that develop cultural, mathematical, and contextual connections for students. (Math in a Cultural Context, n.d.)

It has been seen that Lipka's *MCC* is a combination of Western mathematics, cultural knowledge, and also the inclusion of various pedagogical approaches, most notably the "expert-apprentice" model. Lipka et. al., (2005b) categorizes the three main influences impacting the development of *MCC*: (1) culture and context, (2) pedagogy, and (3) math content knowledge (p. 4) which again, harken to issues we have seen raised in the push for local control and its subsequent impact on the development of Indian curriculum materials.

Effectiveness of MCC

In an article entitled "Counting on Tradition" published in the *Agroborealis* (2009), a claim is made attesting to the effectiveness of MCC curriculum as evidenced in research studies. "The project has conducted 20 studies, finding in every instance that MCC students outperform

control groups at statistically significant levels and with good effect on project tests. This occurred in all trials except for one urban subgroup" (p. 5). In Lipka et. al. (2005b) proof of the effectiveness of the MCC curriculum is posted with the following comment, "MCC is one of the few studies that meets Demmert and Towner's criteria of being a culturally based curriculum and pedagogical approach that uses rigorous research method and that has statistically significant results in favor of the treatment" (p.1).

In the literature the majority of studies conducted came by way of case study. Many of these case studies looked at outcomes as a function of effective teaching practices (Sternberg et al., 2006; Lipka et al., 2005a; Lipka et al., 2005c; Lipka et al, 2007; Webster et al., 2005; and Kagle, 2007). Lipka and Adams (2004) was a quasi-experimental study. Though I do not want to go through each of these studies in great detail I will give some comments below. What seems to be the thread throughout the studies is the relative success of the implementation of MCC and also its dependence on certain forms of pedagogical practices especially the expert-apprentice model mentioned earlier, for success. Also of note is growing evidence that MCC can be used in all classrooms, not just classrooms containing Alaskan Native students in rural contexts, to help better all students' mathematics achievement.

In (Lipka & Adams, 2004) the *Building a Fishrack* unit was used in a quasi-experimental study to compare test scores between classrooms in rural and urban settings. "The results are promising...The results of this study show that the Building a Fish Rack module, a culturally based, inquiry-oriented math curriculum, can improve the performance differences in mathematics for rural AN (Alaskan Native) students (p. 28)." Also of importance is the following, "Further, analysis of data shows the effects of this culturally based curriculum beyond Yup'ik students (p. 28)." This last finding speaks to the universal characteristic of this

curriculum. It can help the learning of mathematics outside the Yup'ik community of non-Alaskan Native students.

The case studies focusing on Lipka's MCC curriculum are Sternberg et. al. (2006); Lipka et al, (2005a); Lipka et al. (2005b); and Lipka et al, (2007); Webster (2005); and Rickard (2005) and Kagle (2007). Some of these studies used the *Building a Fish Rack* to show the relative effectiveness of the MCC Curriculum. Sternberg et. al. (2006) approached this unit from a "Triarchic Theory of successful intelligence" framework and found that "teaching analytically, creatively, and practically in a cultural setting, rather remote from that of the mainstream United States can make a difference to school achievement, at least if the teaching is adapted to the cultural setting of the individuals, in this case, Yup'ik Eskimos in southwest Alaska" (p.16). In Lipka et al. (2005a) and Lipka et al. (2007) the effectiveness of MCC curriculum was investigated as a function of pedagogical practices. In Lipka (2005a) it was shown that the MCC curriculum changed classroom dynamics because it was a different form of mathematics, presented in a cultural context. This change precipitated a change in the teaching and learning of it as well by increasing the level of talk in the classroom about mathematics. However the more important outcome was that because "... the math content was grounded in the local cultural context, all involved found a new sense of ownership and a new, more cognitively challenging connection to math concepts" (pp. 377). In Lipka et. al. (2005b) we see the work of Nancy Sharp, a Yupik teacher engaging students in a pedagogical manner that has come to be classified as "expert-apprentice." A good example of this is illustrated below with some analysis from another Yup'ik educator,

> We noticed in the early phase of the first lesson, while Ms. Sharp was working with the kindergartners and first graders, the students had difficulty following her verbal instructions. A key transition in the lesson occurred when Ms. Sharp turned to the videographer and said "Should I show them one?" The students

> refocused, moved closer to her, all off-task behavior ended, and within a few minutes all of the students were actively engaged. Evelyn Yanez offered the following interpretation, "you have to show it instead of just talking about *qalarutkeqainarpeknaku, piluku*, verbally and kinesthetically, that is how I was raised....May dad always says that a person could be verbally telling people how (to) do things but if he can't show them he may not know...When Ms. Sharp coordinated her verbal behavior and her physical modeling, students were eager to get involved. (p. 49)

What is suggested in this quotation is the connection to elders, not only in the development of culturally based curriculum but also in the process of teaching. This is found in the comment, "My dad always says..." It seems reasonable to think that both context and way of teaching should match for effectiveness.

In two more case studies conducted by Webster et al. (2005) and Rickard (2005) pedagogy is again the focus of inquiry. Both teachers in each study used the *Building a Fish Rack* unit. Webster et al. (2005) describes and analyzes a non-Yup'ik teacher's approach to teaching *MCC.* This case study explored the factors that contributed to students' academic success and focuses on the key elements underpinning these factors: relationships, and the creation of "third space," and how all of this was fostered through the teacher's pedagogical approach. Relationships in the classroom and how they impact teaching and learning provide yet another variable in the equation for greater mathematical success with the use of *MCC* materials. In Rickard (2005), the teacher's pedagogical practice was inquiry based and was rich in mathematical discourse which meant that the students, "share, test, and revise their ideas about perimeter, area, and proof (p. 98)." Again we see that this curriculum, though locally informed could benefit all students. One implication of this case study is that problem-centered, inquiry-oriented mathematics curricula that embed mathematics in a non-Western cultural context, in this case Yup'ik culture and the Alaska context, can support the mathematics achievement of all students" (p. 98).

Lipka et al. (2007) and Kagle (2007) looked at the creation of a third space as a function of pedagogy and described its effectiveness in teaching MCC curriculum. In Lipka et al. (2007) the MCC unit *Patterns and Parkas* was used as the context. This study is important because it shows the way this teacher created a space that paid attention to her home community and culture while at the same time paying heed to school-based mathematical standards. "Ms. Sharp created a classroom environment in which she made authentic and deeply emotional familial, cultural, and linguistic connections, where she simultaneously embedded important school math concepts through the activities of this module, Patterns and Parkas" (p. 100). Again the key here was the inclusion of a pedagogical practice in which MCC could be relayed to students - a third-space between community and formal classroom. "She effectively uses modeling and joint activity...students learn the Yup'ik ways of putting these patterns together...students work alongside the teacher...these authentic connections resulted in better than average gain scores for her Yup'ik second language learners" (p. 94). In Kagle (2007) the *Designing Patterns* unit was taught by nine teachers to determine which pedagogical practices best suited the *MCC* curriculum. It was determined that the "expert-apprentice model" was the best fit for the use of MCC curriculum. It was also deemed important that a "third-space" be created. As alluded to before, this space needed to occupy the area between the traditional school culture and that of the community in order to situate the content.

Webster & Yanez (2007) is an ethnographic study which was unrelated to pedagogy. It is included here because it is related to the *MCC* curriculum. It looked at the process of gathering stories to use in conjunction with the *MCC* curriculum. These stories were deemed an important aspect of the overall *MCC* units because they "have played an important role in the engagement of students in the traditional storytelling genre as well as in the math activities and concepts

presented in the modules" (p. 118). In essence, since story telling is a huge part of Yup'ik culture MCC offers an avenue by which this cultural activity can be connected to mathematics - students learn not just about mathematics but about their own culture through the stories. "Stories can also provide instruction not only in cultural values and norms, how to act, but also in ways of survival and tasks of everyday living" (p. 116) and finally, "Stories perform a number of important functions: They are a way to preserve a people's historical and cultural memory and a way to connect the past and present" (p. 116).

Math in a cultural context is the culmination of the work done by Jerry Lipka, Yup'ik educators and elders. It is a mathematics curriculum that has found a way to bridge traditional Yup'ik cultural practices centering on survival activities with mathematics. It has blossomed from a local context to one that is impacting the teaching and learning of mathematics statewide. It has been shown to be effective and fosters a look at mathematics that is non-traditional - which seems to benefit both the teaching and learning of mathematics.

Conclusion

This examination of the literature illustrating the intersection between mathematics education and Indian education allows one to identify some curriculum innovations in the teaching of mathematics in a local Native context. Some of the developments of mathematics curriculum paralleled those seen in other content areas, especially in the use of elders for guidance and knowledge, the infusion of cultural context into the classroom and the discussion of the uses of the Native language in the teaching of the content. However, little research has been done in this area. Jerry Lipka and the work of Yup'ik educators and elders was the lone example illustrating the process involved in creating a mathematics shaped by the local Native culture over time. Also evident in the research literature is the influence of the evolving research

field of ethnomathematics on culturally centered math curriculum. This field's impact was important in that it helped change the perception of mathematics, essentially promoting the idea that we all do mathematics. This, in turn, allowed for the analysis of Indian cultures through a mathematical lens, which aided in the inclusion of culture in the teaching of mathematics at the local Indian community school level. There is a lack of mathematical curriculum materials using the local Native languages, though Lipka and Yup'ik educators discussed many of the local issues and obstacles that pertain to the topic, it still remains by and large an area unexplored.

Part II of Theoretical Framework: Ethnomathematics

From this portion of the literature review we can glean a few things that can inform the current study. The first is the heavy influence and guidance offered by the field of ethnomathematics in the approach to a tribal specific form of mathematics. Within this field we found a broader understanding of mathematics and also, as a result, the classification of mathematical activities in Bishop's (1991). His framework involving six universal mathematical activities found in all cultures will be used in a similar fashion in exploring the mathematics embedded in Lakota cultural activities as Barta et. al. (2001), Barta & Shockey (2006) and Sternstein (2008). Barta et al. (2001) also provide guidance in relation to exploring not just cultural activities but also the use of the language and culture to express mathematical concepts and terms. Thus, I will pay heed to the need to incorporate the Lakota language by exploring mathematical terms expressible in the Lakota language in this study. It is important to include a look at mathematical terms and concepts expressed (expressible?) in the Lakota language because it points to a possible way of incorporating the Lakota language into the teaching of mathematics (or to recognize its presence in the classroom during observations) which, in turn, was seen as a principle of self-determination practice. Thus, with the aid of principles found in

the field of ethnomathematics, which include the following: broader perspective of what constitutes mathematics, mathematics is present in all cultures, mathematics can be found in cultural activities, coupled with a need to include a look at mathematics expressible in the Lakota language we are ready to try to create a Lakota mathematics based on the following activities: counting, measuring, designing, locating, playing and explaining.

Also in the literature concerning mathematics and Indian education we see the process by which a tribal specific mathematics could be built, specifically in the work of Lipka and the Yup'ik Eskimo. The building of a Yup'ik mathematics started with direction from the community and grew with an increasing involvement of elders and community members. Its curriculum was built upon survival and subsistence practices and included such topics as navigation, the making of parkas, the inclusion of stories (story knifing) and the designing of fish racks. These contexts not only served to inform students of the many mathematical activities present in Yup'ik culture but to also show them the many complex cultural practices used by the Yup'ik in the process of surviving. In doing so, this Yup'ik mathematics helped bridge the divide between Yup'ik culture and mathematics. The process by which Yup'ik mathematics, specifically the creation of MCC materials, provides guidance to this study in that it becomes clear that community involvement in the form of elders, educators and community members has to occur in the development of a Lakota mathematics. It is these community members who will provide the direction and context for Lakota mathematical contexts - for the Yup'ik it was subsistence practices, we are not yet sure what the overriding theme will be for the Oglala Lakota.

I will categorize the second element necessary in the theoretical framework looking at the impact of self-determination on the teaching of mathematics at the local Oglala Lakota

community level, specifically in the design and description of a Lakota mathematics. This I will call the "Ethnomathematical Influence." It includes the following five principles: 1). a broader understanding of mathematics; 2). categorization of mathematics - six universal mathematical activities; 3). expression of mathematical concepts and terms in Native language; 4). use of community members in design and description of Lakota mathematics: elders, Lakota educators and other community members; and 5). identification of overriding theme(s) found in description of local Indian culture?

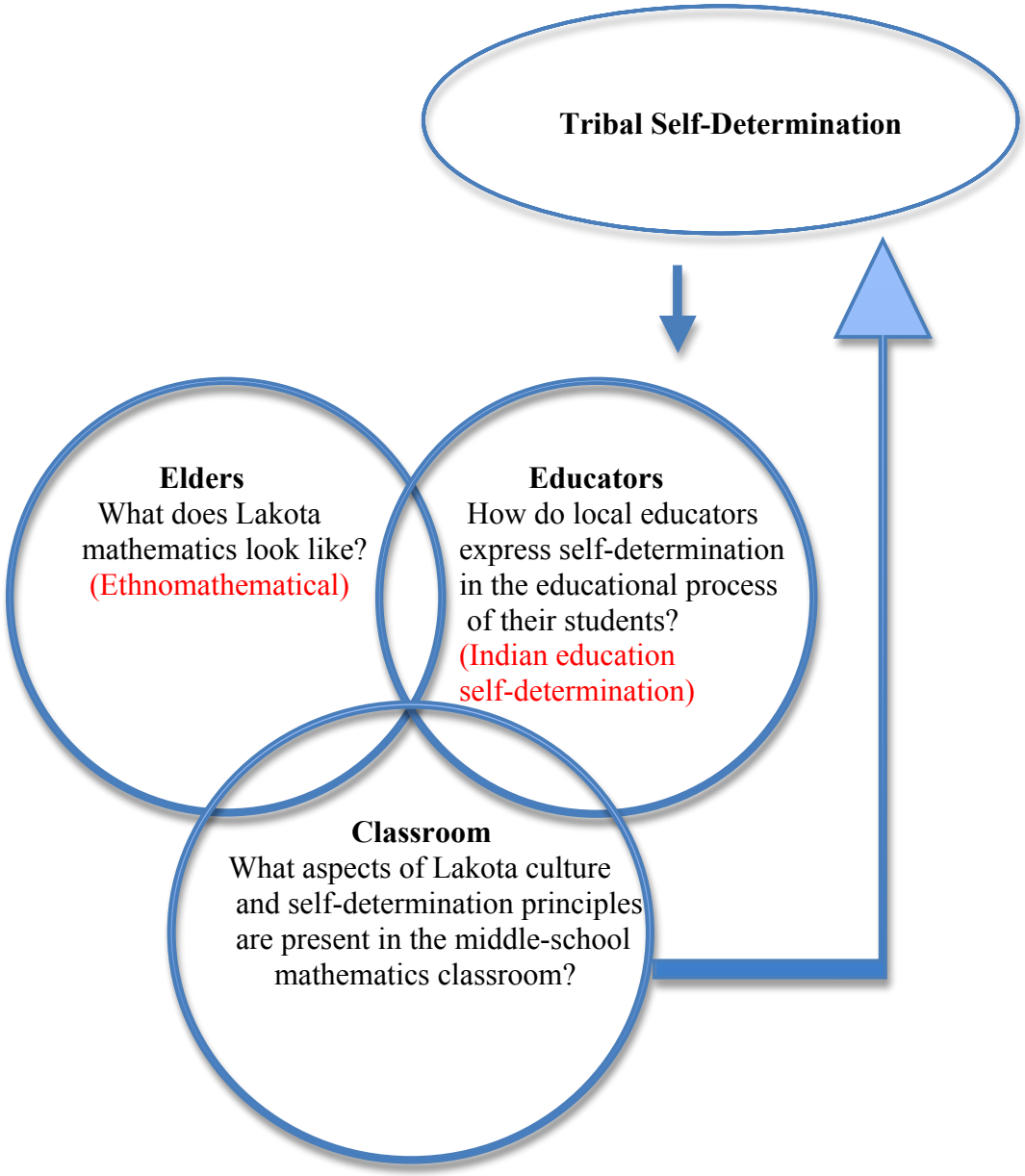
Overall Theoretical Framework

It was the aim of this study to find evidence for the influence of self-determination at the local level, as well as how self-determination might impact the teaching of mathematics in a local K-8 school. This review of literature on mathematics and Indian education coupled with our previous look at the impact of self-determination in local Indian communities and curriculum development both inform the current study. It does so by providing information on where to look for the impact of local control and by providing characteristics of what this impact might look like. It is with these two influences, the ethnomathematical - used for the creation of a Lakota mathematical framework (which will be used as a basis for comparison with the teaching of mathematics in the classroom) and the categorization of self-determination principles - to aid in the description of the impact of self-determination at the local Lakota community and K-8 levels that we can approach the mathematics classroom and definitively answer whether or not self-determination has impacted the teaching of mathematics in this Lakota community.

As can be seen in Figure 2-1 below, this proposed study framework aims to bring these two factors together (the ethnomathematical and the principles of self-determination) to help analyze the local Oglala Lakota context and the impact of self-determination on the teaching of

mathematics. Namely we can use ethnomathematical principles and follow frameworks developed by researchers who have done mathematical work in Indian communities in the past to guide the process of finding a local "Lakota mathematics." The purpose of this aspect in the overall framework, as I mentioned, is to find evidence of mathematical practices and expressions within Lakota culture so that it can help us determine if any Lakota mathematical practices are present in the local Oglala Lakota K-8 mathematical classroom context.

Figure 2-1. Study Framework



In order to describe the mathematics embedded in Lakota cultural activities and also to find Lakota expressions for mathematical concepts I will follow the process laid forth by Indian curriculum developers before me, that is, this information will come by way of elders in the community. This is reflected in the framework whereby Elders are grouped with the concept of Lakota Mathematics within the sphere of Ethnomathematics

The next facet of my framework deals with the notion of self-determination in the local context. With this context we can look into whatever development of local control over the years might have occurred, we can see if it has been integrated into the education of students, and we can see if it pays heed to a "bi-cultural" form of education. As we have seen in the literature local Indian school boards and educators have drawn on the wisdom and cultural knowledge of local elders to create classroom contexts in which students learn about their Indian heritage, language and culture. In theory then, we should see the presence of Lakota cultural activities and language manifested in various ways within the operations of the local school because of the influence of the local community - this in turn, in theory, should impact the teaching of mathematics

Interviewing educators and local community members can inform us of the impact of self-determination and how it shaped the structure of the local K-8 school and how educators chose to approach the classroom. Interviewing educators will allow us to see what aspects of mathematics are present in cultural activities and how mathematical ideas are expressed and understood in the Lakota language. The assumption in this framework is that both elders and educators will have an impact on the design and purpose in educating students at the local K-8 school and that this should also be reflected in the teaching of mathematics. Also in this framework is the intent found in the language of PL-93-638, that is, the purpose of schooling should produce competent future leaders for the tribe - it should strengthen the tribe in the long

run. Does the teaching of mathematics, influenced by the local community, pay attention to this purpose of Indian educational self-determination? This concept is reflected in the framework with the arrow coming from the bottom circle pointing to the main heading "Tribal Self-Determination."

Conclusion

From 1961 onwards Indian people began the push for local control of education. Indian communities received a glimpse of what this looked like with the opening of RRDS on the Navajo Reservation. As time progressed through the seventies and eighties more and more tribes began to include Indian languages, culture, heritage and history as part of the curriculum offered to their children in these schools. The purpose of Indian education became two-fold, to teach Indian children about their culture and also skills to be successful in the "Whiteman's world." The content areas that quickly established a place for Indian culture were typically history, government, art, and to some degree the sciences. The inclusion of tribal languages was also a part of this movement. Mathematics began to be part of the discussion in the late 1970's. It wasn't really until after the mid-1980's that the push for the inclusion of culture in the mathematics classroom took off. With the realization by mathematics educators of the notions of "culturally relevant curriculum" and "culturally relevant pedagogy" and the development of ethnomathematics in the late 1980s do we begin to see a rigorous description of the intersection of mathematics and Indian culture.

Jerry Lipka and his work with the Yup'ik people show the struggles of making such a thing possible with the creation and implementation of his *Math in Cultural Context* curriculum. Although Lipka supports the notion that mathematics can be used to strengthen tribal self-determination the jury is still out on how this might happen. The purpose of this study is to

follow the path set forth by Lipka et al., to see what aspects of Indian educational self-determination and Lakota culture are present at the local level in the Oglala community of South Dakota. If there are aspects present then what are they, what do they look like, and how are they implemented? If they are not present, why not? And what can be done to get the ball rolling towards fulfilling the promises set forth by Indian communities some forty years ago, if these promises have not yet been realized.

Chapter 3: The Study

Oglala Sioux Flag Song (Sioux National Anthem)

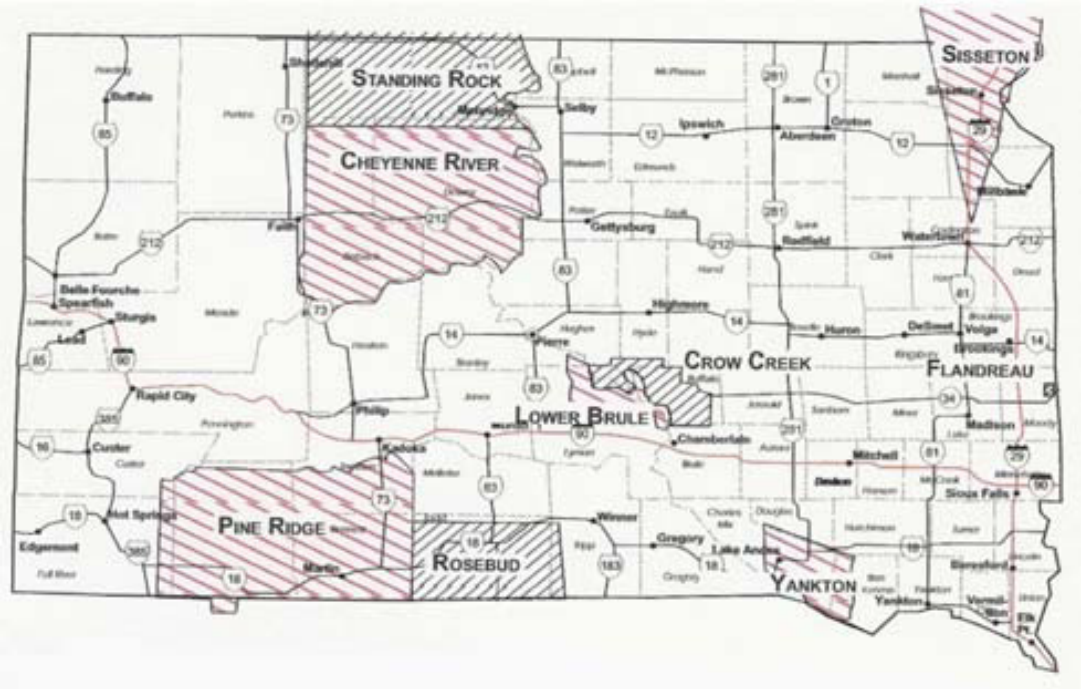
Tunkasila yapi tawapaha kin he.	The President's flag
Oihanke sni najin kte lo	Will stand without end
Iyohlateya, Oyate ki han	Underneath, the people
wicicagin kta ca,	Will continue to grow.
lecamun welo	Therefore I have done that.

Daniels (1970, p. 236)

The Setting

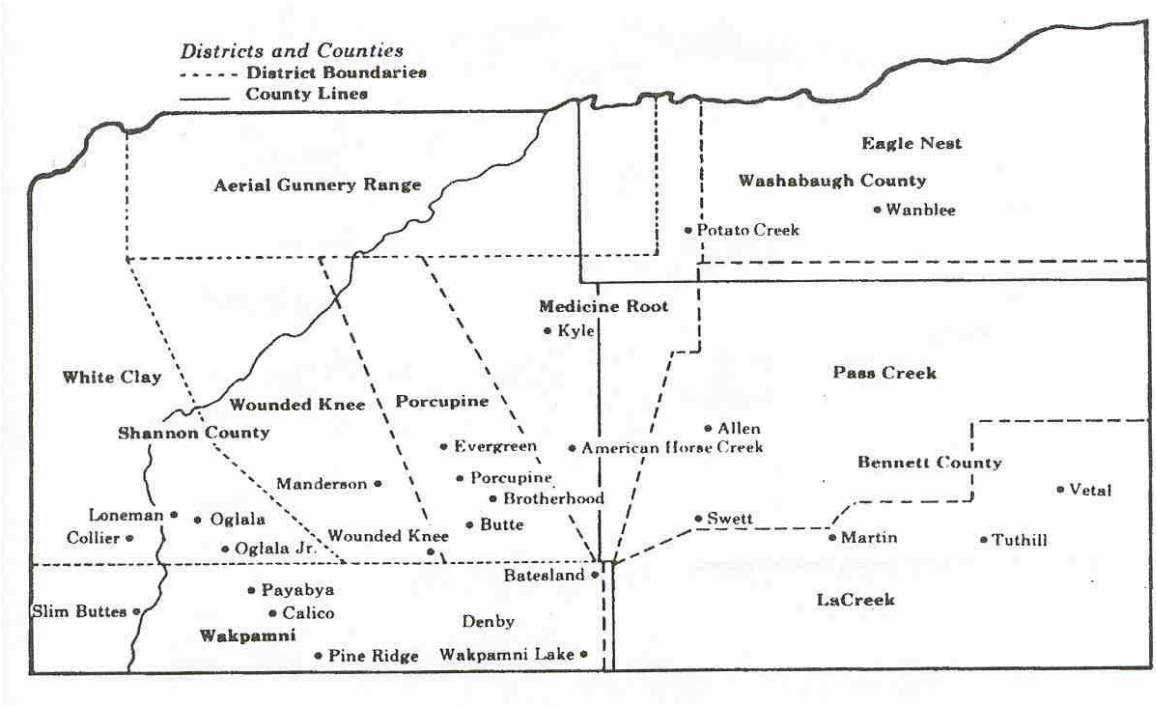
This study took place within the Oglala community, located on the Pine Ridge Indian Reservation in southwestern South Dakota. Pine Ridge is home to some 13,000 Oglala Lakota tribal members. The Oglala Lakota tribe is one of seven bands of Lakota (meaning "allies") who speak the Lakota dialect (related to both the Nakota and Dakota tribes of eastern South Dakota, Minnesota, Montana, and Canada). The Lakota are also known as the Teton Sioux - which means "those who live on the prairie." The seven bands that constitute the Lakota are the Sicanju ("Burnt Thighs"), the Hunkpapa (Camps at the Entrance), the Mniconjous (Planters Beside the Stream), the Sihasapa (Blackfeet), the Itazipco (Sans Arc - Without Bows), the Oohenupa (Two Kettles) and the Oglala (Scatters Their Own). The Lakota reside primarily on four reservations in South Dakota, the Cheyenne River Reservation, the Pine Ridge Reservation, the Rosebud Reservation and the Standing Rock Reservation. A map of the reservations in South Dakota is included below:

Figure 3-1. Map of the Indian Reservations of South Dakota
(EDA, 2000 as seen in Chapman et al., 2003. p.1)



The Pine Ridge reservation is divided into nine districts: Eagle Nest, La Creek, Medicine Root, Pass Creek, Pine Ridge, Porcupine, Wakpamni, White Clay and Wounded Knee. This study sought participants who resided primarily within the Oglala community, which lies within the White Clay district. Oglala is a small, rural community with a gas station/convenience store, a community school and an elderly center. The community has a few Christian churches in which to serve various Christian congregations, mostly, Presbyterian, Catholic, and Episcopalian. It has some rural housing developments scattered about, the biggest being located near the local gas station.

Figure 3-2. A Map of Pine Ridge Indian Reservation with Districts
(Oglala Lakota College, 2002, as seen in Chapman et al., 2003, p.2)



The Lakota community of Oglala is an ideal location to take a look at the impact of self-determination on the teaching and learning of mathematics. It was heavily influenced by ideas of self-determination in the early 1970s. For example, with the aid of local leaders the idea of a Lakota higher education institution became reality in the creation of Oglala Lakota College in 1971 (known then as the Lakota Higher Education Center). Also, Loneman Day School, as *Isna-Wica Owayawa* was called back then, experienced a shift in purpose as local community members wrested control from the BIA by making the school a contract school in the mid-1970's. The purpose of doing so was to exclude the BIA from influencing the direction of the school, to funnel money directly to the school and to include Lakota culture within its doors. It was the first school of any kind on the Pine Ridge Reservation to be locally controlled. Oglala was also one of the locations for the political battle between AIM (American Indian Movement)

supporters and local "goons" that culminated in the infamous killing of two FBI agents on the Jumping Bull Ranch located about five miles east of Loneman.

Oglala is a place where self-determination has gained a foothold in the education of the local community and it continues to be a place where local community members delve into ideas of self-determination. To this day various schooling projects within the community are present. Examples of this abound - Many local community members were involved in the creation of Lakota language materials designed for use in the local classroom (*Lakhotiya Woglaka Po!* Speak Lakota! (2004)). Another Oglala resident added to the literature of Lakota words by creating a Lakota dictionary with terms describing modern developments in technology (Starr, 1994). In addition, two years ago another Oglala community member attempted to start a Lakota immersion school within the community of Oglala. Suffice it to say, many aspects deemed important by advocates of self-determination, especially local control with the teaching of language and culture to the youth, have been present in the Oglala community since the 1970s.

One Community Many School Choices

Children living in the White Clay District/Oglala community can attend one of six schools: Wolf Creek Elementary (K-8), Pine Ridge (K-12), Oelrichs (K-12), Red Shirt Elementary (K-8) and Red Cloud Indian School (K-12) and, of course, *Isna-Wica Owayawa* (K-8). Parents can choose to send their students to any of these schools for various reasons. Wolf Creek and Red Shirt Elementary belong to the Shannon County School district and as such are public schools under the purview of the South Dakota Department of Education (SDDOE). Oelrichs K-12 is also under the SDDOE but in a different district, the Oelrichs School District. Oelrichs is an interesting case in that twenty years ago very few, if any, students from the White Clay District attended school there. It is an off-reservation school, located approximately 25

miles west of Oglala. Because of a perceived lack of educational achievement offered in Oglala-area schools many parents have decided to send their children to Oelrichs. Currently, roughly 90% of the students attending Oelrichs School (K-12) are from Oglala (Information attained from Oelrichs school counselor, personal communication, May 17, 2010). Pine Ridge K-12 and *Isna-Wica Owayawa* K-8 are BIE schools. Both *Isna-Wica Owayawa* and Pine Ridge are contract schools meaning they contract with the BIE to facilitate the way the schools are run at the operational level. Red Cloud is a private Jesuit school. Thus parents of children in the White Clay District and the Oglala community have seven choices for which they can send their children to attend kindergarten through eighth grade.

Isna-Wica Owayawa

Isna-Wica Owayawa (Loneman Day School) was the primary location of this study within the community of Oglala. It was a place where Lakota educators, students and parents could be sought for discussion and interviews. I met many community members there during this study. In addition to the K-8 school a branch of the Oglala Lakota College is on the school grounds, sitting just north of *Isna-Wica Owayawa*. In many ways *Isna-Wica Owayawa* provides a hub for the community. Powwows and wakes and funerals are held there throughout the year. It served as the location where observations of mathematics classroom content/context and interviews with students and school staff (and some community members) occurred.

School Enrollment - Isna-Wica Owayawa

In the academic year, 2009 -2010, the year this study took place, there were only nineteen sixth grader students, nine seventh grade students and fifteen eighth grade students (*Isna-Wica Owayawa* class list, attained 9/3/09). The sixth and eighth grade classes were split into two groups. One sixth-grade class had ten students while the other had nine. Of the two-eighth grade

classes one had 6 students the other had five (two eighth-students were in another class - a resource class and met during the time their eighth grade classes met). As a former teacher I was taken aback by these small class sizes, especially with the eighth grade students. I think there are two reasons for these small class sizes: the rural isolation of the community and access to other schools in the area.

In looking at the enrollment over the years at *Isna-Wica Owayawa* it is becoming clear that the numbers of students attending *Isna-Wica Owayawa* are dwindling. The SDDOE provides enrollment information for *Isna-Wica Owayawa* on its website. (South Dakota Department of Education, n.d.) Enrollment for the past ten years is provided in Table 3-1 below (grade level enrollment was not reported from 1996 through 1999). I included the last ten years to show the relatively large numbers of students that used to attend and the general trend downwards since 2002. People in the community I talked to in casual conversation remembered when *Isna-Wica Owayawa* was the primary school most students in the Oglala community attended. They felt that low academic achievement was the main reason the number of students has dwindled year after year.

Table 3-1

Enrollment Figures for *Isna-Wica Owayawa* per year since 2000

Year	PK	KG	01	02	03	04	05	06	07	08	09	Total
2009	8	36	23	23	18	19	18	22	11	13	0	183
2008	13	31	30	24	21	21	19	22	21	25	0	227
2007	13	48	11	19	21	28	17	30	27	36	0	250
2006	9	36	24	22	19	17	27	27	38	28	0	247
2005	8	30	24	22	19	27	31	40	29	25	0	262
2004	11	30	26	20	28	35	43	30	34	36	0	293
2003	12	24	27	31	38	41	29	31	38	25	0	288
2002	11	26	34	38	49	39	36	38	35	33	5	344
2001	-	38	31	38	39	41	33	30	37	36	10	333
2000	-	31	39	36	35	29	28	29	32	26	10	295

Mathematics Academic Achievement at *Isna-Wica Owayawa*

From the Bureau of Indian Education (BIE, n.d.) website we can take a look at standardized mathematics test scores from *Isna-Wica Owayawa.* This glimpse of mathematics standardized test scores over the last four years will help situate the level of mathematical achievement as defined by the BIE. I will include comparison scores at the state level and then at the national level for the same years. There are currently nineteen BIE schools in the state of South Dakota with an enrollment of 3,354 students (Bureau of Indian Education, n.d.). In the 2008-2009 academic school year there were 186 BIE schools nationally with an enrollment of 46,997 students (Bureau of Indian Education, n.d.). It is important to note the obvious here, that schools under the purview of the BIE are predominantly located in reservation/Indian communities and have a population of students that is predominantly Native American.

Table 3-2

Isna-Wica Owayawa Mathematics Standardized Test Scores

Academic Year	No. Of Students	Basic	Proficient	Advanced
2005-2006	171	89.70%	10.30%	0.00%
2006-2007	110	85.19%	14.81%	0.00%
2007-2008	131	82.17%	17.05%	0.78%
2008-2009	94	92.47%	7.53%	0.00%

Table 3-3

South Dakota BIE School Mathematics Standardized Test Scores

Academic Year	No. Of Students	Basic	Proficient	Advanced
2005-2006	3838	73.21%	25.28%	1.51%
2006-2007	3566	75.35%	23.76%	0.89%
2007-2008	3488	78.08%	20.95%	0.97%
2008-2009	3354	79.54%	19.70%	0.76%

Table 3-4

National BIE Mathematics Standardized Test Scores

Academic Year	No. Of Students	Basic	Proficient	Advanced
2005-2006	24500	70.68%	25.56%	3.76%
2006-2007	22626	67.52%	27.93%	4.55%
2007-2008	21910	67.36%	28.61%	4.03%
2008-2009	22250	66.74%	28.73%	4.53%

Over the past four years *Isna-Wica Owayawa* (Loneman School) had an average of 87.38% score at the basic level, 12.42% of students scored at the proficient level, and an average of 0.195% of its students score in the advanced level. In comparison, 76.55% students who attended BIE schools in South Dakota scored at the basic level, 22.42% scored at the proficient level, and 1.03% scored at the advanced levels for the past four years. For the entire BIE system 68.08% scored at the basic level, 27.71% scored at the proficient level and 4.22% scored at the advanced level. Over the past four years *Isna-Wica Owayawa* had a greater percentage of students scoring at the basic level in mathematics in comparison to the average scores for the rest of the BIE schools in the state of South Dakota and lags behind in mathematical achievement on average compared to all other BIE schools in the country. In a nutshell, *Isna-Wica Owayawa* students have not scored well on BIE standardized mathematics tests.

How do these scores compare locally to other K-8 schools in the area and how do they compare with student scores in schools in the state of SD outside the BIE system? I am under the assumption that students at Red Cloud, Wolf Creek, Oelrichs, Red Shirt Elementary and Loneman all take the SD STEP exam. Since Wolf Creek, Oelrichs and Red Shirt Elementary are under the purview of the SDDOE results are readily available on the SDDOE website. However, Red Cloud Indian School, has not posted its scores on-line and Isna-Wica Owayawa and Pine

Ridge, though they administer the exam, also do not have scores available on-line. Thus, it is hard to compare test scores across schools locally and at the state level because of the three different school systems present on the Pine Ridge Reservation. I have attempted to receive test scores from Red Cloud Indian School, to no avail. It would be interesting to compare scores from all the schools that Oglala community children attend to get a glimpse of their academic achievement as measured by standardized test scores and to see how they compare with test scores from students at *Isna-Wica Owayawa*. I am under the assumption that the BIE does not administer the same exams as Shannon County schools on the Pine Ridge Reservation. This feeling is justified in at least the way the students are scored. In the SD STEP exam there are four categories in which students' scores are placed: advanced, proficient, below proficient and basic. As we have seen, for the BIE, exam results are placed in three categories: advanced, proficient and basic. In any case I am hesitant to compare local student scores across school systems (BIE with Shannon County Schools and private schools) without understanding what the scores mean in relation to each other.

Type of Mathematics Curriculum

Isna-Wica Owayawa K- 8 mathematics teachers use the *Saxon* mathematics curriculum. Those familiar with *Saxon* understand that it is a curriculum predicated on repetition and has a rigid teaching and learning philosophy. That is, teachers of the curriculum are supposed to follow certain teaching guidelines and assess student work a certain way - giving ready-made exams and quizzes at certain points in the curriculum. I have had some hands-on experience with *Saxon* texts and teaching materials, having taught from *Saxon* math curriculum when I was a high school mathematics teacher at Chinle, High School, (located in Chinle, Arizona on the Navajo Reservation). From my experience I can say that repetition (what they call practice) was a key

philosophical tenet in the *Saxon* rhetoric. In my opinion *Saxon* does a good job at some things - algorithmic learning of materials for instance - and not so good in others- visual/conceptual representation of mathematical concepts.

From the *Saxon* website we see comments on its philosophy:

> *Saxon Math* is one of the nation's most thoroughly researched core mathematics programs for grades K–12. Saxon's unique pedagogical approach-based on instruction, practice, and assessment distributed across grade levels-incorporates more than 25 years of research and classroom experience. (Saxon, n.d.)

Saxon is a curriculum that is steeped in the math wars debate because of its pedantic approach to teaching mathematics. It has mixed results, in some places it fares well - even finding a place in Robert Moses's *Algebra Project* because of its usefulness in building certain skills deemed necessary to succeed at learning mathematics. In a study found on the *Saxon* publisher's website the "style" of Saxon is noted: "The Saxon curriculum, published by Harcourt Achieve of Austin, Texas, is a more traditional, scripted program in which teachers offer explicit instruction on effective mathematics procedures" (Viadero, 2009).

In addition to using *Saxon* as the primary source of mathematics curriculum *Isna-Wica Owayawa* teachers took advantage of a computer-based curriculum designed to help students practice their math skills individually and to test them frequently - The STAR Math Program. From their website:

> With STAR Math, you can:
>
> Find the right level for each student. You can instantly determine placement levels for all students and accurately forecast outcomes on high-stakes tests
>
> Get results quickly. STAR Math computer-adaptive testing delivers helpful, time-saving data within seconds after a student completes the test.
> Predict high-stakes test results. Validated with a national sample of nearly 60,000 students, STAR Math is the one math assessment you can count on for accurate and reliable scores...
> Benefit from periodic progress monitoring. Reports provide objective information to help you monitor pretest and posttest progress, compare students to

> national norms, and place new students
> Reduce costs. You don't pay on a per-test basis, so there is no additional cost for periodic testing (STAR Math, n.d.)

Part of the benefit of the STAR Math software in the classrooms was its easy access - it was always there for students to use if they found the time in class to use it. It also gave students instant feedback in terms of their mastery of certain mathematical skills. From what I observed at *Isna-Wica Owayawa* students in the middle-school mathematics classroom rarely used the STAR Math program whereas students in the K-5 grades used it more frequently. There seemed to be no set time or schedule in which students could use it. In a fifth grade class I observed students getting up in the middle of the class, turning on the computer then begin working on it. They essentially decided when they would use it and followed their individual plan on what it was they would be covering (as far as mathematical content was concerned). It was used as supplemental material.

Research Questions

Having described the setting in which this study took place I would like now to focus on the study itself - first the research questions: The global goals of this study are two fold: (1) to build a mathematical framework from a Lakota cultural/linguistic context and (2) to discover how self-determination principles in Indian education have impacted local Lakota K-8 mathematics classrooms. Three primary research objectives/questions, each nested within a particular theoretical context, guide this research study**.** The first of these research objectives is ethnomathematical in nature. By using a framework described as "the six universal mathematical behaviors" by Bishop (1991) and later used by Barta et al. (2001) and Barta & Shockey (2006) I addressed the first research question: **What does "Lakota mathematics" look like?** It is important to include this question in this study from a cultural perspective to create a

baseline in which to compare what is present in the Lakota thinking of mathematical concepts/descriptions to what is being taught in the classroom at *Isna-Wica Owayawa*. The principle strategy for accomplishing this task is through carefully planned questions designed to facilitate discussion with Lakota elders and Lakota language educators on the topics of counting, locating, measuring, designing, playing, and explaining.

The second area of study included an exploration of how self-determination has been instituted in the formal educational realm and how its principles might be interwoven into the thinking of local educators in the community. Those who control the formal aspects of education in the community under study offer a lens through which to explore and frame ideas of self-determination. Just as working with Lakota speakers (elders and Lakota language instructors) help develop "Lakota mathematics," working with local Indian educators help form a local Oglala Lakota version of self-determination. Thus the second research question became answerable: **How do local educators/community members express self-determination in the educational process of their students?** In order to examine this question and its context interviews with teachers/administrators and parents were conducted. To support assertions found in interviews evidence was sought through classroom observations and analysis of school/staff materials and curriculum materials.

The third objective for this study is an outgrowth of the previous two. As a participating member of the school community in which I conducted the study, I observed the nature of the mathematical content being taught in the school. Specifically, I explored the following: **What aspects of Lakota culture and self-determination principles are present in the middle-school mathematics classroom?** This question was pursued through a series of sub-questions. For example, are local Lakota cultural activities present in the classroom? How much of the

Lakota language is used either by the teacher or students in doing mathematics? Is the Indian notion of 'place' used as a context for the study of mathematics? I interviewed students to see whether or not the influence of both their Lakota culture and educational self-determination impacted their view of mathematics. I also wanted to know how students at *Isna-Wica Owayawa* perceived mathematics. Did they see the study of mathematics as something that could help their own understanding of Lakota culture as well as the benefits of studying mathematics for future educational and personal endeavors?

The goal of intertwining these three areas of focus into one study was to be able to describe the impact of self-determination on the local mathematics classroom. Using the descriptions of both Lakota mathematics and educational principles influenced by self-determination, I could search for elements of both within the mathematics taught in the K-8 classroom. The presence (or absence) of these aspects of Lakota culture as uncovered in this study give an indication of the importance of the ideas expressed in principles of Indian self-determination set forth by local Lakota educators.

Answers to the three main research questions above lead to an understanding of the views of mathematics, its purposes, its relation to Lakota culture, and the impact of self-determination on mathematics in the schooling of Lakota children. In addition to these three guiding questions various sub-questions surfaced that helped in answering the three guiding questions. These sub-questions are provided below in Tables 3-5 through 3-7 below. In the table I grouped each sub-question under a guiding research question I thought would add information that would help our understanding of it. Also included in this table are specific data collection methods and reasons for pursuing those questions - both of which will be discussed in greater length in the sections that follow.

Table 3-5

Research Question/Sub-Question Layout I

Research Question 1: What does Lakota mathematics look like?			
Research Sub-Questions	Data Collection Method	Reason	Data Content
Sub-Question 1.1: What terms do Lakota speakers use to describe mathematical terms used in Bishop's six universal mathematical behaviors: Counting, measuring, designing, locating, explaining and playing?	Semi-structured Interviews, published materials. Observations.	To obtain a list of equivalent Lakota mathematical terms	Lakota term meanings, games, cultural conceptions, artifacts
Sub-Question 1.2: What terms do Lakota speakers have difficulty in expressing? Are there terms that are non-existent? Do these terms provide an indication of the uses of mathematics in Lakota culture?	Interviews and conversations	What is not defined or used is just as important as what is defined and used. Can help give a shape of the types of mathematics present.	Answers to open-ended questions
Sub-Question 1.3: Is there evident an incorporation of Lakota descriptions and concepts in the mathematics classroom?	Interviews and conversations, observations.	Will help determine the scope of integration of Lakota culture and mathematics offered at *Isna-Wica Owayawa*.	Classroom artifacts, physical setting, curriculum, teaching materials
Sub question 1.4 - What is mathematics and who uses it?	Interviews and conversations		

Table 3-6

Research Question/Sub-Question Layout II

Research Question 2: How do local educators express self- determination in the educational process of their students?

Research Sub-Questions	Data Collection Method	Reason	Data Content
Sub-Question 2.1: Can local educators express an understanding of what self-determination is and how it has impacted *Isna-Wica Owayawa* through the years?	Interviews and observations, artifacts	Will help to understand if self-determination still is a major part of educational motivation in Oglala.	Answers to open-ended questions, local flyers, school publishing, events.
Sub-Question 2.2: What is present in the physical structure of the school, such as symbols, literature and pictures that might speak of the integration of the Lakota culture at *Isna-Wica Owayawa*?	Observations	Will help to understand if self-determination still a major part of educational motivation at *Isna-Wica Owayawa*	Physical settings, photographs or notes made of symbols and publications posted at *Isna Wica-Owayawa*
Sub-Question 2.3: What is offered in the curriculum at *Isna-Wica Owayawa* that attests to self-determination?	School artifacts, publications, web-site	Will help determine how important the inclusion of Lakota culture is at *Isna-Wica Owayawa* school.	Documents, teacher texts and supplementary materials, in-school activities,
Sub-Question 2.4: What types of self-determination rhetoric is offered by the school administration/school board?	School mission statement, staff orientation, school announcements and programs	Will help illustrate that leaders of the local school are still concerned with implementing self-determination principles.	Observations of in-school trainings, notes of informal conversations with educators
Sub-Question 2.5: What reasons were given for how the mathematics curriculum was chosen?	Interview with principal and math teachers	To see if ideas of self-determination impacted what mathematics should be taught.	Answers to open ended question.

Table 3-7

Research Question/Sub-Question Layout III

Research Question 3: What aspects of Lakota culture and self-determination principles are present in the middle-school mathematics classroom?

Research Sub-Questions	Data Collection Method	Reason	Data Content
Sub-Question 3.1: Is the Lakota language used in the teaching and learning of mathematics?	Observations	Will show how Lakota language is/isn't integrated with mathematics.	Notes during class,
Sub-Question 3.2: Are cultural activities used in the classroom to teach mathematics?	Observations	Will show examples of how Lakota cultural artifacts can be used to teach mathematics.	Notes during class
Sub-Question 3.3: Is the local geographical area or are local community topics used to teach mathematics?	Observations	Illustrates the ideas of Deloria & Wildcat (2001) on their ideas of "place."	Notes during class
Sub-Question 3.4: What forms of Lakota mathematics are present in the classroom?	Observations	Does the math classroom use any of the six universal mathematical activities as expressed by Lakota elders?	Notes during class
Sub-Question 3.5: How does the mathematics teacher view the integration of Lakota culture into the math classroom and is their evidence that he/she is doing this?	Interview, informal conversation	How much is the teacher influenced by Lakota culture? Does he/she see it as a way to teach mathematics?	Answers to open ended questions
Sub-Question 3.6: What are students' views of mathematics and are these views integrated with aspects of Lakota culture?	Interviews	This will help determine if students see mathematics in the Lakota culture.	Answers to open ended questions
Sub-Question 3.7: Are students in the math classroom capable of expressing mathematical terms in Lakota as the elders are?	Interviews, observations	Do students speak Lakota and do they understand that they have the ability to speak mathematical terms in the Lakota language?	Observations, answers to open-ended questions
Sub-Question 3.8: Can students see usefulness with mathematics for the benefit of their own lives and for the tribe as a whole?	Interviews, observations, conversations	What is the purpose of teaching mathematics for Lakota people?	Observations, answers to open-ended questions

From these tables we can see that each research question required various data collection methods. I will discuss those methods pertaining to each question after I discuss the study design.

Study Design

Why an ethnography?

This research project used ethnographic methods designed to (1) get at Lakota cultural knowledge in relation to elementary mathematical terms and ideas, (2) come to understand local Oglala Lakota ideas concerning self-determination and (3) how both of these shape (or don't) the teaching and learning of local mathematics classroom. LeCompte and Schensul (1999) state that ethnography is "an approach to learning about the social and cultural life of communities, institutions and other settings..." (Book 1, p.1). In answering his question, when do you conduct an ethnography? Cressell (2005) states: "You conduct an ethnography when the study of a group provides understanding for a larger issue. You also use an ethnography when you have a culture-sharing group to study - one that has been together for some time and has developed shared values, beliefs, and language" (p. 436). These criteria match well the intended goals for this research on the intersection of mathematics and Indian self-determination. LeCompte and Schensul (1999) note several important "conditions calling for ethnographic research" that are central features to this research context. Those conditions include:

- define the problem when it is complex and embedded in multiple systems or sectors
- clarify the range of settings where the problem or situation is occurring at times when the settings are not fully identified, known, or understood
- explore the factors associated with the problem in order to understand and address them, or to identify them when they are not known
- answer questions that cannot be addressed with other methods or approaches (Book 1, pp. 29-30).

Three primary ethnographic data collection methods were used to gather data, they were: interviews, observations and the gathering of data artifacts. I talk in detail about the interviews later where I give specifics in terms of participants, their numbers and locations. Below I talk in depth about the observations and the artifact collection process.

Interviews

I interviewed four groups of participants: elders, educators, parents and students. The elder-interviews were conducted with Lakota elders in the community. Elders were considered individuals over fifty-five years of age who have lived within the Oglala community. I interviewed seven elders for this study. Most of the elders were bilingual, many having grown up in households where the Lakota language was spoken. These interviews were primarily used to gather cultural information centering on the six "universal mathematical activities" described in Bishop (1991). However, elders were also asked about their opinion of self-determination, its history - the history of local control in the schools and their thoughts on its impact on the schooling of children in the community.

Students constituted the second group of participants whom I interviewed. It was the intent of these interviews to see if students could articulate the impact of self-determination - that is, the inclusion of culture and language - in the mathematics classroom. What effects did this have on their view of mathematics? I interviewed this group to gain goal of gaining information about what they deem to be mathematics, where it is used, how it is used, who uses it, and for what purposes it is used. I also questioned them about Lakota numbers, measurement and time. I interviewed a total of eight students.

The third group of interviews included adults working as educators in the Oglala

community. This group included teachers (Indian and non-Indian), *Isna-Wica Owayawa* administrators and a Oglala Lakota College instructor. I centered on aspects of self-determination, classroom content, school direction/mission, and the use of Lakota culture and language in the classroom in these interviews and for who spoke the Lakota language I asked questions concerning the six universal mathematical activities. Questions concerning purpose of mathematics curriculum instituted at *Isna-Wica Owayawa* were also asked to aid in the understanding of the types of mathematics taught to students. Interviews with teachers occurred in their classrooms. Interviews with the principal occurred in her office. Interviews with Oglala Lakota College instructor(s) or representative took place at the Oglala Lakota College branch in Oglala or at *Isna-Wica Owayawa*. I interviewed seven educators altogether.

The final group I interviewed was parents. I interviewed only one parent - she was actually a grandparent of one of the students attending *Isna-Wica Owayawa.* She was a former Lakota language instructor at *Isna-Wica Owayawa* and had some interesting insights into the use of language in the classroom. It was my intent in interviewing parents to see what their opinions were concerning the inclusion of culture and language in the education of their children. I also wanted to know whether or not the Lakota language was spoken in the home. Unfortunately I had only one parent/guardian volunteer.

Observations

Observations were conducted to find evidence of the presence of Lakota culture and language in the school and in the mathematics classroom. I observed the middle school mathematics classroom and some middle school Lakota language classes during the first portion of the study (Fall 2009). I then observed K-5 mathematics and Lakota language classes during the second portion of the study (Spring 2010). I intended to find out what was taught in the

classrooms and how mathematical content was taught. I observed the Lakota language classrooms to see if there were any mathematical concepts taught as well as the pedagogical approaches to teaching therein.

As a participant observer, which meant that I not only observed but also offered my assistance in the classrooms I observed, I was able to participate in a couple activities at the school. These activities spoke to the incorporation of Lakota culture in the school. The first was the annual buffalo hunt the middle school boys attended in Allen, SD. The second was the back to school powwow held in the gymnasium of *Isna-Wica Owayawa* where the staff danced and were recognized. (I will comment more on these activities in the results section of this dissertation.) I also observed various activities within the school. These included special assemblies - where, for instance, the staff was introduced to the student body at the beginning of the year and also at the weekly school assemblies held at the beginning and ending of each week. These assemblies were usually held with the playing of *Canupa* (pipe) songs and typically concluded with the school drum group singing the Oglala Sioux Flag Song (Sioux National Anthem) - sung by students and Lakota staff. These instances provided a visual context and affirmation to what was expressed at the teacher orientation in terms of the incorporation of Lakota culture in the schools as such provided me with evidence that indeed self-determination principles were alive and well in various manifestations in the school.

Data/Artifact Collection Process

For this portion of data collecting I tried to collect evidence of activities at *Isna-Wica Owayawa* that supported the contention that Lakota culture was included and valued. There is much visually present at *Isna-Wica Owayawa*, in terms of Lakota symbols, language designs and artwork, that would lead a visitor to conclude that this school, at least on the surface, pays heed

to Lakota culture. I noted the artwork on the walls, in the hallways, in the gymnasium and the library that paid heed to Lakota culture. Many of the murals in the hallways represented events in Lakota history. Three in particular: the coming of the White Buffalo Calf Woman - who brought the sacred pipe to the Lakota, the ghost dance and the Sundance were very prominent. I copied (by hand) some of the Lakota language found on the walls and in signs (restroom and building signs). I also collected documents during the teacher orientation week (prior to the start of the school year) that not only showed the mission of the *Isna-Wica Owayawa* but also showed the prominence of Lakota culture in the school with the inclusion of Lakota language standards. Finally, any classroom materials shared with me I kept - these materials included memos to parents about field trips or included homework assignments, etc. All these forms could be used as evidence to the presence of Lakota culture in the schools.

The Participants

Although I have briefly mentioned the groups of participants included in this study I would like to delve a bit more into what each group could offer this study. As I mentioned earlier, there were four groups of participants sought in this study: elders, educators, parents/guardians and students. Educators were either employed by *Isna-Wica Owayawa* or by Oglala Lakota College. They included the school principal, K-8 teachers, Lakota language teachers and Lakota tribal college instructors. There were six educators interviewed in this study. It must be noted that a few of the elders could have been classified as educators since they fit both categories. Parents were members of the community who had children attending *Isna-Wica Owayawa* from kindergarten to the eighth grade. There was one parent/guardian interviewed for this study. There were eight students interviewed for this study: three fourth

graders, three fifth graders and two eighth graders. Of the students five were male and three were female. In all there were twenty-three participants in this study.

Elders

Elders offered a distinct viewpoint of life on the reservation. I was able to discern through conversation with them what aspects of mathematics/mathematical thought are present in contemporary Lakota culture/language. Discussions with elders centered on how aspects of mathematics are communicated in the Lakota language with an emphasis on cultural meanings and uses. Also discussed were historical origins of some of these words and concepts. I tried to illustrate examples of their daily uses of mathematics be it in crafts, song or cultural activity. I was also able to find historical artifacts. These proved useful in comparing what the elders had stated and what was present in Lakota culture in the past. I used the framework offered by Bishop (1991) which identified six "universal mathematical behaviors" to help establish a baseline of these mathematical activities within the community. Bishop's (1991) ethnomathematical framework of mathematical behaviors includes:

- counting
- measuring
- designing
- locating
- explaining
- playing

Using questions guided by these six universal mathematical behaviors this study constructed from Lakota elder responses a picture of traditional mathematical knowledge within the Oglala Lakota community. Barta. et al. (2001) and Barta & Shockey (2006) in studying the traditional mathematics of the Shoshoni (Barta et al., 2001) and Northern Ute (Barta &

Shockey, 2006) tribes, in Wyoming and Utah, respectively, applied these ethnomathematical principles to modern Native American tribes. In each of his studies elders from the tribes were asked to describe these six aspects of mathematics in their native tongue. These studies focused primarily on what was historically present in the language and culture. For the purposes of this study I asked the Oglala Lakota elders to express their understanding in both English and the Lakota languages.

This portion of the study brought forth what has been present in the Lakota language and cultural activities in relation to counting, measuring, designing locating, playing and explaining. As such it provides us with not only what is already present (now and historically) but also what has not been thought about from a mathematical perspective and therefore not expressed in the language. This is important in building a Lakota mathematics because it becomes clear that math is thought to be "just math," by speakers. Various mathematical concepts like negative numbers, most fractions, very large numbers and certain shapes had not been thought about by any of the Lakota speakers and therefore could not be used in the mathematics or Lakota language classroom. Thus, in talking with the elders it became clear that they could help identify what cultural mathematical knowledge students might hold as part of their experience of living within an intact Lakota community.

Educators

Educators, working at *Isna-Wica Owayawa* and/or at the local tribal college (Oglala Lakota College) offer a perspective on the integration of Lakota culture and formal western schooling. Building from the theories and constructs of Indian self-determination, this part of the study illustrates how theory and rhetoric meet practice. Here we will be able to discern how notions of self-determination are formulated and communicated and also the impact of some

forty years of "Indian self-determination" at the local level. Furthermore we may be able to see if self-determination has impacted the teaching and purpose of mathematics in the classroom. Also, since the participants who are educators have also lived most of their lives in the Oglala community they will offer a view of the history of the development of local control within the community. Many were impacted by the changes and would probably not be teaching cultural/language courses at the K-8 or community college level if it weren't for the move to local control in the early 1970s.

Students

The perspective of students at *Isna-Wica Owayawa* were included in the study primarily because they can offer thoughts on what mathematics and Lakota culture are being taught to them. The viewpoint of students is important to this study because they are in the unique position of learning in a formal classroom setting while still being raised in an intact Indian community. They are the result of efforts to educate both for the future of the tribe and for their own futures. As such they will have been educated with attention to Lakota culture and history which is a direct consequence of local control and self-determination. Students will help me come to understand how the Lakota culture they live in and education they are receiving impacts their education as Lakota children.

Parents

Parents offer a perspective important to this study in that it is they who ultimately decide what form of education their children will receive and therefore what school their child will attend. In talking with parents it is my hope that they can give reasons why their children attend *Isna-Wica Owayawa*, what it is they are looking for their children to receive in the form of education. I would also like to know how much of the Lakota language is spoken in the home

and to also get their views on the inclusion of Lakota culture in the classroom. How do they view the education of their children, especially since it is locally controlled? These are some of the questions I wish to discuss with parents of students at *Isna-Wica Owayawa.*

Timeline of Study

There were two phases of data collection in this study. The first phase occurred in the fall of the 2009-2010 academic year starting the first on the 24th of August. The start of this phase coincided with teacher orientation at *Isna-Wica Owayawa*. It was my intention to use this first phase to get reacquainted with the community, re-introduce myself to community members and to build relationships with teachers, educators and elders in the hopes of finding potential participants for the study. I tried to use some close relatives to help identify possible participants and also took advantage of community centers, like the Elderly Center in Oglala and the local gas station to post flyers. The first phase was also designed to give me time to build relationships with staff members at *Isna-Wica Owayawa* and to come to know students in the middle school, two whom I would interview later. The first phase lasted from August 24, 2009 through September 30th. I spent four days per week at the site during this phase. Typically I spent a good portion of the school day in class doing observations and helping as a teacher-aide. I would then find time in the evening to write in my journal. I also spent evening time, especially after making connections with elders, as a time to do interviews. Overall I interviewed thirteen participants during this phase: six elders, five educators and two students.

The second phase of data collection occurred in the spring of 2010. I originally had not intended to do a second phase but questions arose in terms of what was being taught and whether or not this was school-wide. So the second phase allowed me to focus attention at the K-5 grade levels with observations. I added six student-interviews during this time. Also during this second

phase I was able to interview one more elder and two more educators, both Lakota language instructors - they continued to shed light on how mathematics could be expressed with the language and also developed deeper explanations for a Lakota way of thinking about mathematics. I began this phase on March 8, 2010. This phase lasted three weeks, ending on the 25th of March. Finally, I also had not originally included parents as part of the design of the study, but to try to answer questions concerning the teaching of the Lakota language in the home they were included in the second portion of the study. I was able only to interview one parent/guardian. I spent an average of five days per week at the site during this time period. I continued to observe the teaching of mathematics and in some instances the Lakota language at the K-5 grade levels. I also continued to write in my journal in the evenings to synthesize all the events that occurred each day. For this phase of the study I interviewed ten new participants: two educators, one elder, one parent and six students.

Data Analysis and Interpretation

For the analysis of my data I leaned heavily on ethnographic methods that allowed me to make meaning of the data I collected. I approached the data set seeking to organize my data with respect to my research framework, a process that ethnographers follow to support the results and conclusions they draw on during and at the end of a study. One of the significant elements of this process was the coding techniques I applied to the data record.

Coding refers to the process by which patterns or similar ideas and or phenomena are grouped together from a data set (LeCompte & Schensul, 1999)). LeCompte & Schensul (1999) speak of two methods used in concert in developing codes for analyzing data in an ethnography. One approach is a "top-down" deductive approach and the other is a "bottom-up" inductive

approach. Both of these methods for developing codes in which to analyze data gathered in this study were employed. The deductive "top-down" approach is done by

> Choosing a set of concepts first and then sorting out the data in terms of which of the concept they fit best or inductively-by examining the data first to see into what kinds of chunks they seem to fall naturally and then choosing a set of concepts that helps to explain why the data fell that way. (Book 5, p. 46)

Whereas the "bottom-up", "inductive approach

> ...facilitates the transformation of words into coded items that then can be ranked, ordered, or counted in what Miles and Huberman call "arithmetic." Following arithmetic, ethnographers begin to assemble the items into patterns and structures. (Book 5, p.68)

My "Top-Down"

Going into the study I wanted to gain information about aspects of Lakota culture and language with respect to mathematics. Therefore, for example, asking elders about counting, shapes and games were ready-made "codes" taken form Bishop (1991) who supplied a categorization of mathematical activities (counting, measuring, designing, locating, playing, explaining) in all cultures. These categories were expanded to include a look at how mathematical terms and concepts were expressed in Native languages through a lens described by Barta et.al. (2001) and Barta & Shockey (2006). Thus in addition to mathematical activities found in Lakota culture, I also looked for evidence of Lakota expressions and descriptions of mathematical terms in the context of daily life, and in the ethnographic interviews I conducted as well. Thus I went into the data collection phase of this study with the following major codes: counting, measuring, designing, locating, playing, explaining, as well as, a list of sub-codes for each category identified by Barta et. al. (2001) and Barta & Shockey (2006). As examples of codes and sub-categories, under the larger code of "counting" were included, sub-categories like expression of integers, zero, infinity and large numbers. As a second example, within the global

code of measuring, sub-categories included items such as the naming of months, years and days in regards to keeping track of time.

To further illustrate my use of coding as a method to generate understanding around my primary research questions, recall that in addition to paying attention to mathematical activities I approached this study from the vantage point of self-determination in Indian education. Having read the literature on Indian educational self-determination and its development in the local context, as well as and its subsequent impact on curriculum I wanted to see how this was expressed and integrated into the local Oglala community and school context. So self-determination, being an umbrella term, allowed me to focus my questions on history, curriculum, structural integration, and evidence of self-determination principles in the school in the Oglala context. In the schools this meant looking for evidence regarding the use of the Lakota language and for the curriculum, an integration of local context. So going into this study I had the following self-determination categories to explore as I gathered data with sub-categories: evidence of Lakota language in school, teaching of Lakota language and history, culture, history of self-determination in Oglala, integration of local control and influence of local community.

My "bottom-up"

As the study progressed I began to see the need to explore other topics not mentioned in the research I had done prior to the study that was reflected in my review of literature. In the topic of counting, for instance it became clear that numbers were expressible by all up to a certain point, that all could count to a big number if they put effort into it. Yet most did not use the Lakota language to describe large numbers. So inclusion of thoughts around magnitude of numbers was indicative of the relative frequency of terms I had gathered. Inclusion of thoughts was also indicative of the relative frequency of things people generally did not know. So the

inclusion of comments concerning most fractions was deemed noteworthy because Lakota expressions for most of them did not exist. As I became more aware of what was and wasn't expressible in the language I honed in on those concepts and terms.

As another example, consider the mathematical activity of 'playing,' a topic that had closure, so to speak. It became clear early in this study that Hand Games were one of the only Lakota games that participants knew about (though they did mention horse racing, baseball and playing cards as youth). As time progressed in the study I brought along a few prompts to help aid the memory of elders about Lakota games (One Feather's (1974) *Woskate*, Unit 5 curriculum materials). This prompt helped some elders remember games they had seen or played when they were children - but again it was clear, from recollections of vague memories and no knowledge of the rules of these games that most of what could be termed Lakota Games were not currently present in Oglala. So the absence of them in current Lakota culture became noteworthy and thus a code for "not-knowing" was developed and explored.

Similarly, in looking at the history of self-determination in the Oglala community, the influence of AIM came to the fore and became an area for exploration, thus a sub-code. Some other codes that came from the "bottom-up" process of data analysis included: temperature, telling time, Lakota mythology, - Star People, Pte-Oyate, (The buffalo People) place names, the four directions, *tiospayes*, giving directions, formal and informal curriculum, etc.

A code book was developed to help make sense of the growing sub-codes. At the end of the coding scheme I re-assembled what had been placed in categories to try to make sense of what was going on in the data and how it might be interrelated. This is what LeCompte & Schensul (1999) call the "pattern-level" analysis (Book 5, pg. 98). It was at this point that I was able to link back what had occurred in Oglala in relation to self-determination, its origins, its

history and some aspects of its implementation, i.e. Lakota classes in the school, and the teaching of Lakota values. New areas were described in detail such as aspects of an "informal curriculum" as well.

On not-knowing and supplements

I try to make clear in my analysis that a lot of the knowledge I was looking for tended to be person-specific. That is, one person may have known a lot about a certain topic whereas most others interviewed in the study did not. For instance, the Lakota teacher who taught at Oglala Lakota College was the only person who was able to give me any information on the special cultural meanings of shapes. I must also make clear here that I chose to include previous anthropological studies done with the Lakota to help the reader gauge what was currently known by local Lakota people, with what had existed prior based on previous historical records. For example, in designing I included many images and thoughts from Lyford (1940) who had looked at Lakota designs in quillwork and beadwork. Lyford's (1940) work offered supplemental information on designing (as did Goodman (1992) on Lakota star knowledge). It was my intention to try to paint as clear an image of these mathematical topics, in part by, supplementing the information shared with me by participants with information from past studies. These materials became part of my analysis.

Verification procedures

To help insure that data is valid I used various strategies suggested by LeCompte and Schensul (1999) to achieve, as much as possible, what is called call "disciplined subjectivity" (Book 6, p.66). Two strategies that seemed of particular use were:

- maintain personal logs and observations
- keep diaries and journals

I also member-checked with participants to see if what I had interpreted from conversations and data collection were accurate with what they shared with me. Also, member-checking allowed me to confirm the accurateness of my interpretations from the Lakota language to the English language. Finally, I was aided in the interpretation and writing of Lakota words and phrases from a Denver-area Lakota elder who is fluent in the language.

I used triangulation techniques to further insure validity of data and interpretation by using multiple forms of data sources in this process. These forms include my own observations and notes, data from interviews and artifacts and conversations about the material with participants. I also used artifacts from *Isna-Wica Owayawa* such as curriculum materials, and school information (staff handbooks, student handbooks, etc.) to further state the presence of self-determination at the school.

Limitations

There are shortcomings inherent to all methodologies, including ethnography. Certainly the findings will be localized and as such it will be difficult to generalize to any other Lakota community on any reservation in South Dakota let alone any other Indian community. Thus reliability is obviously something that will be an issue. Some Indian communities are further along in coming to an understanding of the profound power of mathematics in shaping the education of their children and their own futures (and also for cultural maintenance). Lipka (1991, 1994) with the Yup'ik in Alaska, where he has tackled notions of pedagogy and how to integrate Yup'ik culture into the formal mathematics classroom (Lipka & Adams, 2004; Lipka et al., 2005a; Rickard, 2005; Lipka et al., 2007; Kagle, 2007) are a prime examples of this very effort. Lipka's *Math in Cultural Context* (MCC) provides a framework for Indian educators interested in integrating the two spheres of Indian culture and mathematics. The use of state

educational boards, as evidenced in the Office of Public Instruction in Montana in bringing pan-Indian curricular themes, like powwows and beadwork, as a context to learning some mathematics is also a step towards integrating Indian culture in the mathematics classroom of the Indian student. But the real question about what to do with it all, and how truly to access a world described by mathematics to better the lives of Indian communities - like strengthening notions of self-determination, have not been addressed. Certainly this ethnography can help the conversation toward that end. However, any findings this study produces must be taken in context, reflective of the unique situation in Oglala and at *Isna-Wica Owayawa.*

Other problems with ethnographies stem from how observations are recorded. Is it really possible to have two ethnographers with the same purposes for observation come up with the same set of recordings of an event? Each ethnographer will see things at least slightly differently. The end results inevitably contain different perspectives and assertions that, though perhaps departing somewhat from one another, do not necessarily imply they are flawed.

One significant limitation is the amount of time I was able to spend in the community. Seven weeks of intensive research is significant but is it enough to uncover the nuances that may be found in such a large, multifaceted and complex study about complex issues? Will I get enough classroom time to make generalizations about what is happening in the classroom all year? Can I really illustrate effectively a framework to not only look at self-determination from a mathematical educational point of view but also can I understand at a deep enough level the inherent cultural meanings and Lakota words that will be communicated to me from the elders?

Although I grew up in the Oglala community and attended school at what was then Loneman Day School (now *Isna-Wica Owayawa*), I am not fluent in the Lakota language. I am able to discern meaning in some things stated to me. I know words and phrases, a lot of nouns,

numbers, etc. (and am capable of correct pronunciation of words,) however, I am unable to hold a meaningful conversation in the Lakota language. Given this handicap I will have to use elders and those fluent in the language as guides when discussing mathematics in the Lakota culture.

I was born in Pine Ridge, lived in Oglala until I was thirteen. We (my family and I) left the reservation when I was going into the eighth grade and have not lived there for an extended period of time since. (My mother and father moved back to Oglala in 1991, and I have a brother and sister who never left the reservation and a brother, and two sisters who have moved back as well and currently reside on the reservation, two in Oglala and one in Pine Ridge.) And the fact that I, as I mentioned, am not fluent in the Lakota language - all of these factors can be viewed as limitations to such an undertaking. However, they can be looked at as strengths from a researcher perspective. I have enough knowledge of the inner-workings of relationships required in Lakota culture to help foster genuine conversations. I am an outsider in that I have been away for so long, but I am also an insider in that I know my relatives and they know me and I know the community I will be studying. I am as much at home in Oglala as anywhere else. In fact, I still call Oglala "home." There is much there that is still a part of who I am. I think I am actually in an ideal position for an ethnographer, that is, as Nurani (2008) put it, "This means that (the) ethnographer examines a cultural phenomena from the perspective of outsider (to whom it is strange) while trying to comprehend them from the perspective of an insider (to whom it is familiar) (p.442)." The structure and purpose of the schooling, along with elder ideas about mathematics might seem strange to me as an adult coming back to my home community, but much about the customs, beliefs and ways of seeing the world are familiar.

I cannot erase (nor do I wish to) the impact my education at what was then Loneman Day School (and later at Red Cloud Indian School) had on me in developing my view of the world. I

sat in the classrooms at Loneman when elders came into the room to tell us "*Iktomi*" stories for the first time. This, as I look back now, was obviously a function of the idea of Indian educational self-determination. I was also fortunate to be graced by the presence of my Aunt and Uncle, Matthew and Nellie Two Bulls, who taught our Lakota language class and how to do certain crafts while I attended Red Cloud Indian School. Not only was the language just being integrated into the schools, but I heard it everywhere. I heard it coming from the voice of Oscar Blackstone at the Presbyterian church up the hill from our house. I heard it when I walked into Joe Lajtay's "Oglala Trading Post." I heard it on the bus going to school at Loneman, and in the hallways at Loneman. I heard it (and continue to hear it) on KILI radio. I heard it in our own church - "Our Lady of the Sioux" in the hymns sung in Lakota and in the drum that was integrated into the services. There are still yet Lakota words said and Lakota songs sung in the Oglala community. They are still yet to be grasped and understood by those who will listen. This I think is true of me (and consequently for this study) - I am ready to listen. I think, because of this cultural knowledge that I already have as a part of me, I was able to overcome my limited Lakota linguistic skills.

I had certain assumptions that can prove to be limitations to this study. I assumed that the elders I talked to have a deep knowledge of history and the uses of numbers and the meanings of concepts used in measuring distances and areas to understand what it is I am searching for. I assumed they would be willing to share such information with me. I assumed there is still a viable Lakota culture as well. Certainly the rise of gangs and an attitude towards sex and relationships speak against what was once deemed Lakota culture. Many things once considered taboo are now part of every day life on the reservation, for better or worse. Many things have changed since I was a child in Oglala, just as they had changed from a generation before. My

mother's generation looked at being "Indian" much differently than my generation. Similarly the younger Lakota look at this identity differently. Pan-Indianism has had an impact on how Indians are viewed and how they view themselves. Sometimes "Indianness" is measured in being able to sing and "dance Indian". Before Pan-Indianism, your "Indianness" used to be measured by your ability to speak Lakota. Things change.

There are limitations to this study. However, despite them, it is important for me as a math educator to get the conversation going in my own home community about the need to push for a greater understanding of the presence, utility and hence power of mathematics in the world of our daily lives. It is in this push that I think we can find ways to strengthen our self-determination both at the individual level and at the tribal level. An understanding of mathematics, I believe, is a key stepping-stone to greater self-sufficiency in an age where technology is everywhere.

Summary

Using a qualitative ethnographic approach - data generated from observations, artifacts and interviews - this study proposes to describe the impact of Indian educational self-determination on the mathematical thinking and learning on a small rural Oglala Lakota community school. Exploring and defining the mathematics inherent in the Oglala Lakota culture will bring forth a baseline for comparison, along with self-determination rhetoric that has been in existence for at least forty years, to help gauge what has been done in the mathematics classroom in the age of self-determination.

Chapter 4: The Development of a Lakota Mathematics & Self-Determination

> There are great possibilities in the young Indians. They are capable of becoming doctors, lawyers, engineers, architects, and road-builders on the reservations. Then too, they should be trained in the history and arts of their people; it is they who should perpetuate the native dances, songs' music, poetry, languages and legends, as well as the native arts and crafts. Music and dancing are talents popular to the Indian-no other people on this continent sing and dance for the same reasons, or in the same manner. (Standing Bear, 1933, p.268)

A Few Things First

Before moving to analyze the data collected in this study I want to mention a few things first. One, both my views and the direction of this study changed as I progressed further into it. They changed because of the conversations I had with Lakota elders and educators. They changed not only because of my own ignorance in understanding what cultural aspects of the Lakota are still present but also because my understanding of the way Lakota speakers used the language was incomplete. Some of these speakers were knowledgeable about certain aspects of the six universal mathematical activities whereas many had not given much thought to any of the topics I was seeking. Initially this was a surprise to me, perhaps it should not have been. Mathematics, narrowly defined, was not a topic thought about a great deal and spoken of less frequently. Mathematics defined as cultural activities as Bishop (1991) defined it, found only slightly more space in the speaking and thinking of Lakota speakers than I had expected. Fluency in the Lakota language seemed to be geared to the daily uses of the language versus use in the pursuit of such novelties as mathematics. The result of these unexpected realizations is that the questions I asked there after explored topics more in depth than as an overview of topics. This was both good and bad. It was good because I received a deeper appreciation of certain mathematical activities. It was bad, perhaps because I did not gain much information on other

topics. In a sense I ended up having to piece activities together from the participants to get a complete analysis versus getting information from everybody on each topic.

Two, I was also unaware of the amount of historical materials on Lakota culture available which needed only to be found and rewrapped in the framework of Bishop's (1991) six universal mathematical activities. Of the six universal mathematical activities an historical literary study of playing, designing, measuring, locating and counting would show these areas to be documented throughout the past hundred and fifty years. If we can look at some of these documents we will see that some of the first white explorers to come across Plains Indian cultures documented some of these activities as a part of their studies. For example, George Catlin (1971), the famous artist who painted many Plains Indians and their cultural activities, described games played by the Mandan Indians and also left visual images of their designs. Many anthropologists, linguists, fur traders and men of the cloth (missionaries) did the same. Given this wealth of information, I decided that some of it (which pertained to the Lakota/Dakota people) should be included in this study's analysis. It is important to include these works because they do offer a sense of some mathematical activities prior to Western contact. Also, they offer points of comparison to what is now present (or not) in the specific Lakota community included in this study.

Three, since the Lakota language and its closely related Dakota language has been studied and written since 1852. There are aspects present in these sources that provide help in the analysis of Lakota mathematical terms - especially at the cultural level. Thus grammars and dictionaries were referenced during the analysis of the data. These resources include: Stephen R. Riggs (1890) *Dakota-English Dictionary;* Riggs (1893) *Dakota Grammar with Texts and Ethnography*; Buechel (1939) *Lakota Dictionary and Grammar;* Buechel (1970) *Lakota-English*

Dictionary; and the *New Lakota Dictionary* (2008). These were referenced where necessary and provided help in making sure my understanding of terms were on par with the meanings shared with me by Lakota speakers. They also helped fill some holes in the study. I will weave information and explanations from these sources into my analysis. I will keep the reader abreast on what came from my study and what came from these literary resources.

Four, this analysis is geared toward the usefulness of what I have studied for the purpose of perhaps creating a Lakota Mathematics Curriculum not just for the math classroom but also as a resource for the Lakota language classroom. Thus you will see materials that were used in the Lakota language classroom that pertain to these six universal mathematics activities and you will also see some analysis directed towards the usefulness of these thoughts and Lakota expressions in both elementary/middle school level mathematics classroom and the Lakota language classroom.

The influence for this direction in the analysis sprang from conversations with elders and Lakota language instructors. I had come into this study looking for the impact of self-determination on the teaching of mathematics at the local level. What this meant was to find evidence of use of the culture and language in the math classroom. Thus in observations, I thought, I would be able to see how much Lakota language was used, whether or not the local area was used in examples or whether Lakota culture was used in presenting math problems. What I found was that I had not thought of the converse of this, that is, how much mathematics is included in the teaching of Lakota language and culture? Given this new set of eyes for observation and analysis it became clear that both the mathematics classroom could be searched for levels of "culturally relevancy" by finding evidence of language and cultural contexts and the Lakota language classroom can become "mathematically relevant" by bringing out notions of

mathematics in the language and activities. The latter can be done, in part, by making explicit the expression of mathematical concepts that are inherently a part of learning the Lakota language and by connecting it, perhaps, to what students have learned in the mathematics classroom.

Five, I was aided in my analysis by the help of a Denver-area Lakota woman who is a fluent speaker. Her help in transcribing and explaining Lakota words and phrases into the written form was invaluable since I am not a fluent speaker of the Lakota language. She was able to look at various words and translate them literally for me as well and also was able to provide insights into the cultural meanings of words and phrases. My lack of fluency in the language was at times a hindrance in this study. It is my hope that I will not show my ignorance in a way that impacts the integrity of this study negatively. Obviously a fluent speaker would have had an easier time in understanding terms and phrases in the Lakota language and as a result may have been able to bring out a richer interpretation than I have done. I think being a fluent speaker also may have made the interviewing process easier for both the participants and myself; many times I felt that if I conversed in the Lakota language with elders and language teachers their comments would have come easier. Instead there was some difficulty with some of the speaker's responses that I believe was due to switching between languages. I am cognizant that there is still some danger, even with this assistance, in putting into some of the explanations and Lakota understandings my own interpretation - which may or may not be correct. This is why I am indebted to my Lakota friend who was of great assistance as I moved forward in this analysis. Still I apologize for making any mistakes or not providing at times a richer explanation of some of the activities explained to me. The big jump over the chasm that sits

between any two languages was sometimes too great for me to make. I will gratefully accept any corrections and future guidance from those in-the-know.

Related to five is the benefit of looking at Lakota words and their literal translation as a way to compare Lakota conceptions of mathematics to Western conceptions for the sake of finding alternate ways of teaching mathematical concepts. Many times in this study I found that the translations of words could be used as a viable way to explain various mathematics concepts when translated into English. Hankes (1988) for example, in her work on the enumeration in the Lakota language speaks of place value being intact in the description of numbers in the language. (We shall see the truth of this as we talk more in depth about counting.) Since Lakota is a very descriptive language it seems plausible to think that in efforts made by speakers over the years to make sense of various mathematical activities they provided a description of the activities which in turn could be retranslated into English. This, in turn, can provide an interesting view of the mathematics activity. Thus an English understanding of the Lakota description could offer another way of teaching the mathematics concept in the classroom.

An illustration of this occurs, for instance, when we translate the Lakota word for percent to English - from which we get a good description of what the concept of percent is. The Lakota word for percent is opawiŋǧe etaŋhaŋ. Opawiŋǧe is the Lakota word for "a hundred" and etaŋhaŋ translated means "from." Thus together we get "from 100." In the teaching of percent in some mathematics curriculum we are told of the historical meaning of the percent symbol, %, which was created to specifically tell a person doing the math that division of the number in front of the percent symbol by 100, should follow. "Centum is the Latin word for 100, and thus percent literally means "by the 100." We often use the symbol % to represent the word percent" (*Saxon*, 1981, p. 136). There are other cases of this that came forth in the study

that I will discuss later. It will be clear that a study of Lakota words for various mathematical conceptions and terms can in fact guide us in the study of some mathematical concepts because they lend a description of the concept itself. As a result they may offer alternate ways (or parallel ways) of explaining and teaching mathematics in the Lakota classroom.

Six, there seems to be some controversy at the academic level pertaining to which orthography to use when writing the Lakota language. I am not privy to all the details in this controversy nor do I wish to be a part of it. As a graduate student I took two Lakota language courses in the Linguistics Department on the CU-Boulder campus. One course, a graduate level course, was an analysis of Lakota texts left by Ella Deloria. In this course a study of the structure of the language was implicit. The second course was an introduction to learning to speak and write the language, using the curriculum developed by the *C.U. Lakhota Project*, which was comparable to one college semester of language study. Saying this I am aware of the different orthographies used in writing the Lakota language. There is software available from the Lakota Language Consortium (which employs the orthography of the New Lakota Dictionary) which has created Lakota font and keyboard applications. I will employ the orthography offered through this software and company. When quoting from other Lakota texts I will try to adhere to their conventions. This may cause some confusion to the reader. I will do my best to make it as clean as possible.

In this study I initially tried to use Bishop's (1991) framework in ways found in two studies, Barta et al. (2001) with the Shoshoni of Wyoming and the other with the Northern Ute in Nevada (Barta & Shockey, 2006). With the Shoshoni, Barta et al. (2001) seemed to be looking for the way tribal people defined mathematics prior to contact with Western cultures, though he concedes that in all likelihood this would be difficult to accomplish. “This is to say that while a

traditional and unadulterated Shoshoni mathematical perspective was sought, the perspectives shared undoubtedly reflect some degree of ongoing cultural inclusion" (p. 8). In my study I originally had this intent as well but as I interviewed various community members who spoke the language it became clear that this would be very difficult to accomplish. Almost all participants did not understand where terms originated nor, as I mentioned, gave much thought to these terms and so did not or were not capable of breaking them down to a literal meaning. Also, since the language is one whose roots are shrouded in time it proved difficult to find specifically Lakota cultural roots for the meaning of terms in the language. I felt that the intersection of the responses in the Lakota language to my inquiries along with an analysis of curriculum materials, the use of historical reference materials (grammars, dictionaries, etc.), as well as the help of a fluent speaker would help me discern, to a limited degree, what was present in the language prior to Western contact and what has been developed since. The question remains, however, whether it is important to make this distinction in some of these mathematical activities.

Finally, I have decided, because of the length of the analysis involved in looking at both the mathematical activities of Lakota culture and aspects of self-determination within the local Oglala Lakota context, to arrange the analysis that follows into eight chapters. In a normal dissertation (study) the analysis would come as one chapter. However, since there are so many parts to this anaysis organizing each section as a chapter all their own helps to keep the analysis readable. Thus chapter four will include the first universal mathematical activity, counting. Chapter five will anlayze designing in Lakota culture, chapter six will look at measuring, chapter seven, locating, chapter eight, playing and chapter nine, explaining. These six chapters encompass the look at Lakota mathematics through the framework offered by Bishop (1991). The next two chapters, chapters ten and eleven, will analyze self-determination, first in Oglala

and the structure of *Isna-Wica Owayawa* (chapter ten) then in relation to the teaching of mathematics at *Isna-Wica Owayawa* (Chapter eleven). Chapter twelve will be the concluding chapter.

Let us focus our attention now on the descriptions of the six universal mathematical activities (denoted below as UMA) given to me by the Lakota people of Oglala, SD. It is my hope that once we are through with this study we can begin to build a framework for the development of a Lakota Mathematics, which in turn can be used to teach Lakota students mathematics with the Lakota language and vice-versa.

Part I: Lakota Mathematics

All cultures count. All cultures produce people who reason. All cultures are rich with art and design and all have places of special importance. Time is measured by all cultures, distances are expressed and movements noted. Activities based on seasons are as perennial in these cultures as the growth of grass on the plains. Stars help guide and create mythology and stories in all cultures. All cultures have games played to help participants develop skills that will help them in their lives. The Lakota culture is rich. Its viewpoint is sought by many. Following Bishop's (1991) cultural mathematics framework we take a look now at what constitutes the six universal mathematical activities among the Oglala Lakota: counting, designing, measuring, locating, playing and explaining. We start first with counting.

UMA #1: Counting – Tóna luha he?

The following are topics that were included in the Barta et al. (2001) study with the Shoshonie when he looked at the mathematical activity of counting: the number line, operations, gestures, written symbols, fractions, and significant numbers. I followed this progression in my study. I approached the look at Lakota counting from a mathematical perspective organizing it

around the concept of a number line. I used a standard number line as a way to organize conversations around numbers and counting while keeping in mind the sets of numbers expressed in Western mathematics. Thus from a number line we have a starting point and the notion that there exists numbers whose values increase as they lie further in one direction, (in the positive direction - numbers bigger than zero) and whose value decreases as they are counted in the opposite direction (in the negative direction - numbers less than zero). The number line can be home to all sorts of numbers, though typically we see in mathematics curriculum especially at the elementary level, only integer values. The number line can be used to show where counting numbers, whole numbers, integers, rational numbers, irrational numbers, complex numbers, etc. lie in approximate relation to each other.

Even though we do not typically think of certain groups of numbers when we talk about the activity of counting (such as rational numbers, irrational numbers and complex numbers) I included these in this mathematical activity of counting to begin to show the types of numbers that are present in the language (or not) and whose further exploration, from a linguistic and cultural perspective would be imperative given their need to be defined for other types of mathematics to be explored. As an example of this, we might go into other forms of mathematics when looking at the mathematical activity of designing whereby patterns can be studied that could lead to contexts for the development of Algebraic thought. So counting in this study includes some discussion on groups of numbers, including those not typically associated with counting.

With this in mind we find that the set of counting numbers {1, 2,3,4...} and the set of whole numbers {0, 1,2,3,4,5,6…} can be expressed in the Lakota language. The concept of infinity can also be expressed and is used as an upper bound for counting. Negative integers {...-

5, -4, -3, -2, -1} are completely omitted, that is, they do not exist in the language and neither do most rational numbers i.e. numbers that can be expressed as an integer divided by an integer {1/2, 5/8. 3 2/3, etc.}. It would seem obvious then that the set of irrational numbers, imaginary numbers and complex numbers are inexpressible in the Lakota language. It is important to keep this in mind as we try to see how we might come to teach mathematics in the Lakota language for there are ways to describe numerical operations in the language (addition, subtraction, multiplication and division) but expressions do not exist to describe results of most of these operations, i.e., how for instance would a Lakota speaker describe the sum of these two numbers: 5 and -8? Or how is the quotient 3 divided by 32 to be expressed? The two mathematical expressions can be stated in the language but their answers cannot. We will examine some of these ideas here as we push forward in looking at how the Lakota count.

As a starting point I began with zero and mention the concept of infinity while giving the names of most of the counting numbers within this range. In Lakota, zero is expressed as Tákunišni*,* which means "nothing." The concept of infinity is expressed as *oihankesni wanice,* meaning, “without end.” Some elders and educators expressed this differently, “Oihaŋke šni waniče ... Oihaŋke šni wanilya – it means without end. There is no end to it. Another said “We say Makȟa...Makȟa oihaŋkešni waniče...It means “forever.”

Let’s now move to the first group of numbers zero through ten - the first eleven counting numbers: (0) Tákunišni, (1) Waŋči (only in making a count, e.g. 1,2,3,etc. otherwise it is wanži), (2) nuŋp or nuŋpa, (3) yamni, (4) tópa or Tób, (5) záptaŋ, (6) šákpe, (7) šakówiŋ, (8) šágloǧaŋ, (9) napčiyuŋka or napčiyuŋk, and (10) wikčémna. It is unclear why the numbers two, four and nine can be expressed in two ways in the Lakota language. One possible explanation (and this explanation is mine) is that there is a very formal way of speaking the Lakota language and then

there is another way called “fast speech” where oftentimes certain words are combined and endings of some words are chopped off and added to the next word. One such example is the Lakota phrase makiyutȟapi in the Lakota dictionary (NLD, 2008, p. 950) which means “a mile.” In Lakota "iyutȟapi" means "to measure" and to express miles it is combined with "makȟa" - the earth, to “makȟa iyutȟapi.” In listening to a speaker describe distances where miles was used these two words are combined to one – where we get “makiyutȟapi.” So perhaps fast-speak can be an explanation for expressing some numbers in multiple ways.

Do not take the introduction to Lakota names for the first eleven counting numbers lightly. Teaching students these numbers might seem trivial. However, in talking to fourth and fifth grade students at *Isna-Wica Owayawa* I was rather shocked to find that all but one of the seven students I interviewed was able to express the numbers one through ten given that all but one of them had gone to school at *Isna-Wica Owayawa* since Pre-K and thus had five or six years worth of work with the Lakota language. Many were able to express some of the numbers. One student even started counting in Lakota and ended by stating the last three numbers in Spanish! None of these students knew how to express zero or infinity in the Lakota language. Here are two examples of these conversations (the text in parentheses represents me talking):

> (So when you were younger, or even now, did they teach you how to say the numbers 1 - 10?)
>
> Silence
>
> (So you don't know want wanži or nuŋpa or...)
>
> "I know what one and two is."
>
> (Okay. What about záptaŋ, do you know what that is?)
>
> Zero?

and another:

(Can you count to ten in the Lakota language?)

"Waŋči, nuŋpa, yamni, tópa, záptaŋ, šákpe, šakówiŋ, šágloǧaŋ, napčiyuŋka, wikčéyuŋka."

In talking with one Lakota parent, who taught for many years at the Pre-K and Kindergarten levels at *Isna-Wica Owayawa*, I mentioned the teaching of numbers and asked: (...what about zero?)

"Zero is tákunišni. I had never even thought of teaching zero."

The numbers 11 through 19 can be expressed in two ways also – by either keeping the tens value, signified by wikčémna, in front of the number and using the term *"*aké*"* (which means "again" or "repeated") as a way to add the ones value to the tens value. The other way is to disregard the tens value altogether but to keep the *ake*. "Most of the time Lakhotas drop the wikcemna, and use only the aké portion of the number (Beginning Lakhota, Vol. 1, p. 5-4)." To continue on we can go through the next ten digits:

11 – wikčémna aké wanži or aké wanži (literally 10 + 1)

12 – wikčémna aké nuŋpa or wikčémna aké num, or aké nuŋpa or aké num (literally 10 + 2)

13 – Wikčemna aké yamni or aké yamni ,(literally 10 + 3)

14 – wikčémna aké tópa or wikčémna aké tób or aké tópa or aké tób,

15 - wikčémna aké záptaŋ or aké záptaŋ,

16 - wikčémna aké šákpe or aké šákpe,

17 - wikčémna aké šakówiŋ or aké šakówiŋ,

18 - wikčémna aké šágloǧaŋ or aké šágloǧaŋ,

19 - wikčémna aké napčiyuŋka or wikčémna aké napčiyuŋk or aké napčiyuŋka or aké napčiyuŋk.

In talking with a former Lakota language teacher she stated:

> One of the first things that I teach, I have—it goes back to that curriculum. I try to teach all the basics, the numbers, according to the wašiču the state curriculum, I try to go by what they require of the kindergarteners. One of them was that, the numbers. After 10, it's just a repetition. It's all the way repetition. So that's good. They just need to know the numbers to 10. After that, you just add 'em. So I made sure that they understand up to 10.

However, none of the children I talked to could count to twenty (if they couldn't count to ten it seemed reasonable to think they couldn't talk to twenty), let alone numbers that were higher. None that I asked knew the Lakota name for one hundred. It seems clear that a push to expand the teaching of numbers, even though it might seem repetitious, past the first ten should be deemed necessary. This need is amplified when we begin to think about including the multiplication of numbers in the Lakota language since in multiplying numbers the values of the products may increase quickly, i.e. big numbers need to be expressed.

From 20 to 99 we see the use of the word "saŋm" instead of "aké" to show place value in numbers. Saŋm means "more, beyond, more than" (from my understanding aké ′ could be used but it is customary to use the word saŋm instead). Buechel (1939) states:

> In telling numbers, the larger always precedes the smaller -- million, thousands, hundreds, tens, units. The numerals are connected by the adverb "sanb" or "sam" from "sanpa", more, which is equivalent to our "plus" or "and".
>
> Between units and tens, however "ake'" (not ak'e') is used instead of "sam", although "sam" is used between units and hundred. (p.109)

The Lakota language book *Beginning Lakhota*, (Vol. 1, 1976) states:

> Counting between decades...is done in two ways. Both are acceptable, and both are widely used...According to the one, the decade number is mentioned first, as in English (twenty-one, twenty-two, etc.), followed by the appropriate teen number. Here for example, are the numbers between 30 and 40:
>
> | | |
> |---|---|
> | wikcemna yamni | 'thirty' |
> | wikcemna yamni akewazi | 'thirty-two' |
> | wikcemna yamni akenupa (num) | 'thirty-three'..." |

> The other style is the same except that ake' is replaced by sam (This is a shortened form of the word isapha 'more, beyond,.) sam is not written together with the following number...
>
> | | |
> |---|---|
> | wikcemna yamni | 'thirty' |
> | wikcemna yamni sam wazi | 'thirty-one' |
> | wikcemna yamni sam nupa | 'thirty-two...' (pp. 5-5, 5-6) |

I will now show the Lakota names for numbers from twenty to twenty-nine. You will begin to see the pattern so I will follow that with the Lakota names for 30, 40, 50, 60, 70, 80 and 90 with random numbers within this range to give the reader a taste of how these numbers are expressed in the language.

20 – wikčemna num (literally ten two – i.e. two tens),

21 – wikčemna num saŋm wanži (literally ten two and one – i.e. two tens + 1),

22 – wikčemna num saŋm num,

23 – wikčemna num saŋm yamni,

24 - wikčemna num saŋm tób ,

25 - wikčemna num saŋm záptaŋ,

26 - wikčemna num saŋm šákpe,

27 - wikčemna num saŋm šakówiŋ,

28 - wikčemna num saŋm šágloǧaŋ,

29 - wikčemna num saŋm napčiyuŋk,

30 - wikčemna yamni,

40 - wikčemna tób,

50 – wikčemna záptaŋ,

60 – wikčemna šákpe,

70 – wikčemna šakówiŋ,

80 – wikčemna šágloǧaŋ,

90 – wikčemna napčiyuŋk,

The pattern is obvious at this point for all numbers between twenty and ninety-nine. But I will give a couple more examples using the number 58 for instance - wikčemna záptaŋ saŋm šágloǧaŋ, and 97, wikčemna napčiyuŋk saŋm šakówiŋ. Let's turn our attention now to the numbers from 100 to 999 with a few numbers that lie between century markers.

100 – opawiŋǧe

101 – opawiŋǧe saŋm waŋži

135 – opawiŋǧe saŋm wikčemna yamni saŋm záptaŋ,

187 – opawiŋǧe saŋm wikčemna šágloǧaŋ saŋm šakówiŋ,

200 – opawiŋǧe num

213 – opawiŋǧe num aké yamni

244 – opawiŋǧe num saŋm wikčemna tób saŋm tób,

300 – opawiŋǧe yamni

400 – opawiŋǧe tób,

etc.

999 - opawiŋǧe napčiyuŋk saŋm wikčemna napčiyuŋk saŋm napčiyuŋk

As mentioned previously, the word saŋm in these numbers becomes clear - it designates place values. I wrote the Lakota word for 135 above and wish to translate it in detail here: 135 – opawiŋǧe saŋm wikčemna yamni saŋm záptaŋ translated it becomes - one hundred more than ten-three more than five or 100 and 3-tens and 5 = 100 + 30 + 5 = 135. The use of saŋm in Lakota to denote place values in large numbers is crucial in making sense of the number. (We will soon look at very big numbers.) One Lakota educator, who showed me examples of

numbers in this counting system wrote a large number on a white-board and put dashes between the digits to show where the saŋm needed to be placed. It looked like this:

1 - 8 - 7 - 7 - 1 -5 -2 -1

I mention this to expound the use of saŋm in the expression of numbers in the Lakota language - it is obviously extensive.

At this point it should be clear that the Lakota number system is a base-ten system and repeats as the Western form of counting does. In Riggs (1893) a look at numbers and counting was included. This form of counting, which relies on the fingers during counting implies a base-ten number system intact prior to Western contact:

> In counting, the Dakotas use their fingers, bending them down as they pass on until they reach ten. They then turn down a little finger, to remind them that one ten is laid away, and commence again. When the second ten is counted, another finger goes down, and so on. (p. 47)

Lipka (1994b) looked for a physical or cultural root for the names of numbers expressed in the Yup'ik language as did Barta et al. (2001) with the Shoshonie. In the English language it is no coincidence that we call both numbers and fingers digits. No one that I talked to in this study was able to tell me from whence the names for Lakota numbers originated. Riggs (1893) gives a reasonable account of the origins of the names of numbers (seen below in its entirety) in the Dakota language. More conversation with Lakota speakers on the origin of the names of numbers would be invaluable. (I included the Dakota language here, because, one, it is closely related to the Lakota and Nakota languages and two, it was studied earlier than the Lakota language - which might give us some reason to believe in the cultural "purity" of some of these terms. Finally, though I do not have a way of verifying at this point, if the Lakota did move westward from their relatives, the Dakota and Nakota, in the past I assume the Dakota language

to be the elder of the Lakota language and therefore, might lay the root-meanings of many Lakota words. I am uncomfortable in stating this but in the absence of other explanations it in the least can offer a starting point for discussion):

> It is an interesting study to analyze these numerals. It has been stated above, that the Dakota, in common with all Indians, it is believed, are in the habit of using the hands in counting. It might be supposed then that the names indicating numbers would be drawn largely from the hand. The following derivations and explanations, it is believed, will be found the main reliable.
>
> 1. Wanca, etc. from wan! interjection - calling attention - perhaps, at the same time, *holding up the little finger*.
> 2. Nonpa, from en aonpa, *to bend down on*, or *place on*, as the second finger is laid down over the small one; or perhaps of nape onpa, nape being used for *finger* as well as *hand*...
> 3. Yamni, from mni (root) signifying either *turning over or laying up*; the 'ya' perhaps indicating that it is done with the mouth.
>
> It is suggested as a further solution of yamni, that the 'mni' maybe an old root, meaning *together or flow together*, as we have it in the reduplicate amnimni, e.g., mini amnimni, *to sprinkle water upon*.
>
> 4. Topa, from opa, to follow; (perhaps ti, a house, and opa, follow with) as we say, 'in the same box,' with the rest, The three have banded together and made a 'ti' or tidan.' as we would say a family, and the fourth joins them...
> 5. Zaptan, from za, (root) holding (or perhaps whole, as in zani), and ptayan or ptaya, together. In this case the thumb is bent down over the fingers of the hand and holds them together.
> 6. Sakpe, from sake, nail, and kpa or kpe (root) lasting as some kinds of food which go a good ways, or filled, as a plump grain. This is the second thumb, and the reference may be to the other hand being completed. Possibly from the idea of bending down as in nakpa, the ear.
> 7. Sakowin, from sake, nail and owin, perhaps from owinga, to bend down; but possibly from oin, to wear, as jewelry, this being the fore finger of the second hand, that is, the ring finger.
> 8. Sahdogan, from sake, *nail* probably, and hdogan, possessive of yugan, *to open*; but perhaps it is ogan or oge, *to cover, to wear; the nail covers itself*. Two fingers now cover the thumb.
> 9. Napcinwaka, from nape, *hand*, cistinna, *small*, and wanka, *lies-hand-small-lies*; that is, the remainder of the hand is very small, or perhaps, the hand now lies in a small compass.
>
> Eli Abraham explains 'napcinwanka' as from napcupe. All fingers are napcupe, in the original sense; that is they are *marrow bones of the hand*. Now

> this finger of the second hand lies down alone. Two fingers have covered the thumb and this has to take a bed by itself. Rather the finger lies in the napcoka, *inside of the hand.*
>
> 10. Wikecemna, from wikce or ikce, common, and mnayan, gathering, or from mna, to rip, that is let loose. It would then mean either that the common or first gathering of the hands was completed, or that being completed, the whole are loosed, and the ten thrown up, as is their custom; the hands in the common position.
>
> 100. Opawinge, from pawinga, to *bend down with the hand*, the pre-fixed 'o' indicating *perfectness* or *roundedness;* that is, the process has been gone over as many times as there are fingers and thumbs.
>
> 1000. Kektopawinge or koktopawinge, from opawinge and ake or kokta, meaning *again* or *also*. This would indicate that the hundred had been counted over as many times as there are hand digits. (pp. 48, 49)

Riggs (1893) was making an educated guess here as to the origin of the names of numbers in the Dakota language. It would seem a near impossible task to try to find the origin of the names of numbers in Lakota since the language is so old and since the roots of it are clouded in the mist of time. Yet it is still an interesting thought and one worth pursuing. I have included the names of fingers in the Lakota language below in the hopes of showing, perhaps, that there might not be such a clean-cut connection to counting and the fingers as Riggs (1893) suggests. However, I know I am only showing my ignorance as well. From Buechel's Lakota-English Dictionary (1970), which I will denote BLED from now on, and the New Lakota Dictionary which will be denoted NLD:

Hand - nape (p. 710, BLED)

Finger - 1. napsu - a finger.

šašte napsu - little finger (p. 468 NLD)

šašte iyokhihe - the ring finger. (p. 468 NLD)

škaŋkapiŋ - the ring finger (p. 483)

napčhokaya - middle finger (sounds a lot like Napčiyuŋka - p. 710, BLED)

waepazo - index finger (p. 548, NLD)

napȟahunka - thumb (p. 710, BLED)

To continue in this vein for a second longer, In the NLD definition for the number "million" we see that no Lakota word was present for the word million in BLED. However it is present in the NLD where the Lakota name for a million was denoted kȟoktašiča, which had the synonym - woyawa tȟaŋka - (which means "a big count"). This excerpt also followed the definition - "The word probably derived from khoka 'wood box,' supposedly because silver dollars were shipped in boxes in the days of the fur trade" (p.288). This seems a plausible root for the word kȟoktašiča. Still I think it is difficult to say with a high degree of certainty the origin of the names for Lakota counting numbers. Lipka's (1994b) work with the Yup'ik people, highlighted this difficulty as well where it became clear in a tribal group discussion on the origin of the names of numbers that the words for numbers up to four hundred existed in the Yup'ik language prior to Western contact (quite logically because they had, as Lipka described, a base 20 sub-5 counting system). Anything greater than four hundred gave way to the Russian influence on Yup'ik culture since the names of numbers greater than four hundred reflected Russian influence.

At this point some elders had difficulty expressing big numbers. I asked one elder how to say 1,000. She stated: " It's in my mind, but I can't...there's so many words that goes with that...oh dear. Have to get my dictionary." The Lakota educator who wrote a 18,771,521 to show me where samn was used in the expression of the number was also able to explain how to say the number in Lakota.

> So this is added to the answer. So *kiktoha pa eyawapi cesni* - this is one million, *kiktopawinge saglogan, iyawapi cesni* means one, but you can't count to one million in lakota.. it is impossible to count to one million in one day in the Lakota language, if you do you will be going forever - it's impossible to try to count to one million Lakota in one day...*kiktopawige saglogan kiktopawigne sakowin wikcemna sakowin kiktopawinge wanji*...so all those have sam in place.

kiktopawige saglogan sam kiktopawigne sakowin sam kiktopawinge wanjica sam opawinge zaptan sam wikcemna numpa sam wanji. That's how long it takes...that's the answer.

Let us move on from the numbers one thousand (1,000) to nine-thousand nine-hundred ninety-nine (9,999).

1,000 - can be expressed in two ways, kȟoktópawiŋǧe (combining kȟoktó with one hundred, ópawiŋǧe) or khektópawiŋǧe or by stating ten-hundreds - ópawiŋǧe wikčemna. (Here I will use khektópawiŋǧe *e* for one thousand exclusively):

1,100 - khektópawiŋǧe saŋm opawiŋǧe or opawiŋǧe aké waŋži

1,200 - khektópawiŋǧe saŋm opawiŋǧe num or or opawiŋǧe aké num

2,000 - khektópawiŋǧe num

3,000 - khektópawiŋǧe yamni

etc.

9,000- khektópawiŋǧe napčiyuŋk

Now for the numbers between 10,000, to 999,999.

10,000 - khektópawiŋǧe wikčemna

20,000 - khektópawiŋǧe wikčemna num

30,000 - khektópawiŋǧe wikčemna yamni

etc.

90,000 - khektópawiŋǧe wikčemna napčiyuŋk

100,000 - khektópawiŋǧe opawiŋǧe

200,000 - khektópawiŋǧe opawiŋǧe num

300,000 - khektópawiŋǧe opawiŋǧe yamni

etc.

10,000 - khektópawiŋğe wikčemna

800,000 - khektópawiŋğe opawiŋğe šágloğaŋ

900,000 - khektópawiŋğe opawiŋğe napčiyuŋk

So for a number in this range, from 1,000 to 999,999 we can express them in Lakota as follows:

587, 345 - khektópawiŋğe opawiŋğe záptaŋ saŋm khektópawiŋğe wikčemna šágloğaŋ saŋm khektópawiŋğe šakówiŋ saŋm opawiŋğe yamni saŋm wikčemna tób saŋm záptaŋ.

To read a number like this in English it might be easier to translate from the last digit to the first one, i.e., the one's digit, then the tens and so on. I will write the translation here: Five ones and four tens and three hundreds and seven thousands and eight ten-thousands and five hundred-thousands. This becomes 5 + 40 + 300 + 7000 + eight - ten thousand, i.e., 80,000 + five hundred-thousand, i.e. 500,000. Adding all of these together we get 587,345.

Let's now look at the Lakota expression for millions. As mentioned previously, the Lakota word for million is kȟoktašiča, (p. 950,NLD), whose synonym is listed as woyawa tȟaŋka (meaning, "a great count"). Woyawa tȟaŋka is also expressed in Riggs (1893, p. 47) as a million. Buechel does not have a word listed in either his grammar or dictionary. If we assume the NLD definition to be correct we can build on this to write numbers greater than or equal to one million. (It must be noted that I was unable to have a speaker relate to me a Lakota word for one million.)

1,000,000 - kȟoktašiča

If one wished to write 1,000,000,000 (one billion) he could say, since this is equivalent to 1000 millions, kȟoktašiča khektópawiŋğe. Or if one would like to express our country's (the United State's) national debt or try to guess the number of stars in the sky we might say since both are astronomically high that it is indeed Woyawa tȟaŋka! Putting in Lakota words a huge

number like the national debt (which was shown to be, according to the online debt clock, as of at the time of this writing to be approximately $13,644, 661,745,026.) would require some thought on the magnitude of the number. (This is something to note since many people have a difficult time conceptualizing what a trillion or even a billion might look like.) The naming of these big numbers in Lakota requires you to understand magnitude. It would be possible to state this gigantic number in the Lakota language with some effort. I will attempt it here if only to show the great difficulty in doing so and will compare it to the English version when I am finished. The national debt, as stated, is $13,644, 661,745,026. In Lakota it is written as follows:

13,000,000,000,000 is 13,000,000 millions (13 million, millions) = kȟoktašiča kȟoktašiča aké yamni,

600,000,000,000 is 600,000 millions = kȟoktašiča khektópawiŋǧe opawiŋǧe šákpe,

40,000,000,000 is 40,000 millions = kȟoktašiča khektópawiŋǧe wikčemna tób,

4,000,000,000 is 4,000 millions = kȟoktašiča khektópawiŋǧe tób,

600,000,000 is 600 millions = kȟoktašiča opawiŋǧe šákpe,

60,000,000 is 60 millions = kȟoktašiča wikčemna šákpe,

1,000,000 is 1 million = kȟoktašiča,

745,000 = khektópawiŋǧe opawiŋǧe šakówiŋ saŋm khektópawiŋǧe wikčemna tób saŋm khektópawiŋǧe záptaŋ,

26 = wikčemna nuŋpa saŋm šákpe,

Combining all of this together we get:

13,644,661,745,026 = kȟoktašiča kȟoktašiča aké yamni saŋm kȟoktašiča khektópawiŋǧe opawiŋǧe šákpe saŋm kȟoktašiča khektópawiŋǧe wikčemna tób saŋm kȟoktašiča opawiŋǧe šákpe kȟoktašiča wikčemna šákpe saŋm kȟoktašiča saŋm khektópawiŋǧe opawiŋǧe šakówiŋ

saŋm khektópawiŋğe wikčemna tób saŋm khektópawiŋğe záptaŋ saŋm wikčemna nuŋpa saŋm šákpe

By comparison, writing the equivalent in English, we get the following: 13,644, 661,745,026 = thirteen trillion, six hundred forty-four billion, six hundred sixty-one million, seven hundred forty-five thousand twenty-six. What should be noticed by now is the inefficiency of the Lakota counting system in comparison to the English/Western version in stating large numbers. It is also clear that since there were/are no written symbols for Lakota numbers it would be a very cumbersome system to use in a Lakota-only mathematics classroom (sans the Hindu-Arabic numeral symbols). This would explain the adaption by Lakota speakers and writers of Hindu-Arabic numeric symbols. It would be most difficult to express very large Lakota numbers in an efficient way in teaching mathematics (as is probably true in most languages) without this system. As one of the Lakota educators I interviewed stated: "...it is impossible to count to one million in one day in the Lakota language, if you do you will be going forever."

Worth noting, as I mentioned previously, is that the Lakota speakers I interviewed did not know the Lakota word for a million. Many expressed that they could, if pressed, figure out a way to say a large number in the Lakota language. One elder said this about expressing large numbers:

(So if I wrote down 10,000, you'd be able to say a word in Lakota? How about 100,000? A million?)

"A million? I could. I would have to—it just takes a little more— [laughs]"

A language instructor had this to say when I asked her about expressing large numbers: "Ahm…you could say opawiŋğe aké opawiŋğe …it'd be…(laughs.)" (So how high would you be able to go with it?) "So that's what? A thousand [sic]?" (So you'd be able

> to go up to what…ten thousand?) Yeah, you can…you just add aké …it means more, you're adding more and more."

So there they are, the counting and whole numbers in the Lakota language. Let's turn our attention now to other types of numbers. I would like to look at the other half of the number line next (meaning the negative numbers) then look at how numbers between counting numbers might be expressed (rational numbers - fractions and mixed numbers).

Negative numbers?

After speaking with participants in this study it became clear that there is no way of expressing negative numbers (numbers smaller than zero) in the language. There is no expression for negative numbers directly. For example, there is no such thing as negative one (-1) in the Lakota language. Various comments I received were:

> "Ahm…you'd have to… say less than zero. I don't know…I don't know…I wouldn't know how to explain it."

and

> "Really, I didn't—I never came across that in the language."

Given that a way of explaining numbers smaller than zero does not exist in the Lakota language a question might arise as to why? One elder explained that the Lakota number line is not really a number line, rather it is a spiral starting at zero then extends outwards:

> The way I would look at it is that our thought process is not a straight line, it's circular. They'll start out in a circle and then they'll spiral out. That's how the growth of the numbers goes, spiraling out. (So you would start at zero, at the beginning?) Yeah. (And then you would just spiral it out? So this idea of a negative number is not at all—) Not to me, yeah.

Pressing the issue further I began to think about perhaps using words in the Lakota language to help express ideas commonly used in expressing negative numbers in the

mathematics classroom. Typical ways of explaining negative numbers in mathematics classes include using an elevator where the ground level becomes the zero floor and all floors above it represent positive numbers while all floors below negative numbers. In the math textbook called *Transition Mathematics* (Usiskin et al., 1995) negative numbers are explained thusly:

> Negative numbers can be used when a situation has two opposite directions. Either direction may be picked as positive. The other is then negative. Zero stands for the starting point. (p.42)

A table is then given with five "situations that often use negative numbers" below:

Table 4-1

Situations for Negative Numbers

Situation	Negative	Zero	Positive
Savings account	withdrawal	no change	deposit
time	before	now	after
games	behind	even	ahead
business	loss	break even	profit
elevation	below sea level	sea level	above sea level

The *Saxon* Algebra 1 (1980) textbook states:

> In addition to the positive numbers and zero, in algebra we use numbers that we call negative numbers and these numbers are also called real numbers. The ancients did not understand or use negative numbers. A man could not own negative 10 sheep...The ancients could subtract 4 from 6 and get 2, but they felt that it was impossible to subtract 6 from 4 because that would result in a number that was less than zero itself. To their way of thinking, this was clearly impossible. (p. 6)

So, resupplied with a list of possible activities that could be used as contexts for describing the concept of negative numbers, I asked participants about debt. Here is a look at expressing debt in the Lakota language.

Debt

One Lakota language teacher expressed debt using the Lakota word ikazo: "You would…well…owing…I guess…I don't know…ikazo. Credit or whatever...you know?" (Ikazo literally means to make a mark or draw a line.) She continued offering perhaps a cultural understanding, according to values as a context for negative numbers:

> Okay that is the number of teachings that we have in the Lakota that rules…yeah that is I guess what they would call it I guess…rules.
>
> (For the whole society?)
>
> Yeah. As a whole, as a tribe, that they have to follow. If they don't follow those then they go into the negative values, and they can't correct them, then they basically just throw them out of the tribe and they have to go live somewhere else (laughs).

An elder stated:

> We would say ikazo. I think this is more of a modern term, but it's ikazo, that you put a mark, you mark that you do owe this person. You give your word. It's mainly the word. We didn't have a written language, so everything that you were communicating, you gave your word. You had to be impeccable. It was truly your word. So a lot of honesty and truth was involved in the language.

Still another elder said:

> Ikazo - means you owe . Not only with money, but I know that maybe lending out some material stuff. You expect something in return if they said they was gonna pay you back. If they didn't say they was gonna pay you back, well—(laughs).

Finally a parent stated:

> (...I know there's a Lakota word for "debt." How would you say "I owe somebody $5"?) "You borrowed it, so that's zaptaŋ olota."

An elder stated the following for the phrases I had asked in terms of borrowing as well:

(I borrowed $15 from that person.) He mazaska aké zaptaŋ owalota ye/yelo.

(I owe that man $15.) He mazaska aké zaptaŋ iwečazo ye/yelo.

(He owed me $15 dollars but he gave me $20 now I have $5 more.)

He mazaska aké zaptaŋ imičazo eyaš mazaska wikčemna num mak'ú ča waŋna mazaska akta zaptaŋ bluha. ye –yelo.

Standing Bear (1928) told a story about his father, who opened up a store on a reservation in South Dakota when he was a child (not long after the forced move to reservations):

> You white people who have 'kept store' know there are always certain customers who do not pay cash, but want credit. It was the same with the Indians. But the manner of my father's bookkeeping would have made you laugh. He never had a day's education in his life (from the white man's standpoint), but he tried to learn. If Running Horse came to the store and wanted credit for ten dollars, Father let him have the amount. Then he would get out his 'books' and draw a man's head with a running horse above it. In front of the man's face he would draw ten straight lines. If Running Horse come back and paid five dollars on account, then Father would cross off five of the lines. (p. 101)

His description of how his father kept track of records for the store is pertinent in this discussion about the Lakota word ikazo. Debt and the notion/act of borrowing and owing would seem a fruitful area to try to build up the language and Lakota phrases around the concept of a negative number.

Numbers between numbers - rational numbers

Some fractions can be expressed in the Lakota language. One-half is okhise. Okhise also means fifty-cents or a half-dollar. All elders easily spoke this fraction. One Lakota language teacher however had great difficulty in stating this fraction: "that's just it, what is a half (in Lakota)?"

One-fourth was a fraction that came with a little more difficulty in terms of being expressed. One elder stated one-fourth to be šokéla, which is the Lakota word for quarter - twenty-five cents. And still a speaker stated: "I wouldn't know how. It's something I would have to think about."

Speaking with a parent I asked:

> (So even in your own experience, speaking the Lakota language, would you know how to say "one-fourth" or "two-thirds"?)
>
> I would know "half," but I wouldn't know "one-fourth" or "two-thirds." It would be čonala (a few). There are words that are descriptive. The way we say things is descriptive. If I were to translate fractions, I would say okhise and then that's money, too. "Fifty cents" is okhise. And "fourth," I'm not sure, "two-thirds," I'm not sure.

All other fractions came with great difficulty for most Lakota speakers. When I asked a speaker to express fractions like one-eighth or two-thirds he responded: "This is ...one-eighth, I don't know. These two are kind of like—I've never used them or heard them, so I wouldn't know. Or even two-thirds, I wouldn't be able to do that." It is not that these can't be expressed in the Lakota language. It is just that most speakers had never given the idea of expressing fractions much thought. Riggs (1893) reaffirms this notion that expressing fractions outside of one-half is not a natural part of the Dakota language:

> The Dakotas use the term hanke*, one-half*; but when a thing is divided into more than two aliquot parts they have no names for them; that is, they have no expressions corresponding to *one-third, one-fourth, one-fifth*, etc. By those who have made some progress in arithmetic, this want is supplied by the use of 'onspa' and the ordinal numbers; as onspa iyamni (*piece third*) *one-third*; onspa itopa (*piece fourth*), *one-fourth.* (p. 73)

A note is provided below this explanation in Riggs stating, "The language more recently adopted is kiyuspapi, *divided*. So that one-fourth is topa kiyuspapi wanzi" (p.73). Of note is the

fact that this word is also in the Lakota dictionary (BLED, p. 313) whose meaning is roughly the same - to break into pieces, divide. Using this notation of placing the number 1 (wanzi), the dividend, and the divisor, 4 (topa), in the example given allows the language a possible way to express fractions as well. Thus it would seem that two-thirds could be expressed as yamni khiyušpapi nuŋpa. That is two divided into three parts.

A Lakota educator had a similar explanation for the expression of fractions not one-half in the Lakota language stating:

> Okay, fractions**,** like 1/4...(writes on board), this 1/2 is *okise*, tópa khiksa is 1/4, šágloǧaŋ khiksa (1/8) that's eight , aké šakówiŋ khiksa -sixteenths, and they keep going on...by halves...okay.... wikčémna yamni saŋm nuŋpa Kihiksa - 1/32. Keep going into fractions like that...or if you are going to do thirds. yamni ksa...one-third.
>
> (So its just the name of the number and cutting?) "Yeah, the cutting."

(Author's note, after consulting with a linguist who studied the Lakota language and with the Denver-area Lakota woman I mentioned earlier, khiksa doesn't appear to be a Lakota word. I may have made a mistake in writing what I heard. I do believe it is from the Lakota word ksa - to cut.)

The expressions of fractions I heard from speakers able to express them had fractions with a numerator equal to one. What about fractions with a numerator other than one? Though I had no guidance on this matter it seems possible to express these fractions in the language. The expression of 2/3 in mathematics can be explained as the addition of two fractions whose values are 1/3 and 1/3. In Lakota we just saw that 1/3 can be expressed as yamni kihiksa. If we use the Lakota word na, which means "and", we can come up with a mathematical expression for two thirds in the Lakota language: yamni khiksa na yamni khiksa. In the language we would be

stating 1/3 and 1/3 (literally), but this literal description taken as a whole means two-thirds. Did this make sense to a Lakota speaker?

> (...I wanted to run this by you. If you've never seen this before (2/3) but you have seen this (1/3) and if this makes sense as a way of making fractions, like what _____ said, you can then say—you don't have a word for this (2/3), but you have a way of describing it, so you can say " yamni khiksa," right? "na yamni khiksa ". And that would be two-thirds, correct?)
>
> "Mm-hmm."
>
> (So you could possibly come up with a way of describing those fractions?) "Yeah."

Thus it seems we can build words for fractions in the Lakota language whose numerators are not one. So there are ways of expressing five-eights, seven-tenths or any fraction between zero and one for that matter:

5/8 = 1/8+1/8+1/8 + 1/8 +1/8 = šágloǧaŋ khiksa na šágloǧaŋ khiksa na šágloǧaŋ khiksa na šágloǧaŋ khiksa na šágloǧaŋ khiksa.

7/10 = šakówiŋ khiksa na šakówiŋ khiksa na šakówiŋ khiksa na šakówiŋ khiksa na šakówiŋ khiksa na šakówiŋ khiksa na šakówiŋ khiksa.

This obviously is not a very efficient way of expressing factions especially if we began to consider expressing a fraction like 27/32 in the Lakota language. But, this is actually a good teaching tool. As a math teacher I can recall trying to teach students how to use a ruler to measure distances (line segments drawn on a piece of paper). On a standard ruler (or on most rulers) halves, fourths, eighths and sixteenths are present. Finding the length of a line segment with a ruler AND using the Lakota language to teach the process might help Lakota students come to understand how to use a ruler and how to name the fractions. The numerator in any fraction tells us the number of pieces we have measured. The denominator tells us the number of equally-sized pieces that the whole has been broken into. So in Lakota when we find the length

of a segment, say 3/8 - the count itself that is the number of times you say šágloǧaŋ khiksa (1/8 +1/8+1/8) would give you the numerator of 3.

More discussion around the idea of expressing fractions is necessary. Adopting the use of the Lakota word khiyušpapi seems to be a more efficient way of expressing fractions. Of note, we have not discussed mixed numbers yet. I did not bring that type of number up with any Lakota speakers but again, I think Lakota language speakers could find a way of expressing these types of numbers especially given the fact that mixed numbers can be described in the English language as a number added to a fraction. Thus, 5 3/4 for instance is 5 + 3/4. In Lakota you could say Záptaŋ na tópa khiksa na tópa khiksa na tópa khiksa. Another way to do this would be to multiply 5 times 3/4. In Lakota (as we shall see) multiplication can be stated as akhigle (times with numerals) and yuota (multiply). So you might say záptaŋ na yamni khiyušpapi num yuota akhilge. (I am not sure of the correctness of this, it is a good attempt in the least, I think.)

In stating these things I am offering something to start a conversation around the idea of using the language to teach mathematics if it hasn't been discussed before. I was unable, when doing research on Lakota numerals, to find anything other than the counting and whole numbers. I find it difficult to believe that of all the Lakota speakers who have gone through our educational systems in America since the late 1800s that no one would have put their minds to describing mathematics, especially mathematics around numbers, into the language.

I am still more surprised that many of our living speakers seemed to have separated the learning of mathematics as an "in-school" function only and did not attempt to find a common ground with it and the language. Perhaps, I should not be surprised given that most people the world over would disassociate mathematics from daily activities. Still, given that I know Lakota speakers who have worked construction over the years it is hard for me to fathom that every time

they pulled out a tape measure that they wouldn't have asked "How would I say this in Indian (Lakota)?"

This completes the look at the types of numbers and their descriptions expressed in the Lakota language. As a summary, all counting numbers and all whole numbers can be expressed in the language. The Lakota number system is a base-ten system. The names of numbers in this system seemed to have derived from the way in which Lakota people have historically used their hands to count. There is no conception of negative numbers in the Lakota language. Finally, most rational numbers are not expressed in the language. Given this, much can still be described in the language, especially fractions and contexts that might help describe what is not currently available in the language so that at some point in the future mixed numbers, all rational numbers and negative numbers can be included in a discussion about Lakota numbers.

Operations (Addition, Subtraction, Multiplication and Division)

Addition

I showed an elder the following mathematical expression and asked him to say it in Lakota: 5 + 3 = 8. He responded, "Zaptaŋ na yamni he šágloǧaŋ." The language used by this elder was also used in a middle-school Lakota language class in problems which were demonstrated on a worksheet:

wanži na wanži = _____

šákpe na šákpe = _____

Another elder offered this as another way of stating the mathematical expression 8 + 3 = 11. "Šágloǧaŋ akta saŋm yamni kin aké wanži." Saŋm and na Lakota the same way, but saŋm seems to be more likely to be traditional.

A parent and former Lakota language teacher mentioned that she teaches her child at home in the Lakota language all the operations - addition and subtraction as well as multiplication and division. She stated, "Me and my little grandkid were doing pluses. And before Christmas, the other granddaughter, she was doing that, too, pluses... nuŋpa na wanži tona he?

Clearly addition is something that is easily expressible in the Lakota language and is being used in the Lakota language classroom. Using the word na for the term addition and also in place of the symbol for addition, seems to be customary. Two other words that came into my conversations with elders when speaking of addition was akağapi - which means "something made in addition to; falsehood; exaggeration (BLED, p. 67) and akhe' ȟokte which, an elder explained, meant "add some more."

Subtraction

A worksheet in the middle-school Lakota language class where subtraction was being taught used the following examples:

wanži yuȟeyab iču wanži _____

šakówiŋ, yuȟeyab iču záptaŋ_____

Yuȟeyab iču means to remove something. So wanži yuȟeyab iču wanži means to remove one from one and šakówiŋ, yuȟeyab iču záptaŋ means to remove five from seven. Thus yuȟeyab iču is used to signify subtraction in the mathematical sense. The mathematical expression for subtraction was stated by a Lakota educator as follows:

9 - 5 = 4. Napčiyuŋka etaŋ záptaŋ yuȟeyab iyaču kin tópa.

Literally this means, nine - from five - you remove - and have four. That is, five removed from nine leaves four.

A key question here, as I brought up before, is the need to extend this notion to include negative numbers or at least a way to express negative numbers. If we asked the question in Lakota: Zaptaŋ etaŋ šakowiŋ yuȟeyab iču. Tóna luha he? What would a Lakota person say in response? Slolye šni (I don't know.)?

Multiplication

The two operations, multiplication and division are expressible in the Lakota language. Let me reiterate here the notion that these concepts weren't always easy to express for most of the speakers even though they do exist. One elder stated: "Multiplying....let's see...(long pause)... I really don't understand that word. When I was growing up we hadn't spoke English...we spoke Lakota." Another elder stated, "I couldn't think of it right away." More work needs to be done in looking for ways in which Lakota speakers can find contexts for multiplication and division. (One such context is found in calculating areas. I talk about area with elders and will that conversation in the mathematical activity of locating.)

A Lakota educator had written the multiplication problem 5 x 2 on the board for me during our interview when I asked him about multiplication and the Lakota language and stated, "Two times five.... Zaptaŋ nuŋpa akhiyagle." He then said "Loyuota -means you multiply. Zaptaŋ nuŋpa akhiyagle loyuota." Then he asked me, Tóna luha he? (How much do you have?)

Yuota - a multiplication - to multiply something, make something plentiful (NLD, p. 956)

akingle - multiplication

The mathematical expression 3 x 4 = 12 was stated by another Lakota educator as follows:

3 x 4 = 12. "Yamni tópa kigle ilawa kin aké nuŋpa."

I had heard prior to this study that a special case exists when expressing certain groups of numbers. For instance if we wanted to express groups of numberes, say groups of two or groups

of five. In the Lakota language this could be done by repeating that number twice. So if I wanted to say groups of four in Lakota I'd say tóbtób. I asked a Lakota educator this in the case of seven groups of sevens and he responded that this was stated by saying šakšakówiŋ. There is not a rule of thumb in the expession of reduplication for numerals. So for groups of three, or two sets of two etc., I still need to find the ways in which these are expressed. A point of emphasis is that this is not mulitplication of a number by itself, but more a way of expressing groups of things arranged in common denominators (groups of five, groups of ten, etc.).

Riggs (1893) provides some insight into this characteristic of within the Dakota language:

> The reduplication of a syllable in Dakota verbs is very common. In intransitive verbs it simply indicates a repetition of the action; as, *ipsica*, to jump, i*psipsica*, to hop or jump continuously; *iha*, to laugh, *ihaha*, to laugh often. In transitive verbs it either indicates that the action is repeated on the same object, or that it is performed upon several objects; as *yahtaka*, to bite, *yahtahtaka*, to bite often; *baksa*, to cut a stick in two; *baksaksa*, to cut a stick in two often, or to cut several sticks in two. Verbs of one syllable are rarely reduplicated. (p.69)

(Author's note, according to a Lakota elder, ihaha means to make fun of somebody in the Lakota language, not to laugh.) Furthermore, in describing numeral adjectives Riggs (1893) writes "Numeral adjectives, used distributively take the reduplicated form; as *yamni*, three, *yamnimni,* three and three..."(p.73).

Division

Initially division seemed a tougher concept to define. However, it is something that is done quite naturally in daily life. You can take a whole and break it up into pieces when dividing. There are obvious connections to fractions since a fraction arises by dividing a quantity by another quantity. In the cases I was seeking I asked a Lakota educator how you might say cutting a cake into eight pieces and also how you would divide up an object so that all can get a piece. Finally I asked about how to express a division expression in the Lakota

language: Here is the first scenario: I have four kids with me and two pieces of gum. If I break each piece of gum into two pieces all four kids will get a piece of gum. "*Cansi num bluha na wakanyeja topapi. Hoca cansi kin hena nunpakiya kiwakakse kin wakanyeja topapi hena cansi hanke icupi kte ksto/yelo*." The second scenario is this: cut the cake into 8 pieces. "*Waskuyeca he saglogankiya waksa ye/yo*." Finally, the mathematical expression for division can be stated as follows: 6 divided by 3 is 2. *"Sakpe yamni kiyakase kin nunpa."*

Thus it seems, the operations of addition, subtraction, multiplication and division are expressible in the Lakota language and thought has already been given to how to communicate mathematical expressions involving arithmetic with the Lakota language. I am not fluent enough to translate directly the meaning of these operations.

What about money - *mazaska*?

A context for counting comes in the way of currency. The Lakota have adapted to the US monetary system and have expressions for the various values of coins and money currency. *Mazaska* is the Lakota word that denotes money. *Mazaska* literally means iron - white or white iron, which is a description of the reflective quality of the metal in early trading with the fur traders. Bushotter (n.d.), a Lakota born in 1864 left an account of his life, written in the Lakota language. In his autobiography he describes coming across the concept of money for the first time. He stated: "It was five cent pieces they offered me; and only after my mother took and converted them into candy at the store did I know what their value was" (Bushottter, n.d.).

I will list here the terms shared with me by Lakota speakers for the different coins and will describe how to say various amounts of money in the Lakota language: Fifty-cents, as we have seen when we talked about fractions is expressed as okhise. A quarter is called šokéla (sometimes it is pronounced to sound like "shogela.") (whose translation deals with the thickness

of the metal), Dime is kašpapi - (in lakota meaning "a slice of"), a nickel is kašpapi okhise (half a dime - five cents). Finally, a penny is mazašala (again deals with the color of the copper penny - red metal). One dollar is expressed as mazaska waŋži. You might guess that fifteen dollars is mazaska aké záptaŋ. In Lakota the value of something is stated as the object that is being measured first then the quantity of it thereafter. This is true of measuring distances, (miles, feet, inches) or in telling time (hours, minutes, seconds) and in speaking of the temperature. If there is a specific numerical value needed it will follow the word denoting what you are measuring. (We will see more of this in the activity of measuring). Thus $25.05 would read, "mazaska wikčémna num saŋm záptaŋ saŋm kašpapi okhise." An elder shared with me that $25.04 would be said this way: mazaska wikčémna num saŋm záptaŋ saŋm mazašala tób. If we have a group of coins that add to 87 cents it would be expressed by stating: Kašpapi wikčémna šágloǧaŋ saŋm šakówiŋ. A definition of kašpapi in the NLD gives an example of expressing the value of a group of coins, "Le kaspapi napciyunka. *This one is ninety cents. (p.274)."* Definitions of the coins as seen in the NLD are given below*:*

kašpapi - dime, ten cents (also applied to coins in general)

kašpapi okhise - nickel, five cents literally half- dime.

mazašala - penny - (maza-sha-la) sa - red.

šlu šlutA - (having spent all one's money), penniless (to be broke) -

maweǧe "I am broke." (An elder stated this way of saying broke)

šokéla - quarter (sho-ke-la) - a quarter section of something; a quarter of a dollar,

twenty five cents.

mazaka - dollar - - mazaska wanji - one dollar,

mazaka thipi - Bank

Special meanings of numbers

"It is curious to find the number seven occurring so frequently in their tribal and family divisions. Of the whole tribe there were seven bands or "council fires;" of the Spirit Lake band there were seven villages, and of this great body of the Dakota Nation there are still seven divisions or subgentes" (Riggs, 1893, p. 187). In a footnote included he states "I have found many examples of the use of mystic numbers among cognate tribes, e.g., seven, four, ten (7 +3), twelve (4 x 3) and in Oregon, five" (Riggs, 1893, p. 187).

George Catlin, in the 1830s, offered the same kind of incredible analysis when looking at the number four in Mandan culture:

> The Mandan chiefs and doctors, in all their feasts, where the pipe is lit and about to be passed around, deliberately appropriate the good-will and favour of the Great Spirit, by extending the stem of the pipe *upwards* before they smoke it themselves; and also as deliberately and as strictly offering the stem to the four *cardinal points* in succession, and then drawing a whiff through it, passing it around amongst the group.
>
> The *annual religious ceremony* invariably lasts *four* days, and the other following circumstances attending these strange forms, seeming to have some allusion to the *four* cardinal point, or the "four tortoises," seem to me to be worthy of further notice. *Four* men are selected by Nu-mohk-muck-a-nah (as I have before said), to cleanse out and prepare the medicine-lodge for the occasion - one he calls from the *north* part of the village - one from the *east* - one from the *south*, and one from the *west*. The *four* sacks of water, in form of large tortoises, resting on the floor of the lodge and before described, would seem to be typical of the same thing; and also the *four* buffalo, and the *four* human skulls resting on the floor of the same lodge - the *four* couples of dancers in the "bull-dance," as before described; and also the *four* intervening dancers in the same dance, and also described
>
> The bull-dance in front of the medicine-lodge, repeated on the *four* days, is danced *four* times on the first day, *eight* times on the second, *twelve* times on the third, and *sixteen* times on the fourth; (adding *four* dances on each of the *four* days.) which added together make *forty*, the exact number of days that it rained upon the earth, according to the Mosaic account, to produce the Deluge. There are *four* sacrifices of black and blue cloths erected over the door of the medicine-lodge - the visits of Oh-kee-hee-de (or Evil Spirit) were paid to *four* of the buffalos in the buffalo-dance, as above described; and in every instance, the young men who underwent the tortures before explained, had *four* splints or

> skewers run through the flesh of their legs - *four* through the arms and *four* through the body (Catlin, 1973, pp. 205-206)

The two accounts of the spiritual incorporation of the number four and seven into the ceremonial and structural lives of the Dakota and the Mandan speak to special importance placed on numbers by Indian people. The Oglala are no different in this regard. Beckwith (1930) writes a similar account when talking about numbers in the stories she collected from some Oglala people:

> Again, the use of the number four for repetitive acts or for groups of objects or individuals is symbolic rather than realistic in treatment. The rehearsal of four successive awakenings of the child, of four days of successful hunting in which he brings in a progressive series of game animals, the tentative ring-throwing before the ring is finally tossed the fourth time, the four Lightning brothers, the four arrows, all follow a ritual pattern rather than an attempt to picture an actual happening. In other tales we find four guardian animals, four magic objects given by four supernatural helpers, a visit to the four winds, four tests put to the hero. (p. 341)

For the most part the people I interviewed had varying degrees of knowledge of the special significance of numbers in Lakota culture. One educator stated:

> Yeah, there's fours and sevens, everything's in fours, like four seasons, four directions, and then in seven too, seven also…like sacred meanings, ceremonial type, and then twelve because along time ago they used to have 12 tipi poles, and then when they had the seven council fires each tipi pole had 24 teachings and they had to go through every single one of them in order to make sure the tribe was going according to each one.

Whereas the other comments I received were **"**Special meaning?...not really." or "I don't recall any."

This signifies the end of the look at the first mathematical activity of counting. The Lakota have a base ten system by which they count. They do not know negative numbers or the vast majority of rational numbers. They can express certain fractions, zero and infinity. They

can also state very big numbers. The counting system may have been based on counting off their fingers in a systematic fashion. As a context for mathematics in the Lakota language there is great potential since there are ways of describing all four arithmetic operations and there are contexts aplenty to which Lakota speakers can apply their language to invent or express various mathematical concepts related to counting.

Chapter 5: UMA #2 - Designing – *Tioti wakan*

Barta et al. (2001) included in designing the purposes of shapes, their spiritual significance, their names, names of angles and what patterns were important and how they were constructed and designs for clothing. Included in this mathematical activity in relation to Lakota culture are the names of shapes with their cultural significance (if they had any). In addition to names of basic shapes, various other shapes were also included that are not typically included in standard math texts but were used in beadwork, quillwork and seen in designs on the reservation as well as in the school.

It must be stressed here that some of this information, like the names of basic geometrical shapes (circle, square, triangle, rectangle, star), is easily obtained in the BLED and LLD Lakota dictionaries. The names of these shapes were readily available to students at *Isna-Wica Owayawa*. The text used in the Lakota language middle school class entitled *Lakhotiya Woglaka Po! Speak Lakot*a! listed the names of basic shapes on (p. 24). These names and drawings of them hung on the walls of the Lakota middle school classroom. Many Lakota designs were on full view for all to see at *Isna-Wica Owayawa*.

What also must be stressed is that not many of the speakers I had spoken to knew the names of all these basic shapes. Some gave different names. Circle was easily stated and so too square, rectangle and star. However shapes such as a pentagon, hexagon, octagon, etc., were not typically expressed. Also, many shapes had cultural meanings though these meanings were unknown to all but one person. Designs signifying mythical beings within the Lakota belief system were offered to me by this individual - a Lakota educator. He expressed that some geometric designs existed that symbolized Iktomi, Iŋyaŋ Hokšila (Stone Boy), Tioti Wakȟaŋ (the

Four Stops), and alluded to their connections to the Wičaȟpi Hiŋȟpaya (Falling Star - Star People).

It was difficult to find the space and people to observe the construction of these designs, whether in beadwork or star quilting or with any kind of craft. Thus, the thought process that went into making these designs and their creation by hand is omitted from this study. I did get a short explanation of how the "War Bonnet" design was constructed. Further study on this process is important since the creation process might have a place in the teaching of geometry to K-8 Lakota students.

I was able to find a great resource concerning Lakota designs entitled *Quill and Beadwork of the Western Sioux* (Lyford, 1940). This study included a far more extensive look at designs used in beadwork and quillwork than I gave within the context of my own study. I included images and explanations of the meanings for many designs from this resource in my analysis to supplement what was shared with me by participants and also to provide the reader with an understanding that I am really only scratching the surface with this look at designing within the Lakota culture.

There are many other Lakota cultural activities that had the potential for study under the mathematical activity of "designing." Not seen was a look at the artwork done on shields or the paintings done by artists in the area. *Isna-Wica Owayawa* has many murals depicting scenes from historical cultural events hanging on the walls of the hallways, the library and the gymnasium. These events include "The Great Race", the Sundance, the Coming of the White Buffalo Calf Woman among the Lakota, and the Ghost Dance, to name a few. Should these be included as a part of the mathematical activity entitled "designing?" I decided not to include them in this portion of the analysis. Deciding to leave them out is in part justified by keeping in

mind that we would like to look at these activities with a mathematical eye whose final purpose is to try to find a fit for them in the Lakota mathematics classroom (if they are not present already). With this in mind I concentrated on geometric shapes (regular polygons, circles, stars, etc.). It isn't just the names of shapes and their construction that is important in looking at the mathematics found in the activity of designing. Other forms of mathematics spring from these shapes, like the uses of symmetry, perspective, patterning, etc. I will comment on some of these contexts later. All would agree to the obvious fact that designing and constructing geometric shapes have a natural place in all levels of mathematics.

Names of Shapes

Found in the textbook, *Lakhotiya Woglaka Po!* (p. 24), are the following shapes and their names: A line is named ičazopi*;* triangle - oise yamni; square - obluthuŋ; rectangle - obluthuŋ haŋska*;* circle - mimela, *mimela;* star - wičhaȟpi, *i*; diamond - pȟestola. Looking at the names of shapes in the NLD a pattern arises for naming shapes. The names of shapes in Lakota are based on the number of corners of the object *(*oblo means "corners - as of a square or cube where three sides meet, an angle (p. 368)"). Theoretically then we can name all polygons in the Lakota language. A list of the names of these shapes (some taken from the NLD - page number is included if they were taken from NLD) and the corresponding number of corners is included in Table 5-1 below:

Table 5-1

Names of Shapes

Number of corners of an object	English name of shape	Lakota name of shape
three	Triangle (p. 1069)	oise yamni *or* oblo yamni
four	Rectangle (p. 1000)	obluȟuŋ haŋska
four	Square (p. 1041)	obluȟuŋ
four	trapezoid (p. 1068)	obluȟuŋ kaitebya
four	diamond (p.854)	pȟestola
five	Pentagon (p.975)	oblo zaptaŋ
six	Hexagon (p. 910)	oblo šakpe
seven	Sexagon	oblo šakowiŋ
eight	Octagon (p.964)	oblo šağaloğaŋ *(p.368)*
nine	Nonagon	oblo napčiyuŋka
ten	Decagon	oblo wikčemna
many corners, angular	n-gon	obluȟuŋtȟuŋ *(p.368)*

It is one thing to get these names out of a dictionary and another to see how they are named (or not) among Lakota speakers of Oglala. Most everybody I interviewed (adults) knew the Lakota name for circle (mimela). However circle was expressed in a couple different ways: mimela, gmigma *(*gmigma means round*)*. Square was also expressed differently by some of these participants as obluȟuŋzi and ohi topa. The Lakota elder who expressed a square as ohi topa also stated that an eight-sided figure would be expressed in Lakota as ohi šağaloğaŋ. From her it seems that any shape could be expressed by stating ohi followed by the number of sides (or corners). This way of stating polygons was not echoed by any other speaker and I do not know the correctness of this way of naming polygons. Ohi according to BLED means, "to be able to reach to, tall enough to reach up to, long enough to reach down to." Another elder had explained to me that in stating a shape in this manner it signified the action of reaching from one corner to another. So if we stated a square as " ohi topa " it would mean that we would reach four times in succession to get from one corner back to the original corner.

Triangle was stated as "Yamni, our words, it's backwards, "ohiye yamni oblazo yamni." Star was easily expressible (wičhaȟpi) What about a line? ″I'll probably say, _ ičazowe __. I'll probably describe it. _ičazowe." There were some shapes/objects that were included in my discussion about shapes with participants that are not typical of shapes seen in mathematics curricula but were expressed to me by elders. These included the arrow, called wahinkpe, and a ball, tȟapa.

Special significance of basic shapes

As far as special significance of shapes goes one person was able to share with me his knowledge of the meanings of some of these shapes. Caution must be used here in thinking that all basic shapes have universal names among the Lakota. Lyford (1940) states,

> Just as the Sioux beadworker often named her design after some natural object, after she had looked over the finished work and noted some resemblance, so she sometimes used it as a symbol of some mystic idea or tribal scene. Because individual women occasionally used design in this way there has grown up an impression that this was regular practice and that there was almost a language of beadwork, capable of telling a complicated story which any Sioux would understand. This impression is not confirmed by inquiry among individual beadworkers. It seems rather, that each woman named her design as she saw fit...The design might be indeed a symbol, but only for its maker. (p. 76)

These designs are personal. They may be designs from within a family. They may come from visions or dreams. "A special design might be adopted by any person as the result of a vision or some important event or exploit" (pp. 79, 81).

The personal use of certain designs was commented upon by a Lakota elder/educator:

> I know a little bit of this on my own, because—I don't know if my husband had it. He's got a peace pipe bag, so I just went ahead and used that, but my children's outfits are rainbow colors. The backgrounds are usually yellow, red, blue, and white. It's always that, no matter what. And right now, I'm doing my youngest son's outfit (powwow), and his is yellow background, but I still have those. I have to write out something about it. Like he says, the four stages of the earth, and that's kind of like what I have, plus the rainbow. So one of my daughters has all

> rainbows, and my son. The inside of it is the ___. So that's in the middle. That's how I have it. And then the four this way, too.

So, universal meanings for designs cannot be assumed though the design of some can logically lead one to conclud what it might represent. One elder was unaware of many of the meanings of these symbols as she talked about the use of colors within the medicine wheel:

> I never really noticed. You know, I never really noticed until just lately. I don't know where it came from, because when I grew up, I didn't know the circle like that...that color. I didn't know that (meaning the medicine wheel colors).

With this in mind what was shared with me about some basic geometrical shapes and their meaning according to one Lakota educator follow. According to him the rhombus, rectangle, square and a combination of triangles symbolized a lake, Stone Boy, feathers and a tipi, respectively:

Ble

"That's a lake. This also represents a lake too." So the diamond shape or rectangle was a symbol of a lake "ble."

Figure 5-1. Ble

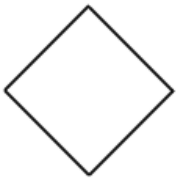
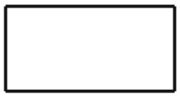


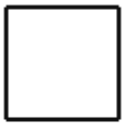
Figure 5-2. Ble



Iŋyaŋ Hokšila - Stone Boy

The square was a symbol for a mythical cultural hero named Stone Boy. "And the square is the Stone Boy story."

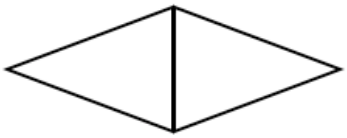
Figure 5-3. Iŋyaŋ Hokšila



Feather

The diamond shape formed by placing two congruent isosceles triangles together at the base formed a symmetric shape, which designates a feather:

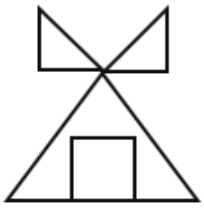
Figure 5-4. Feather Design



Tȟipi

"This is *yamni iya* a triangle. This is a home, a tipi. And then they had a door to it and the flaps. Some have intricate designs on it. " The tipi design is made from three triangles as shown below - for the door a square is added.

Figure 5-5. Tȟipi Design

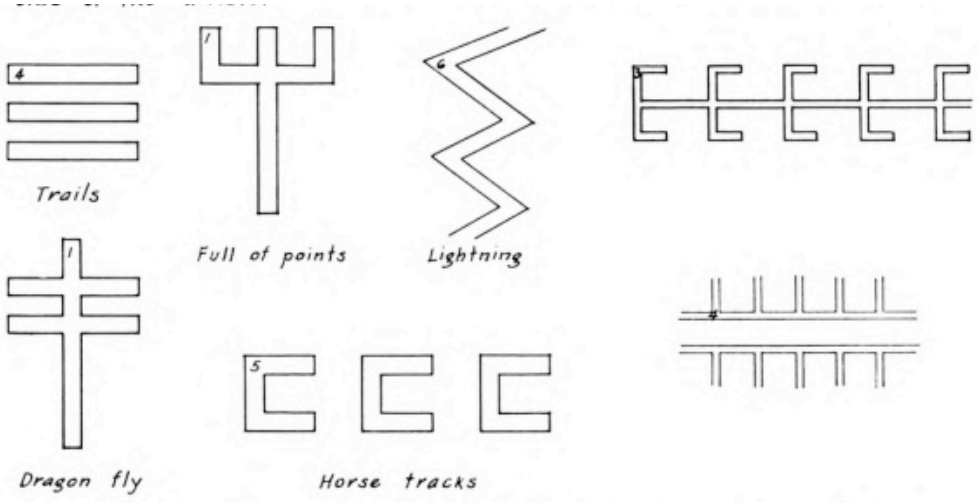


The line, triangle, square and rectangle provide what Lyford calls "design elements" in Lakota quill and beadwork.

The line

> The straight line or narrow band, usually the width of several beads, has been used in simple arrangements since the days of the early porcupine quillwork. The lines are continuous, parallel, or crossed, occurring alone or as an attachment to their design elements. Joined at angles of different degrees, the straight lines are used to form the box, the rectangle, the dragon fly, the three pronged fork the full-of-points, and the horse track design units which form the basis of many of the Sioux design patterns. (Lyford, 1940, pp.71,72)

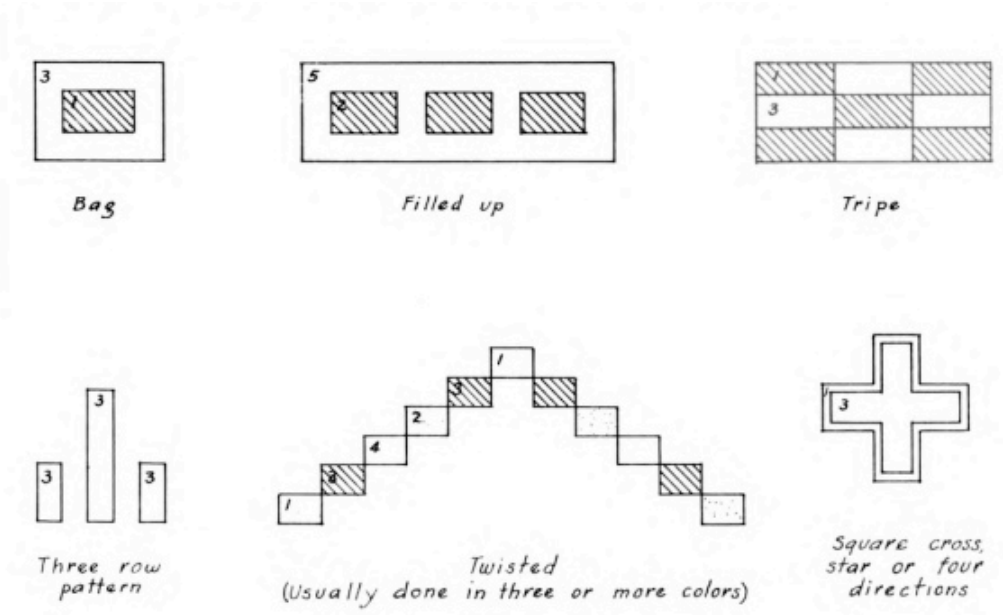
Figure 5-6. Sioux Design Elements - Lines (Lyford, 1940, pg. 73)



Squares/Rectangles

"Squares and rectangles are much used in Sioux designs, frequently surrounded, entirely or in part, by a border of contrasting color" (Lyford, 1940, p. 73).

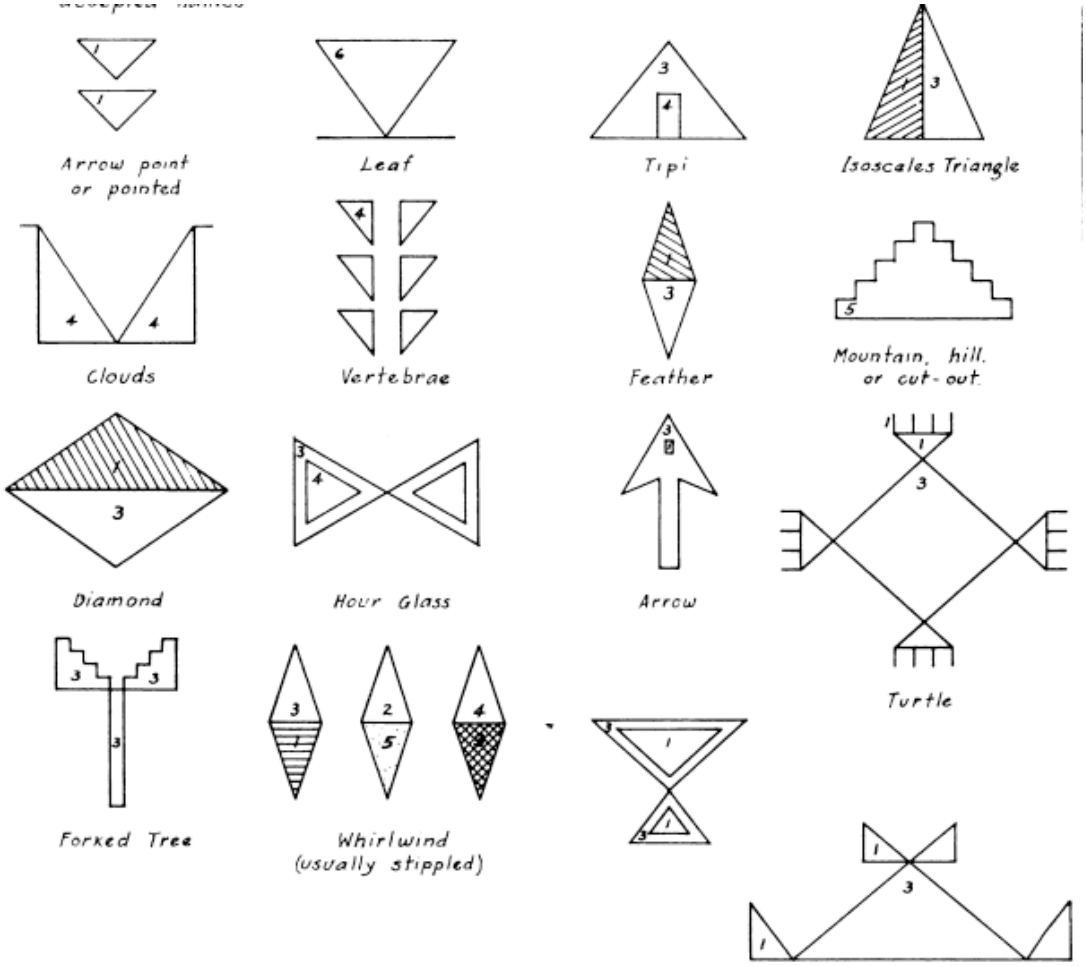
Figure 5-7. Sioux Design Elements - Squares/Rectangles (Lyford, 1940, pg. 73)



Triangles

"Triangles (equilateral, isosceles, or right angled) are much used in Indian Beadwork, alone, or in a few often repeated combinations. In beadwork the triangles are necessarily serrated or stepped. Some of the combinations have generally accepted names" (Lyford, 1940, p. 74).

Figure 5-8. Sioux Design Elements - Triangles (Lyford, 1940, pg. 73)



So, in addition to the basic shapes provided by participants in this study (ble - diamond, rectangle, Stone Boy - square and, Feather - two congruent triangles) we have additional shapes provided by Lyford (1940): the dragon fly, the horse tracks, lightning, full-of-points, and trails).

Lines, squares, rectangles and triangles formed the bases for the geometric figures in Lakota bead and quillwork.

In a statement by Lyford (1940) included above and restated in part below she implies that it was the women who did the beadwork and quillwork within the tribe and thus were the creators of these very intricate geometrical designs. : ""Just as the Sioux beadworker often named her design after some natural object, after she had looked over the finished work and noted some resemblance, so she sometimes used it as a symbol of some mystic idea or tribal scene (p. 76)." This was echoed by a comment made by an elder:

> "To me, men, always, when they did any kind of design work, it's always animals. The women did the moccasins. I really wouldn't know what the—the only thing I know about the geometric was that when my aunt did it, the design pointed out this way, it meant things that were on earth. If it pointed out this way, it meant to the universe and to Mother Earth. A lot of her designs were in four directions, but they were designs. That's where I got the concept of the creator dancing with Mother Earth. You danced with your relatives and your family. That's how I understood the beadwork. That's just the way I taught ____(his wife) how to make designs, either one direction or four directions, depending on what she wants to do, too."

So it seems that it was the Lakota women who came up with the geometric shapes seen in the designs of beadwork and quillwork whereas the men made images pertaining to animals.

There was very little discussion about the meaning of circles in Lakota culture. The circle came up in Lyford (1940). Many quillwork designs are circular and circular designs do play a prominent role in many Lakota symbols. You will see an example of this in the description of the War Bonnet design below. Lyford does state this about circles.

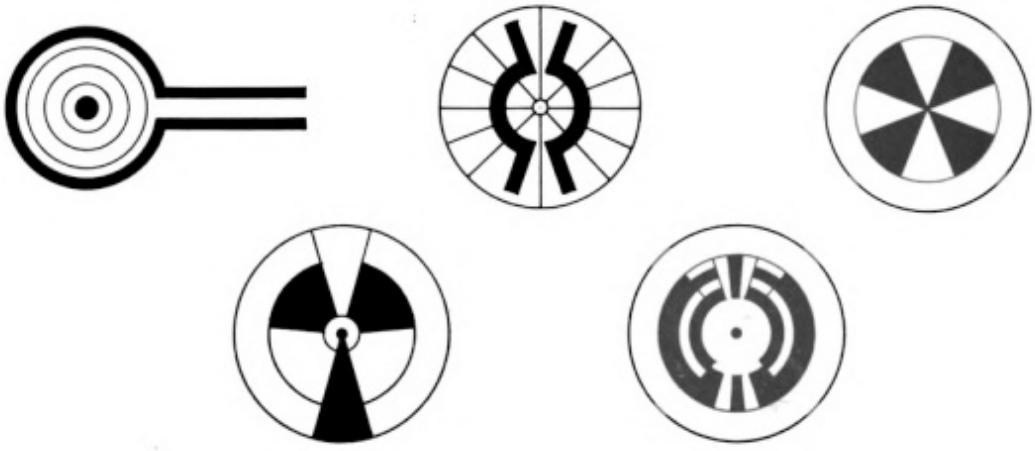
> Circular designs were used on shields, blanket bands, tents and on the large buffalo robes that served as ceremonial costumes in the old days. A large circular sun design made up of the feather element or motive and popularly known as the "black war bonnet," was painted in soft earth colors on many of the old robes worn by the men. The circular designs such as the medicine hoop or circle with a central dot were not used for decoration, but to invoke protection or for other

> symbolic purpose. Today circular shield designs are used as decorations on tents where the element of protection is symbolically invoked. (p.78)

Only one participant commented on the meaning of circles, though very briefly. "The circle, that's the sacred circle, the sacred hoop. That stands for the nation. Those are the ones that I know of. There's probably more (meaning to it)." In my journal while observing the 5th grade class I noticed a passage on the wall about the circle. It stated, "The circle has healing power; In the circle we're all equal; No one in front of you; no one behind you; No one above you; No one below you." I have included below some images of circular designs from Lyford's study in figures 4-9 and 4-10 below

Figure 5-9. Shield Design (Lyford, 1940, p. 79)

Figure 5-10. Circular Designs (Lyford, 1940, p. 94)

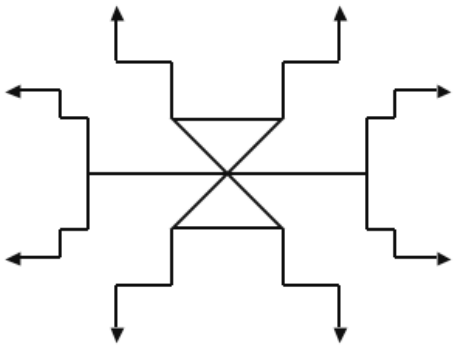


More intricate designs

Iktomi

Iktomi, which means spider in the Lakota language, is also the name of a mythical being in the Lakota belief system. He was known as the Trickster. He had a special, more intricate symbol shown below. " Iktomi - Spider...sometimes they put these on them. (the eight legs). This is Iktomi the spider he has eight legs, but this is the symbol that ours got (the hour glass symbol, commonly seen on black widow spiders)...there are different species of spider (that have this symbol)."

Figure 5-11. Iktomi Design



One elder commented on this design: "They use it in Sundance. Iktomi, the spirit. Remember ____? She said there's good Iktomis, and bad Iktomis, good medicine men and bad medicine men, and you have to know the difference. There's lots of Iktomis in this whole world. And then she talked about there are ways (ways to distinguish the good from the bad) — Bad Iktomis are all best dressed, and the good ones are not. Aata She was talkin' like that.

Tioti Wakȟaŋ, Tiotipi Wakȟaŋ - the Four Stops

> "This design is a design we use on our moccasins - this represents the earth, the four stages, four stops in the earth, *tiotipi wakan - tioti wakan* - the four stops - the people came onto the earth. There is a place in the Black Hills called *Maka Inilya* "the breath of the earth." It came out of the earth. These are the trees that covered the mountains (the triangles in the shape). These are the minerals of the earth (the lines beneath the top line). This is where our people came forth (the square at the bottom of the symbol)...So that's the symbol of that.
>
> So they said that this *Wicahpe Hinphaya*...was one of the star people, he was one of the star people that came down to earth. His mother was human his father was a star man. And he saved the Lakota many times. They walked over these mountains many times back and forth over the earth. They put those on the sides of your moccasins."

Figure 5-12. Tioti wakȟaŋ, Tiotȟipi Wakȟaŋ

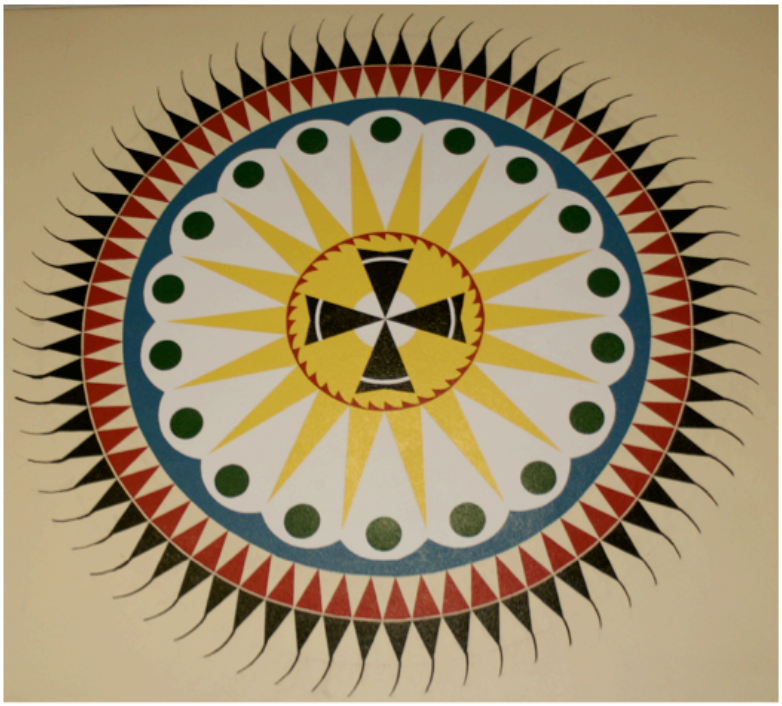
Other Lakota educators commented on this design: "All my children, their design is this, if you remember, my oldest son that dances...and the girls, too. But I have a different—it's kind of like that, but I talk to them about it."

An elder had spoken about doing beadwork:

The War Bonnet Design

The War bonnet design is a very intricate design. It is difficult for me to construct one on a piece of paper. I will put a copy of a photograph of a War bonnet design that was prominently displayed in the gymnasium at *Isna-Wica Owayawa* below.

Figure 5-13. War Bonnet Design



Construction of the War Bonnet Design A Lakota educator shared with me a synopsis of how this design was made.

> But they lay the stick down, the women and the men, when they are making that design and they notch it to get their measurements...a cross piece here - just like in quarters or sixteenths or however many there is going to be...they have to figure that out so they lay it out to get the correct figure...those are "War bonnet Designs."

A more detailed description of the making of this design - centering on the thought process that goes with planning and actually coming up with the final War Bonnet design would add much to this initial look at Lakota designing. This, along with a look at how a Lakota woman beads or does quillwork and thinks about this process is something I did not look at in this study. Along with beadwork there are other craft areas I think would be fruitful as contexts for the study of mathematics - star quilt design, and Indian dance costumes.

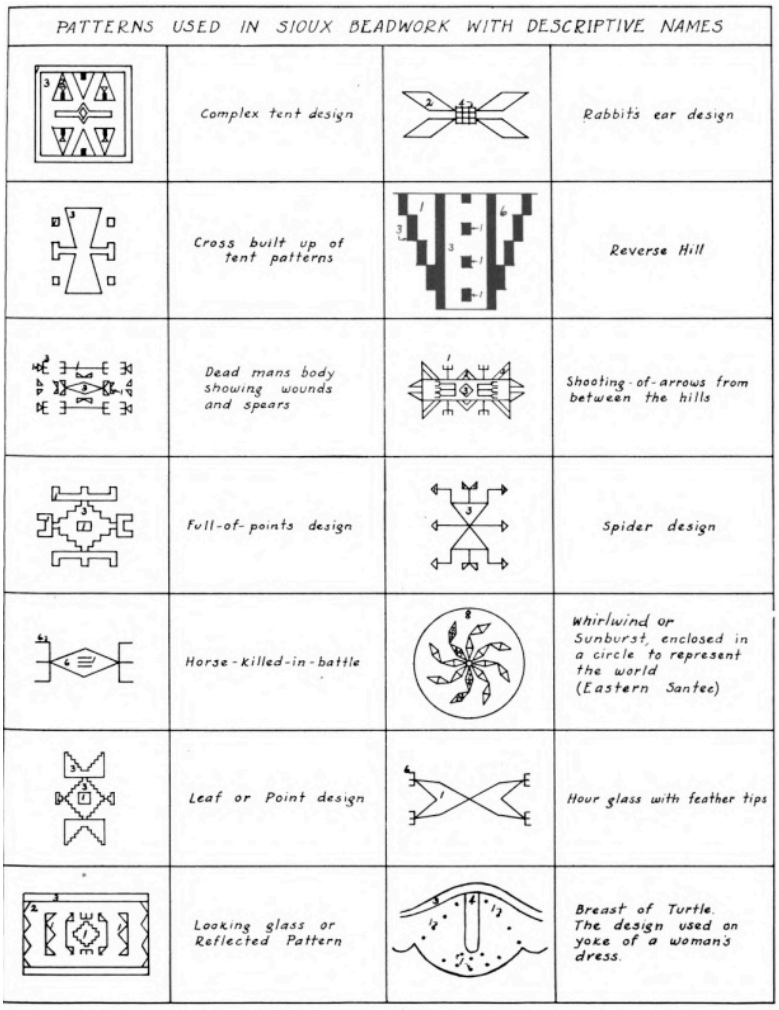
There is some craftwork that the Lakota do that I did not come across in this study: the designs painted on tipis, the design of beadwork on medicine bags, or on ceremonial objects. One Lakota educator talked about the use of symbols placed on horses. - A handprint on the back of a horse meant a fierce warrior rode that horse. She also mentioned that a red mark on the scalp meant that the person wearing that "killed somebody..." I have not talked about the Winter Count with its many symbols nor the designs found on shields etc. Lyford has many more designs from beadwork and quill work. These designs are very intricate. First I will include some of these designs with their symbolic names then I will look at one of the more intricate designs paying attention to some mathematical properties.

More Designs - Lyford (1940)

The Lakota work is rich in design, just as many, if not all North American tribes. Many people before me have studied Lakota designs, Lakota games, spirituality, the various societies, history and bands of the Lakota (not to mention the language). It seems here that I am only weaving together these various parts within this framework by using both the knowledge of current Oglala people and studies left behind by many others before me.

Figure 5-14. Patterns used in Sioux Beadwork with Descriptive Names

(Lyford 1940, pg. 77)



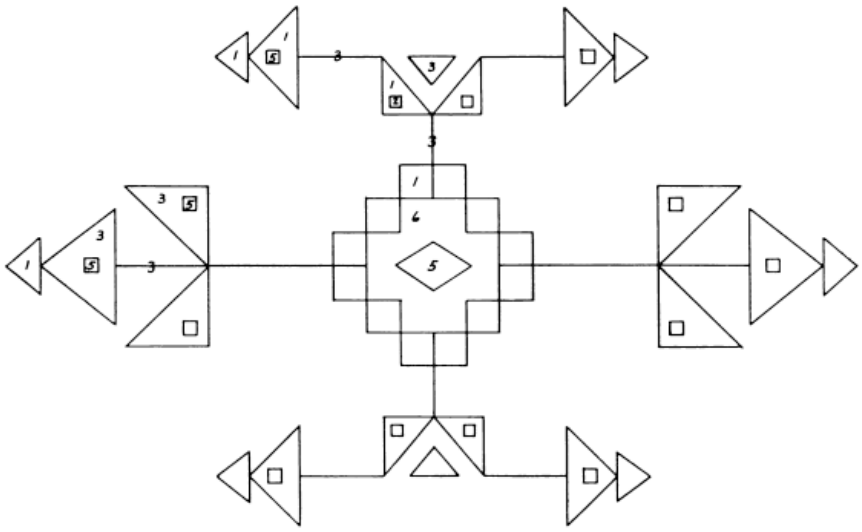
Where is the math in designing?

The inclusion of designing of as a one of the six universal mathematical activities would seem an obvious choice especially given that we have a whole area of study called in mathematics called Geometry. A look at the SD State Standards concerning Geometry for grades K-8 we see connections between designing and mathematics namely: the naming of shapes, properties of shapes, angles, lines, points, planes, translations, rotations, symmetry. The

use of Lakota designs can provide another way of naming basic shapes they can also provide a context in which to organize these shapes and classify them. In looking at the designs of the Lakota for K-8 mathematics classrooms can provide a context to analyze types of angles, similarity, congruence and properties of parallel and perpendicular lines. A fruitful look at mathematics can arise when using Lakota designs as a context for conceptualizing reflections, rotations, symmetry and translations. Finally, mathematics will arise when asking students to reconstruct the designs in the classroom or to analyze areas of designs.

I will provide a Lakota design below and comment on some of the mathematical activities or concepts that could be gleaned from such a piece. This look is by no means exhaustive. The figure comes from Lyford (1940, pg. 107).

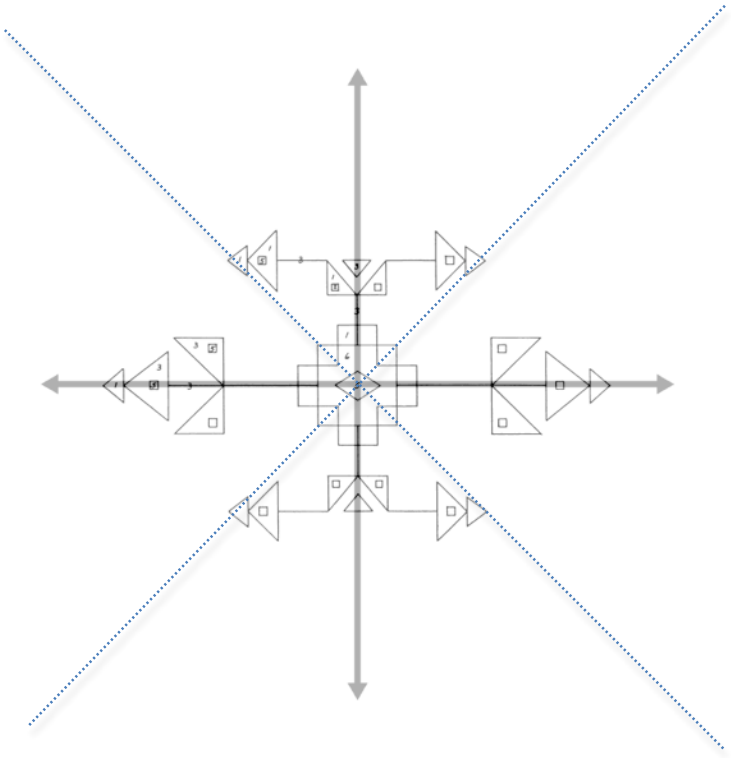
Figure 5-15. Design for Symmetry



From Serra (1997) *Discovering Geometry: An Inductive Approach*, we see a chapter on transformations. He states, "Geometry is not only the study of figures; it is also the study of the

movement of figures" (p.374). Implicit in transformations is the concept of symmetry. Serra names five types of symmetry: reflectional symmetry (line symmetry, bilateral symmetry or mirror symmetry (pp. 386,387)), rotational symmetry, point symmetry, translational symmetry and glide-translational. This provides the first context for our Lakota design. The first thing we notice about this design is the number of lines of symmetry. Placing this design on a xy-coordinate plane (see below) we see that there are two lines of symmetry for the whole design, - the x and y axes (x=0, y = 0). In Lyford's collection of designs two lines of symmetry is commonplace.

Figure 5-16. Designs for Symmetry II



Reflectional symmetry occurs over these two lines of symmetry. We can then see that there are two directions of reflections, over the lines x = 0 and y = 0. If we ignore the outer part

of the design and concentrate on the square cross portion in the middle of the design we can see two more lines of symmetry, $y = x$ and $y = -x$. According to Serra (1997) we also have, with the whole design two-fold rotational symmetry. Finally, taking the left-most cluster of triangles and then comparing it to the right-most cluster we see that we can slide this cluster then flip it over to get an exact copy of the right-most cluster giving us a look into glide-reflectional symmetry.

From a purely geometric-shape stand point we can identify various figures and concepts. These include parallel and perpendicular lines, right and equilateral triangles and rectangles, squares and a rhombus (in the center of the design).

Finally, if we wanted to move the math to algebraic applications we could give the dimensions of the sides for the shapes in the design and ask questions concerning areas. In this calculation we could see the benefit of symmetry, needing only to calculate the area of one-fourth of the design then multiplying that value by four to save us some work.

It is my hope that the reader can gain some appreciation of the mathematics involved in including designs from various cultures. Lakota designs come in many forms and offers contexts for a look at many of the concepts included in K-8 math curriculum. For a look at more advanced mathematics involved in designs I refer the reader to the work of Gerdes (1988b, 2005). Gerdes is probably the most well-known ethno-mathematician who has taken a look at the mathematics found in indigenous peoples of Africa. He suggests various forms of mathematics can arise if we take certain assumptions found in the weaving patterns of African tribes. An interesting study done with Frieze designs in Indigenous contexts by McDonald &Weston (n.d.) took a look at the designs found in indigenous peoples of the Americas to help classify Frieze designs.

Using Lakota designs as a context and vehicle for exploring geometric concepts is rich. The many designs of the Lakota found in beadwork, quillwork, star quilting shield designs, and ceremonial designs offer great potential in helping Lakota students come to understand geometric shapes, concepts and their applications. They can be used to help students identify shapes, understand congruency and similarity, parallel and perpendicular lines, and also can be useful in discussions around symmetry and translations. They offer an avenue to look deeper into the meanings of Lakota culture with connections to mythic figures like Iktomi, Iŋyaŋ Hokšila, Star People (Wičhaȟpi Hiŋȟpaya) and the story of Tioti wakȟaŋ. Finally a look at designs in a historical sense can help Lakota students see the development of these designs over time with the impact of quills, then various forms of beads. They may also show the creative ingenuity of Lakota women who are the creators of these designs and authors of their meaning.

Chapter 6: UMA #3 - Measuring – Makhiyuȟab

Let us now focus our attention on the next universal mathematical activity, measuring. Measuring, because it necessarily deals with comparing and ordering, both of which are tied to the notion of scales, is a very rich context for the learning of mathematics. Measuring in this study included taking a look at how the Lakota kept track of time historically and in present times; this meant looking at how the years, seasons and months were noted. With the coming of Western culture and Christianity the Lakota began to conceptualize time not only in winters and moons but also in the in-between (weeks) and also began to number days. Because of the influence of the clock time took on new forms of expression - the Lakota adapted words for hours and telling time. Distances provided another context for measurement. In Lakota culture distances were expressed in terms of time and thus offered a way of looking at space and time as interrelated phenomena rich in description. Since distance is not separated from time (or effort) the concept of rates was explored. Finally, a look at the expression of temperature and height offered a glimpse at the comparing and ordering language used by the Lakota in the hopes of showing how this is done in Lakota culture.

In thinking about the concept of measuring I have tried to keep in mind that because I was trained in mathematics and taught mathematics from a Western perspective that I do not look at measuring in Lakota culture as something "quaint" or lacking. As Bishop (1991) states, "However, we must be careful when looking cross-culturally not to be blinkered by our own measurement systems" (p.34). I have, at times during this study, found myself doing this very thing during conversation with participants. I can recall thinking the following thoughts when asking participants about how some things like speed and temperature were expressed: "Wow, that is not very precise!" or "Geez, they (speakers) rely heavily on English." Although these

things stemmed from actual conversation, and I still feel they are true to a certain degree, the danger is that this perspective I fostered lacked an appreciation for the way the Lakota measure. So I consciously had to withhold judgment on some of the responses in the hopes of uncovering the nuances necessary to understand measuring in the Lakota culture. In searching through the responses I found that I was able to gain a better understanding of the scales people used in measuring and thus a better cultural understanding of the measuring "process." By stripping away the "universal" scales I had in mind when asking about distances or time I was able to explore other forms of scales the Lakota may have used. This meant that I could now see that the body was used as a scale, that is, hands and feet were used to measure. In addition, with my bias in check, I was able to gain a greater appreciation for the meanings found in the responses of the descriptions the participants had for various ways of measuring.

Bishop (1991) states measuring is "concerned with comparing, with ordering, and with quantifying qualities which are of value and importance" (p. 34). He calls the words used in comparing within a culture "comparative quantifiers" (p. 35), words like, "heaviest, longer, faster, slowest, etc." (p. 35). I have as part of this study, asked participants to express some of these quantifiers to help construct a "scale" of sorts for measuring height and temperature. (There were other topics of measurement that I did not get a chance to cover in this study. It is my hope that these two, along with a look at distance, rates and measuring time will provide the reader a good sample of the practice of measuring in Lakota culture.) For instance, in determining height, I asked participants for what I would consider a word that could be placed on one side of a scale and then for a word on the other, opposite side. So, for height I asked participants for the Lakota word for tall (*hanska)* and for small (*ptechela)*. Once these words were stated I begin to ask for other types of words. In the case for height, what words were used

for huge, bigger, smaller, really small...etc. By doing so I tried to find words that could be used for the upper and lower bounds of a continuum. Thus haŋska supplied a temporary, convenient upper bound and ptečela a lower one. The next question became, what lies between haŋska and ptečela? Or what is above haŋska, and what is below ptečela? By doing this I was also able to come up with more "comparable quantifiers" and was then able to place them (order them) in relation to each other. Thus, I come to see the importance of quantifiers in estimating a scale for certain measurements.

In Lakota culture measuring is done with minimal precision in many cases. As I have stated, there are words for tall and short there are also words for big and small, hot and cold, etc. All of these are relative terms, that is, there is not a universal scale of measurement for these things, outside perhaps the relative scale of each other. This "personal scale" is reflected in the language the participants in this study used when describing the measuring of something. For example, An elder talked about her method of measuring when I prompted her about her use of measuring utensils in her cooking, "I know how much flour I'd use. (Is there a name for how much you put in?) Probably a pinch of that...(laughs) a handful of this...:(laughs). I remember my grandma making bread, she used her hands. I never saw her using a cup or a spoon to measure." The scale used in these two instances of cooking by the woman I interviewed, and her grandmother speak of the use of the body, the hands and fingers (a handful of this, a pinch of that), to measure the ingredients used in making bread. This personal scale is not unique to just Lakota people. There are people the world over who go about their business using approximations. As universal as this might be it is of note that the Lakota employ the body when measuring. I would like to share a story about my own experience with the use of the "scale of others." This anecdote reflects the relative uselessness of the high degree of precision. A few

years ago when I was back in Oglala visiting I asked an aunt of mine to show me how to make "kabubu″ bread (skillet bread) since I wanted to make some for myself when I was away from home. She went about her business of adding flour and salt and baking powder. I asked her, "How much flour did you put in the bowl?" I was looking for a standard measurement. She replied, "Enough for two (people)."

Often, because of the lack of a "universal scale" within the Lakota language Lakota speakers will rely on the use of English for exactness. For example, in discussing miles per hour an elder stated: "When I was a boy, we would emphasize going fast as 50 miles an hour. " Aata *50 miles an hour* ki glikiya." "Geez, that was fast!" Or when asking an educator about how he would express temperature he stated, "You'd probably have to use the English understanding of it. For 75 degrees, okȟate, means it's hot, not that hot, lila okȟate is really hot. Oluluta means kind of beyond hot. You have to use those terms and then (the) degree, with the number." Exactness takes a back seat to practicality in many instances and practicality oftentimes came out in the form of efficiency in the use of language. It was easier for many to express some types of measurements using the English language.

In mentioning the relative lack of precision in Lakota measuring I am not trying to say that the Lakota do not have a need for precision. One need only look at the beautiful designs from the previous section to realize that precision is necessary for such things to contain their mathematical properties, especially symmetry. What I am saying is that in the modern way of thinking about measuring tied deeply to exactness, the Lakota language seems to have left it to the English language to express very precise measurements. This is not to say that a Lakota can't use a ruler to measure the length of a line segment and then use the Lakota language to express its length. What it does mean is that some difficulty does exist in doing so, especially if, as we

have seen, the expression requires a person to state 5/8 of an inch in the language. It also means that precision is in the eye of the beholder and is also a prisoner of context. What types of daily experiences do we encounter where we would need to measure to the thousandths of a second and when do we use a millimeter to measure any sort of distance? Why would it be necessary for me to ask a Lakota speaker to express temperature in degrees?

The Lakota know what a yard is, in fact they have a word for it (čhaegle - which means, a step). They have words for foot, mile, meter, kilometer, etc. Knowing this it is clear the Lakota vocabulary is not devoid of modern ways of measuring. It is also clear that they have not abandoned their own forms of measurement. Using very descriptive relative terms and adapting English terminology for precision allows the Lakota to measure in ways befitting the times and when necessary, the contexts that seem to be imposed upon the language as a result of the ways and characteristics of Western culture.

Time

The Lakota prior to contact with whites did not keep track of time in terms of numbering days as we now do. There were no words for Monday, Tuesday, etc. Bushotter wrote in his autobiography in the late 1800s: "In those days I sometimes went along on the deer-hunting trips, and helped with all they did; and I did not know Sunday" (Bushotter, n.d.). Ella Deloria, a Dakota scholar of the mid 1900s, who spoke and was also able to write the Dakota language, translated Bushotter's texts. In doing this she provided commentary about his writings. In these notes she alludes to the fact that time was not precise as we know precision to a certain degree with our timing devices and clocks, "Walehaŋl means approximately at this time. No time was exact without a clock but sunset and sunrise." Thus precision was approximate.

Years

The passing of years is stated by the number of winters that have past. *Waniyetu* is the Lakota word for winter. Thus *waniyetu wanji* is one year. *Waniyetu nitona he?* Asks how old are you in the Lakota language. Riggs (1893) confirms it as a cultural norm, "The Dakota have names for the natural divisions of time. Their years they ordinarily count by *winters*. A man is so many winters old, or so many winters have passed since such an event" (p.165). (His emphasis) The Lakota kept track of the passing of years with a tool called the "winter count." Each band (thiyošpaye) had a person designated as their Keeper who took care of the winter count. The winter count was a collection of symbols drawn on animal hides. Each symbol represented one major event that occurred during a year. An online exhibit, offered by the Smithsonian National Museum of Natural History, has ten winter counts available for viewing. It is stated on this website that,

> Winter counts are histories or calendars in which events are recorded by pictures, with one picture for each year...The Lakota call them *waniyetu wowapi*. *Waniyetu* is the word for year, which is measured from first snowfall to first snowfall. It is often translated as "a winter." *Wowapi* means anything that is marked on a flat surface and can be read or counted, such as a book, a letter, or a drawing. (Smithsonian National Museum of Natural History, n.d.)

In this exhibit the oldest winter count, Batiste Good's, dates back to 1701. The winter count, then, was essentially a way for the Lakota to record their history through the passing of time - one event per year. (The winter count did not surface in my conversation with elders and Lakota educators and so I do not know the extent of their knowledge about the topic.)

According to Thornton (2002) there were over 150 winter counts. Hassrick (1964) describes the winter count. "They were painted...usually in spiral form with the first record at the vortex. Each picture served as a reminder of the most important event of each year...The years

were titled, not numbered. Each was named for one outstanding event, such as the death of a famous man or some startling and unusual phenomenon" (Hassrick, 1964, p. 8). Iron Shell's winter count first recorded a reference to a white man in 1807, guns were first mentioned in 1813. Other notable events were the coming of Smallpox (1818), a great meteor shower in 1833, an eclipse in 1869 and a great fight on ice against the Pawnee in 1836 (Hassrick, 1964, pp. 8-10). The great meteor shower, since it is noted in most winter counts, provides a useful way of "synchronizing" winter counts. It is thus possible to ascertain the start of the winter counts by counting backwards from this meteor shower image. "This meteor shower "occurred on 12 November 1833 and is a typical notation on Sioux winter counts" (Thornton, 2002, p.726).

Seasons

"The important thing is that the idea of a year having a beginning or ending was of little matter to the Indian. The winter served as a designation point in a spiraling series, unmarked by any periods in the sequence" (Hassrick, 1964, p. 11). There are four seasons in the Lakota year. One educator told me that in spite of having names for the four seasons there is no Lakota name for season per se, "“Seasons,” there really isn’t any word for seasons. What was that word I was using? I think we were saying "makpašpe", which is the four—right there again, the four. I think that’s what we were using. And “years” is omakȟa, “months” is wi." The seasons are expressed in the Lakota language as follows: waniyetu (winter), wetu (spring), bloketu (summer) and ptaŋyetu (autumn).

Seasons seemed a fruitful context for Lakota language instructors. I asked educators who taught the Lakota language the following question: (Did you ever teach kids time?) "Yes, yes. [laughs] Yes! I really liked that. I really like doing clocks, and I like doing seasons." Another educator stated that teaching about the seasons allowed her to teach about topics that occurred in

each season, "Autumn, spring, winter, and fall. And then you go on describing what's gonna happen during that time. Usually it's the weather, and the trees in fall, the leaves are falling, " "Čaŋwaphe hena hiŋȟpayiŋ kte". And still another stated, " Okȟata oni, the weather. I taught weather. We do have that. Degrees, we didn't really get into degrees. But what is the weather like today? And pretty soon they (the students) were all saying it." Finally, one elder commented on the seasons and the temperature in the winter, ″Osni kteks wana waniyetu kte." That means it's gonna be winter, so it's gonna be cold."

Months

Months are measured in "moons" as in the number of moons that have passed. As seen above, *wi,* is the Lakota name for moon and thus month. According to some of the Lakota participants in this study there were thirteen months in the Lakota year. This was somehow adjusted so that the months did not get too far off track. Riggs (1893) offers some insight into the confusion that might be caused by having thirteen moons to a year and how it was taken into account:

> The Dakotas often have very warm debates, especially towards the close of the winter, about what moon it is. The raccoons do not always make their appearance at the same time every winter; and the causes which produce sore eyes are not developed precisely at the same time in each successive spring. All these variations make room for strong arguments in a Dakota tent for or against Wicata-wi or Istawicayazan-wi. But the main reason for their frequent difference of opinion in regard to this matter, viz,. that twelve lunations do not bring them to the point from which they commenced counting, never appears to have suggested itself. In order to make their moons correspond with the season, they are obliged to pass over one every few years. (p. 165-166)

Hassrick (1964) also provides proof of the use of thirteen months to a Lakota year and helps shed some light on another process of "keeping track" of months in a year:

> According to Iron Shell, the year of thirteen months began in April, and the basis for this was that his father (also named Iron Shell) replaced the moon-counting stick at this time:

> In the evenings, when the moon first rose, Iron Shell made a nick in a long pole he kept by the bed for that purpose. Every night he made another nick, until the moon finally disappeared. Then he said, "The Moon died." There were usually 25 or 26 nights for each month, for there are three days when the moon cannot be seen. On the other side of the pole, Iron Shell marked a single nick to show the passing of a month.
>
> Iron Shell carried this stick whenever he went. He got a new stick each year, cutting in the moon of the Birth of Calves. (p. 8)

Two elder Lakota language instructors told me that the back of a turtle shell had 13 sections on it - this provided yet another way in which the Lakota used to help keep track of months in a year. "Our calendar is a little different from the 12 months, it's 13 cycles of the moon. If you look at a turtle shell, there's 13 squares, and that's how they kept track."

Names of Lakota Months

I was unable to get the names of all Lakota months from the various participants in this study. Oftentimes they would point out a calendar that contained them on the wall or if they didn't have one available they would state that they wished they had their calendar with them. "I know there's words for it, but I just can't think of it. I'll have to find my calendar. I have a calendar that has 'em all. Loneman had them." Or there would be an allusion as to where I could obtain that information, (How about months, how would you name the months?) "Like fall...well...every month has a name. I have those all written down all the stuff at the Head Start." Another elder had this to say when I brought up the naming of months in Lakota,

> That's changed, too. I could probably tell you a majority of what they mean in English, but I've seen a number of the calendars where somebody says, "This is the moon of the popping trees," but that's different from identifying the month. Even the months were different. (They moved them around?) Yeah. Because I remember, Dad used to say, "In the springtime, the wind blows." I can just hear the words, but for some reason I can't get 'em out. "When the wind blows in the springtime, that's making the grass grow. When the wind blows in the spring, the grass grows tall." For some reason they were under the impression that it (the wind) must have pulled the grass out.

The names of the months in the Lakota language can be found in the following resources (Riggs (1890), BLED, Hassrick (1964), *Lakhotiya Woglaka Po!* (2004) and NLD (2008)). I have included the names of the months below. There are multiple names for some months. I have decided to include the names of months in the Dakota language as well (Riggs, 1890). I did so for the same reasons I stated in looking at numbers in the Dakota language. As you will see the names of certain months have not changed due to the change in dialect from Dakota to Lakota. What is interesting is the change in names due to changing landscapes. Perhaps the Lakota migration from their Dakota brethren from east to west can explain some of the changes from a sedentary hunter/gathering/farming culture in the woods to a nomadic people who followed the buffalo on the plains.

Riggs's Dakota-English Dictionary is the oldest resource I used for obtaining the names of months. His Dakota-English dictionary (1890) predates his grammar (1893) by a few years. BLED (1970) offers the first look at Lakota names for months. Hassrick (1964, pp.174-175) gives only English translations for the names of months (the names he gives are below, following the English name for each month). The Lakota language text *Lakhotiya Woglaka Po!,* published in 2004, was followed by the NLED (2008). The last two texts, *Lakhotiyapi Woglaka Po!* (denoted LWP) and the NLED, are published by the same group, the Lakota Language Consortium. I will include below an amalgamation of these Lakota/Dakota names of the months. I will start with the month of April since Hassrick (1964) is adamant in telling us that the Lakota began each year in that month. Finally, I will include the Lakota name for each month and its English translation if it was included in the various sources:

April - Moon of the Birth of Calves (Hassrick)
Magaokada-wi (the moon in which the geese lay eggs) (Riggs);
Wokada-wi (the moon when the streams are again navigable) (Riggs);
Magaksica-agli-wi (the moon when the ducks come back) (Riggs);

Wihakaktacepapi wi (The youngest wife had to crack bones; for on the marrow they would get fat.) (BLED);
Phezi Tho Wi (the green grass moon) (LWP and NLD)

May - Moon of Strawberries or Moon of Thunderstorms
Wozupi-wi (the planting moon) (Riggs)
Canwapton-wi (the Moon of Green Leaves) (Riggs)
Canwapto wi (the moon in which the leaves are green) (BLED);
Wojupi wi (the moon of planting)
Chanwape Tho Wi (LWP, NLD)
Chanwape Nableca wi (moon of unfolding leaves) (NLD)

June - Moon of the Ripe Juneberries
Wazustecasa-wi, (the moon when the strawberries are red) (Riggs);
Tipsinla-itkahca-wi (the moon when the seed-pods of the Indian turnip mature) (Riggs, BLED, LWP, NLD);
Wi-pazoka-waste-wi (the moon when the wipazoka (berries) are good) (Riggs)
Wipazuka waste wi (the month of the good June berry) (BLED, NLD)
Wakichepa wi (animals become fat again moon) (NLD)

July - Cherry Ripening Moon
Canpasap-wi (the moon when the choke-cherries are ripe) (Riggs);
Wasunpa-wi (when the geese shed their feathers) (Riggs);
Taykyuha wi (the deer-rattling moon) (Riggs);
Canpasapa wi (the moon when the chokecherries are black) (BLED);
Wiocokanan wi (the middle moon) (BLED)
Chanpha Sapa Wi (LWP, NLD)
Waziskeca wi (Wild strawberry month) (NLD)

August - Moon of the Ripe Plums
Wasuton-wi (the harvest moon) (Riggs, BLED, LWP);
Kanta-sa -wi (the moon when the plums are red) (Riggs, NLD)

September - Moon of the Yellow Leaves
Psinhnaketu-wi (the moon when rice is laid up to dry) (Riggs);
Canwapegi-wi (the moon in which the leaves become brown) (Riggs, BLED, LWP, NLD)

October - Moon of the Falling Leaves
Wi-wazupi (the drying rice moon) (Riggs)
Canwapekasna-wi (the moon when the wind shakes off the leaves) (Riggs, BLED, LWP, NLD)
Wayuksapi-wi, (corn-harvest moon.) (Riggs)

November - Moon of the Hairless Calves (butchering a cow, the fetus was found to be still without hair (Hassrick, pg. 174)

Takiyuha-wi (the deer-rutting moon) (Riggs, BLED, NLD);
Winyetu-wi (the winter moon) (Riggs, BLED, LWP, NLD)

December - Moon of Frost in the Tipi
Tahecapsun-wi (the moon when the deer shed their horns) (Riggs, BLD, LWP, NLD)
Wanicokan-wi (waniyetu cokanyan wi) (the mid-winter moon) (Riggs, BLED)

Jan - Tree Popping Moon
Wi-tehi (the Hard Moon) (Riggs)
Wiocokanyan wi (the middle moon - applied to January and July) (BLED);
Wiothehica wi (the sun is scarce moon) (BLED, LWP, NLD)

Feb - Sore Eyes Moon
Wi-cata (the Racoon Moon) (Riggs, BLED)
Cannapopa wi (the month the trees crack by reason of the cold) (BLED, LWP, NLD);
Tiyoheyunka wi (frost settling on the inside wall of houses or tents) (BLED);

Mar - Moon when the Grain comes up.
Istawicayazan-wi (the sore-eye moon) (Riggs, BLED, LWP, NLD)
Siyo istohchapi wi (BLED)- translation not given in BLED

Obviously there are some differences in the names of the months, particularly the spring months, given in these sources. This is probably not surprising given the fact that Riggs (1893) alludes to the difficulty involved in depending on the activity of nature and animals for the names of months. Hassrick (1964) seems to be off a step in naming the months.

Weeks

The Lakota did not divide the month into weeks as is the custom in modern times. "They have no division of time into weeks (Riggs, 1893, p. 165)." I asked an elder about the existence of weeks in Lakota culture prior to the coming of the white man, (So they didn't have seven day weeks before the white man right?) She shook her head in agreement. BLED does not contain a Lakota word for week, however, the NLD lists the word oko as the Lakota equivalent for week (p. 1087). The definition of oko in the NLD is the "space between; crack, hole, gap, opening, aperture. If week in Lakota refers to "between" or to "a gap or opening the questions remain, between what or a gap in what? I asked this question to a Lakota educator, he said, "Oko really

means there is an opening. I think that this word was selected for one week, the Lakota month is from one moon to the next and the settlers chose to divide a month into 4 weeks, so in essence *oko'* became each of the 4 weeks in between two moons."

Days

The Lakota did not name days prior to the coming of the white man. As we saw in Bushotter's autobiography: "I did not know Sunday." I could not find reference to days of the week in BLED and Riggs (1890) except for Sunday - Aŋpetu Wakȟaŋ - Holy Day. Nor could I find days of the week in *Lakhotiya Woglaka Po!* I did, however, find the mention of names for days of the week in NLD. Monday translates to the first day, Tuesday is the second day, etc. Saturday refers to cleaning, washing up. One educator stated,

> "I understand that originally there was no word for Saturday, but when days of the week were established with the coming of the settlers, then the days were numbered and repeated every 7th time. (Saturday) became known to the Lakota it was called OWANKA YUJAJAPI. The 3 Christian religions that came into Indian country, the Episcopal, Catholics and Presbyterian...is probably what led to the naming Saturday as Owankayujajapi Anpetu, it was a day to clean after working for 5 days, Monday to Friday, to clean up in preparation for Sunday. Sunday was viewed as the day of rest and prayer.

In my interviews with a Lakota educator Saturday translated meant "the day you wash the floor." The days that this elder/educator gave me matched with the names of days given in NLD:

Monday – Aŋpetu Tȟokahe, Anpetu Tȟokaheya (the first day)- NLD p. 953
Tuesday – Aŋpetu nuŋpa (day two)
Wednesday – Aŋpetu Yamni (day three)
Thursday – Aŋpetu Topa (day four)
Friday – Aŋpetu Zaptaŋ (day five)
Saturday - Owaŋkayužažapi (day to wash the floor/clothes)
Sunday – Aŋpetu Wakȟaŋ (holy day)

Telling Time

The time of day was approximate in Lakota culture. However, with the coming of the clock the language goes from the telling of time via actions in nature (i.e. the position of the sun and stars) to the telling of time via mechanical apparatus. One elder told me that her grandmother used to tell time by planting a stick in the ground and then looking at the shadow to get an approximate time, "They used the sun. My mother's mother used a circle they never had a clock, what they do is draw a circle and put a stick in the middle...it kinda....if it was noon there was no shadow, if it was one o'clock there is a shadow...by shadows (they told time)." Hours, minutes and seconds were foreign to Lakota culture. Seconds and minutes are still not expressible, per se, in the language, though there are ways to describe them. One elder talked about using the location of the morning star to help him determine the time prior to the sunrise, "...and then the morning star says a lot too...it comes up probably at 4:00, 4:30...sometimes I stand here looking at it."

Mazaškaŋškaŋ is the word for clock in the Lakota language. It literally means "moving-iron" which is a reference to the moving hands on a clock or the moving of the pendulum back and forth. The Lakota use the clock to tell time nowadays. In stating a specific hour one would state mazaškaŋškaŋ followed by the number indicating the time of day. So, for instance, one o'clock would be mazaškaŋškaŋ *waŋži,* two o'clock would be mazaškaŋškaŋ nuŋpa, etc. An educator had this to say about telling time: "Today we use the clock (looks at clock) " Waŋna šakpe, šakpiyape samiya," then " Mazaškaŋškaŋ, škaŋškaŋ wikčemna nuŋpa." Twenty minutes after. It's close to twenty minutes after...six... šakpiya means "right on the dot" - six o'clock."

According to one Lakota educator the Lakota do not have words that he was aware of for seconds or minutes. I asked him to translate a couple examples where minutes and seconds

might be used. In the first example I asked him if he would you be able to say in Lakota that it is 3:27. He responded, "3:27 would be mazaškaŋškaŋ (wičhokaŋ/haŋčhokaŋ - am/pm) hiyaye saŋm yamni saŋm nuŋpa saŋm šağaloğaŋ kiyela.″ The second example was to translate the following statement into the Lakota language, "The runner ran 100 yards in 11 seconds? "Kiiŋyaŋke kin lila okahuŋya (11 seconds) čaiyutȟapi opawiŋğe inyaŋke."

Distances

A long time ago the Lakota measured distances at least in a couple ways. For the Dakota large distances were measured in the number of nights it would take to complete a journey. "When one is going on a journey, he does not usually say that he will be back in so many days, as we do, but in so many nights or sleeps (Riggs,1893. p. 165)." Most people I spoke to suggested that the Lakota measured distances in the number of days it would take to get from one place to the next. In either case distance was not viewed as we might view it today, in the physical distance from one place to the next, but more as a rate. That is, it was inherently tied to the amount of days it would take to get from one place to the next. Measuring in days is measuring in time.

Even though a "day" (or night) was an approximate fixed measurement of time the distance one was able to travel in one day depended obviously on the mode of transportation as time progressed– first on foot, next on horseback, later by wagon perhaps, then by car. One elder followed this procession in his description of the explanation of Lakota distances with the language:

> We pretty much measured things on how you'd get there in a wagon or on horse. I found (that when we) were on horseback, of course, you'd get there a little quicker (than by foot). If we came to the Sundance powwow in Pine Ridge from Manderson in a wagon, we'd say, " Aŋpetu opta." "It took a whole day to get there." We measure distances by days.

An educator mentioned this as well,

> Oh, the distance. A long time ago, the only distance that they calculated by was a day's walk or a day's ride. "Makȟa manipi aŋpetu waŋžiča." How long it takes one person to walk in one day. If they are going from here to Ethete, Wyoming, my grandpa was telling me in Lakota one time, "Aŋpetu aké nuŋpa ekta waŋžiyapi ekta waŋpipi." That says, "It took them twelve days to get from here to Ethete, Wyoming crossing Wyoming...that's by wagon.

In another instance an elder discussed that distances were determined by the number of moccasins a person went through (wore out) for the duration of a trip if he was walking. In this case time is not referenced for the distance but in the effect the distance had on the footwear of a person.

> And then from the stories I heard, before the horse, they would tell 'em how many moccasins you need to take with you because when you ran or walked, you wore out moccasins, so you had to have moccasins to wear. There's a song, "Tȟahaŋpa kidi din mani," that they hung the moccasins around their neck to show the distance that they were gonna travel. That's how - before the horse, that's how they would measure how many pairs of moccasins they would take.

This second way of measuring distances has interesting connections to modern times and technology. Do we not measure the wear on a car based on the number of miles our cars have been driven? In such a case we could measure the distance a car travelled based on the number of oil changes the car has had.

The modern mind wants to know how far, in miles (or km), constituted a day's distance, that is, how far did a person travel in one day, Hassrick (1964), gave an answer to this for the Lakota, "An average days march might cover as much as twenty-five miles; under pressure bands could travel over fifty miles" (p.173).

"Tȟehaŋl" means far away and "kȟiyela" means close. I asked an elder to describe going a great distance. He pointed in the direction of a river located a few miles away and said in English, "The river is way over there, but I don't want to go there." That is the distance was

calculated by the amount of effort it would take to get there. Thus it was too much for him to want to travel there.

The Lakota have adopted ways of expressing distances from the English language. iyutȟapi means to measure in the Lakota language. The Lakota equivalent for miles is makhiyutȟapi. This is a combination between the words makȟa, meaning earth, and of course, iyutȟapi. Thus the literal translation for miles is "measuring earth." Čae'glepi in Lakota is a step and čaiyutȟapi is the Lakota word for measuring a step. Literally čaiyutȟapi means measuring the length of a step. By quantifying a step with the word for one, waŋži, we get "one step measure" - that is, a yard. Finally, from BLED we also see *ca'gle iyuthapi s'e mani*, "to make big steps as though one were taking a measure of something" (p.113). A foot (twelve inches) is stated in Lakota as siiyutȟapi. Si is the Lakota word for foot. I do not know the Lakota word for an inch. I asked an elder and he stated, "No, I don't —there is, but I can't say it. I think there is." A kilometer can be defined as makhiyutȟapi lečhala. Lečhala means "lately, a little while ago, soon." I interpreted it in this context as, a new way, thus makhiyutȟapi lečhala means a new way of measuring which I believe refers to the coming to the later arrival of the metric system. Meter is defined as čaiyutȟapi lečhala, which is essentially measuring the earth by means of a new step. I did not find any words for centimeter or millimeter.

Given that the Lakota have ways of expressing units for distances derived from the English language I did not put myself in a position to observe how they might use these units in a physical context, i.e. in an activity that might have used a ruler or yard or their own "personal scale - body units. How, for instance, would a person making moccasins and who beads the designs on the moccasins figure out how to center the design that sits above the foot or how many iterations of a border design would fit? Or how would a person who makes star quilts go

about her business? These are areas of observation that I did not have access to for this study. I believe that observing some of the measuring, not just looking for evidence in the language, would add much to a cultural understanding of measuring, especially in terms of smaller lengths and areas used in crafts and designs. In the previous section I had mentioned the use of notches in a stick to help construct the war bonnet design. Again, how much richer a description of measuring would I have gotten if I was able to observe this activity and activities like it?

Rate

Rate as measured by miles per hour is the total distance traveled (in miles) divided by the time it took to complete the trek across that specified distance. Mathematically speaking, rates don't just deal with distances and time. Rates are a special ratio in which the units measured are different. For instance an employee's pay rate might be $25.00 an hour. Mathematics textbooks use linear equations to model rates. Linear equations use a generic rise on the y-axis (Y2 - Y1) and divide it by a generic run on the x-axis width (X2-X1). As far as the line is concerned this ratio provides its slope. Thus we can see graphically the effect a change in rate has on the things we are measuring. From the examples given by the Lakota in their description of distance we could model distance as the number of miles traveled in one day, or the number of miles per moccasin.

Given that time is inherently tied to reckoning distance it is quite interesting to see that the Lakota have a somewhat difficult time expressing rates in typical ways, like miles per hour. I concentrated on the ratio, miles per hour, related to the distances traveled over a given unit of time for the context of the conversations with educators and elders around rates. Participants had interesting and varied ways of explaining descriptions of speed but invariably stated the speed in miles per hour. A parent and former Lakota language teacher stated:

> Yes. That's different (saying 32 miles per hour) when you have to describe it that way. 32 miles per hour. [laughs] "How fast are you going?" You'd say in Lakota, Tona wakȟalahe nish ka hi. Long time ago, I don't know if you remember _____, but he used to drive so slow. I'd call him kheya (turtle) and all kinds of stuff, descriptive.

A current Lakota teacher struggled a little as well with this concept. Her thought process is interesting to follow as she tries to wrap her head around expressing it in Lakota:

> "OK, oȟaŋko means "fast," and lila means "faster than oȟaŋko." So lila oȟaŋko is "really fast." He lila oȟaŋko ksto onahe 65 miles an hour is the speed limit, and you go on describing it. So I think it's going 80, so then you'd say probably Ko.. ila oȟaŋko wikčemna šakowiŋ ičeyahaŋ makhiyutȟapi. How do you say "miles"? ___.iyutȟapi probably means "to measure...Yeah. makhiyutȟapi. But that doesn't sound right. makhiyutȟapi means "miles." I don't know. I never really thought about it. If you were gonna describe it like that, it'd be just oȟaŋko and then lila oȟaŋko makhiyutȟapi owapiki 15 miles.
>
> Or we always say He iyečhiŋkiŋyeka ki lila oȟaŋka ye. That means "really fast." Lila oȟaŋkaye or you say l oȟaŋka ye, it means kind of fast but not that fast. ″Lila oȟaŋka he tuktel kaptaŋyin kte ye ksto.″ You might turn over some place, you know? It's not really—that's kind of hard.

Another educator stated what we see above that English provides the simplest, and probably a more efficient way of stating rates at least in terms of how to describe a change in distance over a unit of time. "Over here we go by, let's say you're going 65 miles an hour, you'd use the English term because it's..ah... easier, so a lot of people say "Waŋna okiyape nahaŋ waŋna aata 65 okiyaŋka. We're running at 65 miles an hour."

Here the speed in miles per hour is stated as such, in English, but the interesting thing to note is the descriptive language used once the speed is quantified. Kheya, which is an allusion to the slow moving turtle, is used to describe slow. From the statement "We're running at 65 miles an hour." one can picture in their mind a man running on foot very quickly. Or "You might turn over some place (if you continue going that fast)" So in describing rate in the Lakota mind,

which is directly connected to distance, we get a description of that speed, whether fast or slow as it relates to something visual - a turtle walking, a man running and a car flipping over.

This isn't always the case. I had a man describe speed, and again he spoke of speed in English terms, in the following way, "Like I would tell another elder that this young man just "Aata le 90 miles an hour optakiye." He just went by about 90 miles an hour. Whereas, back when I was a boy, it was 50 miles an hour." Even though he expressed speed in English terms, he did put it in the context of speed based on technology -walking on foot, riding horse, riding in a wagon or driving in an old car compared to the newer cars. The description of speed had to change due to technology. That is, what was once considered fast is no longer. 50 miles an hour is kheya compared to 90 miles an hour.

At this point I would like to concentrate on some of the terms used to describe rate, not shown above. In the Lakota langauge fast is luzahaŋ, whereas slow is ȟ'aŋhiya. Fast also comes in other terms, "Oȟaŋkoya - I think just...means—you can use that describing whatever you're talking about, a car or a falling star, whatever it is you're talking about." "Huŋkešni," an elder said, "means either they're running slow, or you can also describe that as bein' weak, too."

Wealth

Bishop (1991) places the concept of wealth and the various ways cultures defined wealth within the mathematical activity of measuring. "Convenience and rarity value combine to provide the measures of economic value, which we call currency" (p. 37). He later adds, "Clearly measuring is deeply embedded in economic and commercial life" (p. 37). In modern American culture it seems that wealth is defined as an accumulation of material goods. The acquisition of goods comes via an exchange in capital, in our case through the dollar (currency). Wealth is attached to what one owns which in turn is dependent on making money. The more

money a person has the more able he is to have material possessions. Money allows for the purchasing of cars, houses, toys, and the acquisition of land. Possession of all of these material things are indicators of a person's wealth. How did the Lakota define wealth and how do they now define it? What forms of currency were used a long time ago and currently, besides the dollar in exchange for goods and services, what currencies are in use?

The participants I interviewed defined rich and poor using these two terms, *zica* for rich and *unsica* for poor. In a conversation with two elders I asked the question about the Lakota word for rich and an explanation of what it means to be rich

> 2. " žiča enit."
>
> 1. "Nobody's žiča."
>
> 1. "Children." (So the number of kids you have?)
>
> 2. "Actually, I think that Lakota people are really žiča. Not with money—(material goods). Knowledge, and to be able to survive what we went through in the past, what our ancestors went through."
>
> 1. "The way the kids act around here, every one of the kids I work with there's like over 50 - they think I'm their real grandmother. When bake sales come, they look for me. I have to hide. [laughs] I have to go hide in _____ office. "
>
> 2. "They won't ask me. [laughter] And they don't ask for a quarter any more, they say $10."
>
> 1. "$10, Grandma." "Gee, what are you gonna do with $10? I haven't got $10."

What about the old days before the coming of the white man how was wealth defined? One person responded, "In the old days it was horses..." Hassrick (1964) comments on the reasons the horse was highly valued,

> To the Indian here was an animal able not only to do the work of dogs but also carry a rider. Men mounted on horseback could bring under their control much wider areas of land than had ever before been possible. Now the buffalo could be

> surrounded and driven with greater ease and more assurance of success. In battle, the horse offered an ideal conveyance for attack as well as an excellent means of escape. As a result of these undisputed advantages, the Sioux, like many of their neighbors, made the horse their medium of exchange...the horse was accorded an honored place. (p.70)

An elder commented on a few other things a person might have possessed if he/she was to be considered rich a long time ago.

> But if his parents were not considered poor it meant they had the ability to do big giveaways, such as horses, weapons and status in the tiospaye (played a role in the view of one's wealth). The ability to attain materials possessions relied on ability to work by helping others and accepting what was given to him in giveaways and he was skilled ...Money was not a factor in the old ways.

So it seems that not just material wealth in the form of horses and possessions helped determine one's wealth, but it also lied in one's ability to help, to be able to take care of his family (and extended family) and his responsibilities and also his ability to give.

> Another precept of the Sioux was stated frequently by the tribesmen: "A man must help others as much as possible, no matter who, by giving him horses, food or clothing." Generosity was a virtue upon which Sioux society insisted. To accumulate property for its own sake was disgraceful, while to be unable to acquire wealth was merely pitiable. The ownership of things was important only as a means to giving, and blessed was the man who had much to give. (Hassrick, 1964, p. 36)

Even though it seems paradoxical that in a society that values the accumulation of wealth it is a sign of one's wealth to willingly give these things away yet it is the ability to give that determined your true wealth. The "give-away" is a cultural activity where such things occur. The give-away is done in many instances on the reservation. I personally have been involved in give-aways throughout my lifetime both as a recipient of gifts and as a member of a family who "gives-away." Give-aways are done at funerals, weddings, and at Huŋka ceremonies, among other structured community activities. "Not only was spontaneous and informal gift-giving carried out continually, but innumerable ceremonial occasions were provided which made

possible the even more dramatic "giveaway." Here the Sioux crystallized the concept of generosity by institutionalizing large-scale giving" (Hassrick, 1946, p.37). The intention of the giveaway is not done for the sole purpose of showing off one's wealth and therefore not an outward sign of wealth per se, rather is done as a way of honoring - giving in somebody's name. "Families saved up in order to make a good showing, for the more gifts that were given, the deeper was the respect displayed for the person honored. (Hassrick, 1964, p.38)" However, to have been able to accumulate these possessions for the purpose of giving them away does say something about one's relative wealth. Not mentioned in these comments by Hassrick (1964) is the amount of work needed to have a giveaway and the fact that relatives and extended family are willing to give to the person who is having a giveaway so that all those in attendance may not leave empty handed. Thus it has very positive community effects for both those involved in giving and those receiving.

One of the participants viewed self-sufficiency and the helping of relatives as part of Lakota life,

> "Yeah. One of the basic things that I remember in my life was not looking for anybody to provide for you. You know, when you had a death in the family, your family got together and your family fed at the wake, your family fed everybody, or you did it yourself. You didn't look to the tribe for anything. And that's one of the big differences that I see. Nobody does anything for themselves any more. Bein' self-sufficient back then was one of the things that they kind of took pride in, but now, self-sufficiency is, if you do it, they make fun of you for tryin' to be self-sufficient any more."

Thus wealth was measured in the accumulation of certain possessions (mainly horses), the ability to help others not just with material goods but also in the form of labor, also wealth was clearly seen in one's generosity, and especially seen in the "give-away" one held in honor of a person. Finally, one was rich if he was self-sufficient.

If horses helped define your wealth a lack of horses obviously showed that you were poor. What other factors might lead one to conclude that you were poor a long time ago?

> A long time ago a person would be considered poor if his parents lived the same way, (for example), in marriages (where) the male would go live with the spouse's family where he helped in every way he can. Females rarely go to live with the in-laws, even today. If he was lazy, (not) helping his in-laws he was despised - if they had to take care of him and his needs.

Here the issue of taking care of your responsibilities and self-sufficiency arises again. If you were a burden on society, you were considered poor.

How do the Lakota view wealth nowadays? "Nowadays (it's having a) car." There also is an emphasis these days on the owning of land, a house and cattle as outward signs of wealth. Thus, like American culture in general the possession of certain material things shows wealth in Lakota culture. There is really not much difference today in terms of how wealth was viewed versus a long time ago except for a few notable exceptions. The first difference with the need to provide is employment, the second is one's education - which, to a certain degree, allows one to be employed. However, each of these only makes one rich if one is willing to use these to help others.

> Nowadays I think that a person who is a happy person and helps anyone no matter how waȟpaniča (poor) that person is...(another way) he is considered rich which would probably (be seen in) the relationship they have with others..(also) today having a job increases a persons status by being generous...if he was a steady worker wherever he can get a job...

> Today thiyošpaye systems are dismantled by common law marriages, HUD housing and land holdings. Despite this those that hold jobs are considered well-off, not rich...having a degree to get the job gives him/her status, and again if he is helpful and happy he could be said to be rich.

The overriding theme for the Lakota way of looking at wealth is encapsulated in one's willingness and ability to be generous. If you are wealthy it is expected that you help others with

your wealth. You can do this by either giving away your possessions or helping with your time. In this light you are also expected to fulfill your responsibilities and obligations to your family and extended family. You are poor if you have few material possessions and/or you are unwilling to be generous with time and resources.

Forms of Currency

Currency is really a material good that allows one to exchange one thing in place of another. Thus currency inherently is a medium for bartering. In terms of currency among the Lakota we see some really interesting forms. Money of course is a key currency and is used on the reservation just as it would be used anywhere else. Since bartering is a large part of the economy on the reservation, various goods and services take the place of money when there is no money to be exchanged. According to what an elder told me the forms of currency tend to change based on the season. In the winter, wood is used as a form of currency. In mid-summer thiŋpsila (wild turnips) are used as currency and then in late summer, choke-cherries and plums are used. In a story related to me by a family member it seemed that a long time ago, when the allotments of land were given out to families, one group of families in particular received land by what is now Red Shirt Table. The water available to these families from the land was not very good, being very high in alkali. This was the case except for one allotment in particular which had a spring with very good water. So, people from neighboring allotments who had the bad water on their land would bring wood to the owner of the allotted land whose water was good in exchange for access to the good water spring.

Some more forms of currency that were used for an exchange of goods include labor and alcohol. I have been a witness to government commodities being used as a form of currency also, so too crafts in the form of beadwork, quillwork, star quilts and paintings. The elder who

mentioned the previous story to me stated that old car parts were also used as currency. Thus many things were used as currency. I am reminded of a scene in Dances With Wolves whereby the Lt. gave up a hat for a knife and the middle aged Indian man looked at him and motioned his arm forward and stated, "Good trade." Various things become currency when both parties feel that one thing is worth the value of the other. On the reservation these things can be just about anything.

Size

I want to look at two more contexts for measuring, though there are many more. The first is how the Lakota measure height, and the second is how they measure temperature. I wanted to start with some Lakota terms that were equivalent to the English words for big, really big, or humongous. I asked an elder how he would describe something that's really huge. He responded, "That would be, like,...I would describe something like wakȟaŋ tȟaŋka, it's so vast, lila tȟaŋka. It just— tȟaŋka isamiya is "bigger than big." (As you work you way down so you just have "big," would you say tȟaŋka?) "Yeah."

What about something that just goes on and on? "Saŋm wayaŋgpičasni" means something that you can't see any more, but it's out there. An educator helped with figuring out degrees of big and small. Tȟista...those were words that were large, tȟaŋka, words that are large, haŋska means tall. What about degrees of smallness? He stated, "čik'ala means small, tistilla, really small, lila čik'ala, lila čistilla, ištawolakake šni, means things you can't see with your eyes...there's mniwatuhala some creatures in our mythology that we call it mniwatuhala...those are the descriptions of the one's that are in water that you can't see with your naked eyes. They call them mniwatuhala - little tiny micro-creatures they can see with a, what do you call it...A microscope."

What about a word for medium or in the middle? You could say "čhokaŋ wahečetu *wahechetu*." It means "it's about half of that." You can measure something and you could talk about something and then measure it down to half of it. An elder gave the context for average, "ikčeka." Like, say, "Ha ikčeka" means "average skin." People say, "He ha ikčeka." It means average. Or "Ikče wičaša"...which means "an average man, just a common man."

Thus for a continuum for size from very large to small in the Lakota language can start with wakȟaŋ tȟaŋka, then work their way down the scale: "Saŋm wayaŋgpičasni, lila tȟaŋka, tȟista, tȟaŋka isamiya, tȟaŋka, čhokaŋ wahečetu, ikčeka, čik'ala, tistilla, lila čik'ala, lila čistilla, ištawolakake šni then finally mniwatuhala. At the upper end and lower end of this continuum we get into the spiritual realm in terms of describing size. Wakȟaŋ tȟaŋka is the Lakota word, as defined by NLD, meaning "the universal spiritual power invariably translated as God. Nothing is bigger than Wakȟaŋ tȟaŋka. What is interesting also is the notion that it is so big that you cannot see it, you know its out there. So the scale deals with the fact that size can be so large it disappears just as small can be so small, microscopic, that it disappears as well. The Lakota word dealing with small, so small that you cannot see, speaks in terms of microorganisms, large is spiritual, small too is spiritual in the sense that mniwatuhala. is a term given to a mythical water creature. Thus, on one end of the continuum of size we have a spiritual bound and on the other end, a mythical creature whose nature is physical but whose conception comes from Lakota mythology. All of the other terms in this continuum deal with relative sizes in comparison to something else. As one Lakota elder put it, "I think when they describe that, they probably compare it with something else."

Perimeter, Area and volume

I have already looked at how the Lakota speakers participating in this study might have expressed the concept of area when looking at area as a context for multiplication. Though I have included a cursory look at expressions for perimeter and volume it must be noted that I did not discuss how to express these concepts in the Lakota language instead I looked exclusively at how these topics might be described using "real life" language. We will look here at some expressions for the concepts of volume and perimeter. A look at how to describe these topics conceptually in the Lakota language still needs to be explored.

Perimeter

Perimeter is the sum distance around an object. If the object is a square its perimeter would be the length of the four sides added together. If the object is a circle its perimeter would be the diameter of the circle multiplied by the mathematical constant known as pi. In asking the Lakota speakers to help me with the language to help describe perimeter I first asked about words referring to going around the object. " mm...okay...oh my...ohomni omani. Omani is walk, ohomni is around."or "Ohomni is "go around."

When I was discussing the notion of going around an object to an elder I mentioned the idea of a fence around a corral. He then stated that "čhuŋkaške" was the word for fence. And still when I asked another about perimeter the participant stated, " Perimeter is the overall ata yuha, the whole thing. "Aata yuha, "the whole thing."" ″Le ata yuha, le čuŋs'e iyuha ožuyiŋ kte - *you fill it all like this."*

It would be possible to use these Lakota words and the Lakota words for addition, which we have seen before, with geometric shapes to combine perhaps some figures to calculate the perimeter of an object. Again this is left for another date.

Area

Area is one way in which multiplication can be modeled. To find the area of a rectangular object you could multiply the length of a side by the width of that side to divide the object into unit squares. I had not initially thought about including area as a context for multiplication until I had asked an elder about how to express the area of an object in the language. He said:

> Hmm. [long pause] For measuring distances, it's "makhiyutȟapi." It would probably—we would probably just use—I heard it this way, just use those two terms, and not the area. Say maybe _" makhiyutȟapi zaptaŋ na makhiyutȟapi yamni" (measure five this way and three that way) and say, "This direction and this direction."

He went on to state the area of a square (which in this case was a rectangle). Square expressed in Lakota is oblotȟuŋ and rectangle is oblotȟuŋ haŋska: "If you use the word " oblotȟuŋ" that's the square. yamni oblotȟuŋ zaptaŋ - three by five."

Volume

The volume of an object is found by multiplying the height of an object by the area of its base. So for a rectangular prism whose height is 10 inches and whose base length is 4 inches and base width is 3 inches the volume of the object would be 10 in. x 3 in. x 4 in. This product becomes 120 cubic inches. I asked some participants who spoke the language to describe how I might say a container is full or to describe the inside of an area that might be empty. Here is what was stated: "Huŋȟlala...it's...full." And, "I never think of that. ___, but that's "inside." imahel means its inside." An elder gave me the name for full and empty: empty - henala (nothing left) and full ožula. One speaker didn't know how to express notions for volume. When I asked a Lakota educator the following question, "How would you describe the inside of that container? (I pointed to his water bottle - it was empty)." He responded by stating "I don't know. Long time ago they used to go by pints, half-pints, gallons, (shows a motion on his arms

to signify volume...bartering...) on their arms." I asked, "To signify how much you had?" He responded, "They would barter for their whiskey like that with the traders- a gallon of moonshine."

Temperature

Measuring temperature within the Lakota language is done in relative terms. Going from really hot to really cold on a continuum, the Lakota terms would be: Oluluta (beyond hot, sweltering), lila okȟate (really hot), okȟate (hot), kȟata (hot). If the temperature is nice it would be stated as mašte. Cold is osni, really cold is lila osni. Measuring exact temperature is left to the English/Western way of doing it. I asked a participant if there was a way of saying that it's 50 degrees outside. He responded by saying, "No, nothing like that. It's just either really cold, cold or really hot and hot." Another person responded to this same question stating, "50 degrees? - No, no way of saying it."

In looking at measuring in these two contexts, size and temperature, and after having discussions with Lakota speakers (educators and elders) I began to see a trend in the way measuring was done. I stated my understanding of measuring to an educator, (So you have a description, I am seeing a trend here, you have a Lakota description, and then when someone wants to be precise they would use the English degree , or word for depth or whatever…) He agreed. So with size if I wanted to be more precise in terms of getting somebody's height or measuring a distance in miles I would use siiyutȟapi (feet) or čaiyutȟapi (yards) or even makhiyutȟapi (miles) and then follow it with the number. For example, if I wanted to state that I was six feet tall I might state siiyutȟapi šhakpe. If I wanted to say, "My son is four feet three inches tall I would say, ″Le čiŋkšiwaye ki hanska siiyutȟapi tob na..." We saw this when we looked at precision in rates whereby the phrase, "miles per hour" appeared in many of the

speakers Lakota description of rate. In measuring temperature an educator pointed out saying that we would probably use the English understanding of it. I believe that if I pressed any Lakota speaker to say that not only was it hot outside but that it was 97 degrees he would use the English word for degrees and then follow it with a number either in Lakota or English. Thus the scale used in measuring, in these two cases, was the Western scales for rate and temperature. Relative terminology for comparing and ordering exist in the Lakota language. Words for hot, hotter, cold, fast, slow, faster, slower, exist in the Lakota language and "body" scales for measuring in certain activities do exist (cooking, measuring with a step) and tools are used as well in designing (a stick). However, when it comes to answering questions like How fast was he going? or How tall are you? or How hot is it outside today?, if we are looking for precise language the Lakota would answer these things in both English and Lakota by first giving you a description of height, temperature, distance or rate in the Lakota langauge and then the scale (for precision) he may express it in Lakota.

As a way to gather this information together I compiled a list of common measurements used in English (now American) system and tried to find the equivalent in the Lakota langauge in the tables below. Some of this information I had mentioned above. Some of this information I had gathered while collecting the data and entered it in my journal where I was able to ascertain some information from elders and educators (the table below had been compiled in my journal) and some of it I received from the New Lakota dictionary. Included are my translations for the Lakota equivalents.

Table 6-1

Time Measurements

English Word	Lakota Word	English Translation
Year	waniyetu	Winter
Month	wi	Moon
Week	Oko	Oko = between, "between moons"
Day	Aŋpetu	Day
Hour	Oapȟe (NLD, p. 367)	to the striking (apȟe) of the old clock
Minute	Oapȟe čik'ala (NLD, p.367) Oapȟe oȟaŋko (NLD, p. 368)	čik'ala = small oȟaŋko = fast
Second	?	?
Half-an-hour	Oapȟe okise (NLD, p. 368)	okise = half (half dollar)
quarter an hour	Oapȟe Šokéla (NLD, p. 368)	Šokéla = a quarter (25 cents)
Clock	Mazaskaŋskaŋ	Moving metal - refers to hands on a clock

Table 6-2

Distance Measurements

English Word	Lakota Word	English Translation
Mile	makhiyutȟapi (NLD, p. 328)	makȟa = earth, iyutȟapi = to measure
Yard	Čae'glepi (NLD, p. 71) Čaiyuhtapi	Čae'glepi = 1 step, iyutȟapi = to measure
Foot	siiyutȟapi (NLD, p.888)	si = foot, iyutȟapi = to measure
Inch	siiyutȟapi čik'ala Oiyuthe ciscila (NLD, 921)	si = foot, iyutȟapi = to measure, čik'ala
Kilometer	makhiyutȟapi lečhala	makȟa = earth, iyutȟapi = to measure, lečhala = new
Meter	Čae'glepi lečhala? Čaiyutȟapi lečhala	Čae'glepi = I step, lečhala = new
Centimeter	?	?

Table 6-3

Solid measurements (Weight)

English Word	Lakota Word	English Translation
Ton	tke iyutȟapi tȟaŋka (NLD, p. 1065)	tke – weight, iyutȟapi = to measure, tȟaŋka = big
Pound	tke iyutȟapi (NLD, 984)	tke – weight, iyutȟapi = to measure
Ounce	tke iyutȟapi čik'ala?	tke – weight, iyutȟapi = to measure, čik'ala = small

Table 6-4

Liquid measurements (liquid volumes)

English Word	Lakota Word	English Translation
Pint	mni iyutȟapi šağloğaŋ?	mni – water, iyutȟapi = to measure, šağloğaŋ = 8
Quart	mni iyutȟapi tob?	mni = water, iyutȟapi = to measure, tob = 4
Gallon	mni iyutȟapi (NLD, p. 894)	mni – water, iyutȟapi = to measure, tȟaŋka = big
Cup	Wiyatke	Wiyatke = generic cup

In my journal I had made the following comments concerning the translations of some of these terms, especially since they are descriptions of the thing which is being measured - liquid, weight, distance:

> Another possibility is to look at how the Lakota conceptualize mathematics terms and how they have named them. Yard for instance is cagle (pronounced cha-glay – the g is glutteral) which when translated means "one step." In looking at how measurements of such things as liquids, solids (weight), time and distances we catch a glimpse into the way the Lakota might view certain things. For the passage of time we see Lakota equivalents for year, month, etc…We can also see equivalents in other areas of measure with weights, distances, liquid volume - see chart for the list of words and translations. It is in the translation (though obviously some things can be lost in the translations) that we begin to notice see that some things are attached to the earth – maka iyutapi, with kilometer we see a "new way of measuring the earth."
>
> This can be useful in at least one way, one with the use of the translation to add meaning to the unit of measurement. Some students might have difficulty remembering some conversion factors say between quarts and gallons, in Lakota that would not be a difficult thing – the Lakota equivalent for pint is "mni iyutȟapi šağloğaŋ this means "water to measure, eight" One might ask, why is eight attached as a description of this unit of measure, well, there are 8 pints in a gallon, similarly for quart it is mni iyutȟapi tob – 4 pints per gallon. Another way it is meaningful is that it helps students to see that we are measuring liquids = mni, with this unit of measurement. In the Lakota translation for distance we end up measuring the earth.

Conclusion

Measuring is inherent in all cultures. It involves comparing, quantifying and ordering. A characteristic of the Lakota language is that it is rich in description. This characteristic is seen in the many ways it is used to describe things like time, rates and distances. All three of these concepts take root in nature. Distance as measured in Lakota culture cannot be separated from time therefore it more resembles a rate. This rate has the units of distance per time and also distance per work (wear). The Lakota way of measuring time has changed as a result of interaction with the Western world. So too the measuring of wealth, temperature and size. In this short look at measuring among the Lakota we have seen that even though the Lakota language is rich in description in terms of how it measures it is reliant, to a certain extent, on Western language to meet the Western need for greater and greater precision. This takes nothing away from the Lakota. Practicality trumps precision and efficiency in many cases. This need for efficiency, I believe, is reflected in the use of English in the language as well. As one educator said to me, "it is easier," to use the English as a way of stating some of these things.

Chapter 7: UMA #4 - Locating

Tate Topa Olowan (Four Direction Song)

Wiyohpeyata etonwan yo!...
Waziyatakiya etonwan yo!...
Wiyohiyanpata etonwan yo!...
Itokagata etonwan yo!...
Wankatakiya etonwan yo!...
Makatakiya etonwan yo!...
(Olowan, 1973, pp. 54-55)

Our attention now focuses on the fourth universal mathematical activity, locating. Bishop (1991) stresses the importance of locating in mathematics, "I chose to place this activity next, not to satisfy any 'mathematical' ordering principle but because it seemed necessary to demonstrate the significance of the spatial environment for the development of mathematical ideas early on in the search for universals" (p. 28). Later he states, "Nevertheless we can find important and interesting data, not only to substantiate the claim of 'universality' but also to indicate the significance of locating for mathematical development. This time of course the ideas relate predominantly to geometrical notions,...it provides us with the kinds of ideas characterized as...topographical" (p. 28). How people use space, how they decide to situate themselves in it and how they express this meaning in relation to one another is embodied in the universal mathematical activity of locating.

As we have seen in the previous section, space is intrinsically related to time in Lakota culture. When we think of space in this section we need to expand our notions of what space is, that is, we shouldn't limit ourselves to the physical. Mathematics is overflowing in the development of abstract spaces and also has been used exceedingly in scientific cosmology. Mathematics allows scientists to express their understanding of space and simultaneously use it to further their understanding of it. So, let us not forget that we aren't just referring to the

physical geographical space around us when talking about locating (although this is important) but that we are concerned with the space above us and below us and also with its connection to time. We shall expand on this notion with the Lakota understanding of space in this section intertwining it even more with Lakota cosmology and its effect on the Lakota view of locating.

The Lakota have very explicit connections between the physical and the spiritual dimensions. They believe that the two are intrinsically locked; one reflecting on the other whereby establishing a certain kind of symmetry between the two. An elder spoke to this connection when discussing the design of a tipi with me, "It's a structure that goes up like this and then goes up (even more), what's up in heavens from earth is the opposite...And then it all ties in together spiritually right there (points to where the tipi poles are tied together)." Thus, from the Lakota perspective, what is above is below. This connection is illustrated in many of the stories concerned with locating, especially when looking at Lakota creation stories and the marking of the four directions. Vine Deloria (1991) commented on this connection when contemplating star knowledge found in Indian tribes, "Much Indian knowledge involved the technique of reproducing the cosmos in miniature and invoking spiritual change which would be followed by physical change...The principle involved was that whatever is above must be reflected below. This principle enabled the people to correlate their actions with the larger movements of the universe" (p. 16). Goodman (1992) reflected on this principle as well when looking at Lakota beliefs and their relation to the stars,

> Research into Lakota stellar theology has added new dimensions to our understanding of how the People generated the mentality for experiencing the sacred. It shows that they felt a vivid relationship between the macrocosm, the star world, and their microcosmic world on the plains. There was a constant mirroring of what is above by what is below. Indeed, the very shape of the earth was perceived as resembling the constellations. (p.1)

We will investigate these connections between the stars, the earth and the resultant movements of the Lakota people below.

What must be noted as well is the fact that not only did the physical geography mirror heavenly "geography" but the stars were guides for Lakota people in a temporal sense as well. "The star knowledge helps us to understand this temporal spatial dimension more fully. We can see now that many Lakota activities were timed to mirror celestial movements" (Goodman, 1992, p. 1). It was the expectation from above to be in certain places at certain times for certain events. This information was given to the Lakota from both the position of certain constellations in relation to the sun and also from the star people themselves, especially in stories about "Fallen Star", and Woope.

Since it has been the intention of this study to look at both contemporary uses of the Lakota language to describe mathematical activities and concepts and to try to uncover the way these things might have been presented and used in older times I have had to use both human sources as well as research and studies conducted in the past to make sense of the information given to me. The former implies a mining of knowledge of these topics with Lakota speakers, educators and community members and the latter implies a look at what is available in the research. In this process I have found myself relying on the responses of Lakota speakers for guidance in the literature. Many elders have words for many of the things I have been looking for but may not know the history of them or their origins. Oftentimes I was only able to get surface level information. For instance, I was able to get elders to talk a little about some of the constellations and stars - the Big Dipper and the Milky Way. In these conversations they would mention connections to ceremonies and have ideas about what was supposed to happen at certain times. However, of the many constellations available for discussion I only heard a few. Thus, I

felt it necessary to supplement some of this information with what may have been documented in the past. For better or worse, books and articles (research done by many anthropologists, missionaries, government agents as well as Oglala Lakota authors) have come into play, in a large way, in this analysis.

It was not my intention from the outset of this study to look at Lakota mythology and their cosmological understanding of the universe when looking at cultural mathematical activities. But the language and examples used by speakers - for instance, they are the ones that brought into designs the names of Iktomi, Iŋyaŋ Hokšila and the Wičaȟpi Hiŋȟpaya - necessitates their inclusion in this study. One cannot look at Lakota designs without wondering at their meaning, which forces a look at both the physical world and the spiritual world. I found much the same need in the analysis of the data concerned with locating in Lakota culture. That is, names of more cultural mythological figures continued to surface as I searched for answers to the questions concerned with the movements of the Lakota. So in locating we hear about the Pte Oyate, the Buffalo People, we hear of the Wičaȟpi Hiŋȟpaya, the Star People, of Woope, we also hear of the personification of the four directions (Okağa, Eya, Yata, and Yaŋpa) and their role in Lakota creation. Thus, with the dual focus on contemporary and historical expression in the activity of locating I find that I am dealing with a complex understanding of location wrapped in the physical, the spiritual and the cosmological.

That said I focused on three major topics in this look at the mathematical activity of locating among the Lakota. From the outset I desired to know about the influence of stars and the Buffalo in the movements of the Lakota. I wanted to know how the Lakota a long time ago decided where to move, when to move and why. The second aspect of this portion of the study was an exploration into how the Lakota expressed direction in a very typical sense, that is, I

sought Lakota words for directions - up, down, left, right, near and far, etc. This in turn led to expressions of the four cardinal directions and their origin and importance in the Lakota belief system. As I progressed through the study I began to see the need for gathering information about place names. Luther Standing Bear (1933) mentioned in his book *Land of the Spotted Eagle* the incident of choosing an English name when he was at Carlisle Indian School, "Almost immediately our names were changed to those in common use in the English language. Instead of translating our names into English and calling Zinkacaziwin, Yellow Bird, and Wanbli K'leska, Spotted Eagle, which in itself would have been educational, we were just John, Henry or Maggie as the case might be" (p.233). I had a similar epiphany when looking at place names on the reservation, that is, what can we learn about the people of Oglala by investigating the Lakota names for places on the reservation? How do the Lakota refer to certain places and why? These are important because there is much historical, cultural, political and spiritual information in place names. Thus three areas: movements of the Lakota, expressions of direction and place names constituted my look at Lakota culture regarding the mathematical activity of locating.

The Movement of the Lakota

The Stars (Wičaȟpi)

The Lakota word for star is Wičaȟpi. Lakota stories have as main figures in their mythology the people of the stars. In the Lakota creation story related by Dooling (1985) Woope, the daughter of Škaŋ (the mover of all things) comes to earth to the father of the four winds, Tȟate, as a falling star and when asked who she is identifies herself as one of the Star People. She is later identified as the White Buffalo Calf Woman who brought the Sacred Pipe and the seven sacred rites to the Lakota. The stars to the Lakota are entities who provided guidance and help throughout their history. They are major players in the mythology of the

Lakota. They also provide much information to the Lakota, physically and spiritually. As a result stars are justifiably prominent in discussions about the movements (both physical and spiritual) of the people.

The Milky Way (Wanağı Thačhanku)

"The study of the heavens was not just provoked by their wonder and beauty, there was also a highly practical significance to this work" (Bishop, 1991, p.32). To the Lakota the practical didn't mean just moving with the buffalo (which I will talk about later). It also meant staying in tune with the spiritual. In discussing the stars and constellations with Lakota elders, educators and community members we see reference to the constellations but invariably the talk is about what those constellations mean in terms of the spiritual and how it affects life here on earth. One elder spoke of the Milky Way thusly:

> The Milky Way, the way I learned it was, our Sundance tree. A lot of our ceremonies were about choice, what kind of choices are you making? Even through the Milky Way, going two directions with the fork, the Sundance, it's the same thing, the Sundance tree with the fork. It's about choice. What kind of life are you gonna make for yourself by these choices? That's what I learned from the Milky Way, the Sundance tree.

According to Lakota belief, after you die you travel on the Milky Way (Wanağı Thačhanku - the Ghost Road) to the place of the spirits (Wanağiyata) "...which is somewhere in the southwestern sky world" (Goodman, 1992, p.23). On your way there you will come to an old woman who sits at the place where the Milky Way forks into two directions. She will look you over to see if you have a certain tattoo on your body. If you do she will let you pass to the place of spirits. If you don't bear the tattoo she will push you off of the road and you will fall back to Earth where you will roam as a ghost (Powers, 1975, p. 53). The origin of this belief is suggested in a story Bushotter related about the dying of a young man who experienced these very things

then came back to life (he had died in the morning then was revived in the evening as he was being buried.) The story is called, *The Man who Came to Life Again*.

> So he spoke and related all he had experienced, and then he saw that his parents had been weeping too, and their hair had been shorn carelessly off, and he thought, "What is the meaning of this?" And so he said, "I was sure I had slept." And they replied, "This morning you died, and now, just as they were about to bury you this evening, you came back to life, " They said. (Bushotter, n.d.)

Standing Bear (1933) also mentions Wanağiyata stating it "was a place of peace and plenty...a place of green plains on which roamed the buffalo..." (p. 198). Thus, according to the participant in this study responsible for the quote above, the Sun Dance tree is a symbol of the fork in the Milky Way, and your choices here not only impact the fork you can take while alive but also impacts the fork you can take later after death has found you. It is clear there is a connection to the stars and the physical and spiritual here on earth.

The Center of the Big Dipper

As related in Goodman (1992. p.22) the Lakota believed that the Big Dipper did once have a star in the middle of the "spoon" portion of the constellation. This is the opening by which the spirit enters on its journey from earth to the Wanağiyata .The elder quoted above spoke about the opening to Wanaği Thačhanku:

> The only one (constellation) I know of really good is the Big Dipper. That was our rite of passage, because what's up there is opposite down here, so when we pass on we go to the south, we go this way to the north through that - there used to be, according to our people, there was a star, (which) used to be in the middle of the four stars on the Dipper. When we die, that's where we come in, and then we come down here, so when the wind blows in, it brought the spirit in, and when the wind blew out, it took the spirit home through the rite of passage.

Gooding (1992, p. 3) speaks of the creation of this hole in the sky (which I paraphrase here) whose place is in the middle of the Big Dipper. The story is of a Lakota boy named

"Fallen Star" who is the son of a Lakota woman who married a star (along with her sister who at the same time married another star). While living with the star people she was instructed not to dig turnips. She did anyway. Upon digging a turnip from the ground she creates a hole in it. Through this hole she can spy her former home and people. Overcome by homesickness she tries to get back home by tying turnips together and climbing down. She falls to earth and dies but the child she carries with her lives. This child is Fallen Star who eventually becomes a protector of the Lakota people.

Six constellations and the Black Hills

During the course of my study students at *Isna-Wica Owayawa* were taken on fieldtrips to various sites. Three trips occurred in the early fall. One trip was to Crazy Horse's burial site, another trip was the annual buffalo kill located in Allen, SD. The third trip was to Bear Butte, just north-east of the Black Hills. I asked one of the Lakota educators at *Isna-Wica Owayawa* about other locations the school might have taken students. He responded by saying, "The same thing that is done by the wamakȟaškaŋ (wamakȟaškaŋ is the generic word for all things that move upon the earth) in the stars, we went to Devils Tower, Medicine Wheel, Beaver Wall, Hudson Ming, Cascade Springs, Harney Peak, Pesla, Crazy Horse Monument, Wounded Knee massacre site, Little Big Horn, and the Rosebud fight site." What is interesting is the fact that this educator would reference the stars and the movements of the constellations (the animals?) as a way to organize the sites to be visited by the school and its students.

It is no coincidence that we see among the historical sites listed by the Lakota educator the following: Devil's Tower, Harney Peak, Pesla, and Medicine Wheel. Each of these places were/are important places in that they are spiritual places and they each have connections to the night sky. Goodman (1992) discussed these connections in detail. Constellations played an

important role in the movement of the Lakota because they provided a "mapping" of a geographical area - namely the Black Hills. Goodman (1992, p. 29) provides an image of connections between constellations and places in the Black Hills associated with those constellations.

From the image found in Goodman, (1992, p. 29) a reflected symmetry is shown - certain constellations being associated with certain land marks in and around the Black Hills. It is the stars, and the time when the sun traversed one of these constellations, that determined where the Lakota were to be and also provided them with the information they needed in terms of they type of ceremony they were to be conducting at that place. As one elder put it,

> Star Knowledge, at certain times, they did ceremonies. Like, in the summer, that was the time of the Sundance (and) preparation for the fall. In the springtime, that was a time to welcome back life, doing ceremonies during those times because of the stars and the moon and all those things and the solstice, the sun moving a certain way, these things. They had a way of measuring it...There are certain places that do acknowledge the solstice change.

Present in this picture is the inverted connection between the stars and geographical locations around the Black Hills. The figure reminds us of the comments made by the elder who described the symbolic meaning of the tipi earlier in this section. In mathematical terms this relationship looks very much like a translation/reflection over an axis. Goodman (1992) provides an explanation of the connection of these constellations and movements of the Oglala, which I will only paraphrase here. Four constellations were used to describe the movements of the Lakota in relation to the Black Hills for the three months from the beginning of spring to the annual Sun Dance. When these constellations were traversed by the sun the Lakota people knew they were supposed to be at certain places at certain times to conduct ceremonies. When the sun was in the constellation of Čhaŋšaša Ipsuye the Lakota were to be in their winter camps and

were to perform the pipe ceremony. When the sun was in the Wičhiŋčala šakowiŋ they were to be at Harney Peak (Hiŋhaŋ Kağa Paha) and were to be doing the Welcoming Back of the Thunders ceremony. When the Sun was in the Ki Iyaŋka Očaŋku they were to be at the center of the Black Hills (*Pe Sla*) and to be performing the Welcoming Back all life in Peace and finally when the sun crossed the Matȟo Paha (the Bear's Lodge) constellation the people were to be at Matȟo Tȟipila (Devil's Tower) during the summer solstice performing the Sun Dance ceremony (Goodman, 1992, p. 12). It is with this knowledge that we can say that the Lakota did not just wander the plains following the buffalo. A major factor in their movements was the night sky and the need to continually mirror below what was above.

The Great Race

I had heard mention of the Great Race when discussing this dissertation project with an elementary special education teacher at *Isna-Wica Owayawa*. He spent a little time discussing with me a math project he put together for a summer program sponsored by Oglala Lakota College. He had used the "Great Race" story as a context for the math. He later showed me the drawings he used for the project. Also, of note is a daily reminder to students and staff of the Great Race - a gigantic circular mural hangs on the gymnasium wall that tells the story of the Great Race. As a kid I had heard the story as well from an elder in the community. Before moving on let's answer the question, what is the Great Race? The Great Race is a mythical event whereby an argument is settled. All the four-legged animals raced against all the two-legged animals. If the two-leggeds won they would prosper. If the four-leggeds won they would eat the two-leggeds. The race-track where this race took place is said to be around the Black Hills. (Luckily for humans the two-leggeds one - being grouped with the winged-ones.)

As holds true to form there is a stellar counterpart in the skies - a Race Track present in

the heavens to correspond to the one around the Black Hills. This track is called in Lakota Ki Iyaŋka Očaŋku. "Thus the Black Hills is viewed as the microcosmic hoop out of which annually new life is born" (p. 7). Amos Bad Heart Bull, an Oglala Lakota left pictographic accounts of Sioux history in the late 1800s. Blish (1967) published these pictographs. Bad Heart Bull left an image of the Black Hills with important places therein (Blish, 1967, p. 289). Very prominently portrayed among the many buttes in this pictograph is the Great Race Track around the Black Hills. I have included a picture of the Black Hills (taken off of Yahoo Maps) below to show some of these places in relation to each other.

Figure 7-1. Map of the Black Hills

"We can begin to understand how the actual features of the spatial environment affect the language and representation of locating as does the societal need for consistency and precision" (Bishop, 1991, p.33). What is above is below and what is below, above. This principle, held by

the Lakota in relation to the stars and geographical features in and around the Black Hills, illustrated briefly above shows the attention paid to the stars with the understanding that there were paths to follow and places to be when certain things were occurring overhead. The Lakota did not just wander aimlessly on the plains nor did they just follow the buffalo, though, as we shall see, they had to. It was written for them in the stars their obligation in terms of place and in terms of ceremony. In essence they followed a star map, found the corresponding places on the face of the earth and maintained themselves within that space with continual guidance. The Star People led them, especially in the coming of Woope, who would show them how to live their lives and also in relation to their ancestors, the Pte Oyate. Powers (1975) states, " The myths are (expectedly) rather vague in defining just where many of the supernatural activities take place. However, there is linguistic evidence that points toward an undifferentiated earth-sky relationship, at least at an earlier period, one no longer recorded in the data" (p.177).

On not knowing

In my look at the use of the stars among the Lakota it became clear that many of the people I talked to did not know names for many of the constellations nor how they might have been used in moving from place to place. One woman stated that she probably didn't know much about the stars because she was afraid of the čičí's (ghosts) as a child that might have been roving around at night. "The only thing I knew about was the Wanaği Thačhanku. I knew the Milky Way or whatever, and the Dipper, that's about it. They'd tell us stories about the Stone Boy. Us big chickens, as soon as the nighttime came, I would be inside. I'd never go outside (at night)." Another educator cautioned about getting too overly concerned with what happens in the above, there would be a time for that later, "I think star knowledge tell *Hunkaka* stories - the

only thing we're concerned about is from here to the maȟpiya (the clouds). It's always the big concern. When you die, you worry about everything else. Anything from here to huŋkaŋkaŋ if you're gonna talk about the universe, you did it in the huŋkaŋkaŋ (when you tell stories)." Thus, according to him, it is not necessarily in books that one becomes knowledgeable nor should one be too overly concerned in trying to figure out the above. This knowledge would come, one could gain it when listening to stories being told to them.

The information about the stars and the land and in various ceremonies is available to the people who partake in the ceremonial. It is in these situations one can find deep connections. In gathering this information it is clear that there is some knowledge about the stars. There is an understanding that there are connections to the movements of the people and the stars. There is also reference to the many mythical figures who came from the stars who have helped the Lakota time and time again. But the issue seems to be that an overall understanding is somewhat lacking. One elder put it this way, "I heard stories, but I can't remember a lot of 'em, because I heard 'em when I was fairly young, about certain star positions and planets that look like stars. They would say things, but I can't remember exactly what they said. I don't want to give you wrong information."

Further evidence in the data suggests this same general understanding among most of the participants in this study. I asked a Lakota language teacher about the movements of people and their use of the stars. "I am pretty sure they did (use the stars) because at certain times of the year they had to do a certain ceremony for each one. Like fall, you go to the fall camp and that correlates with some of the stars...and then the same way with spring and winter and summer. There's certain places you have to go and that has something to do with the stars at the time..." I asked her about constellations and she mentioned one about Star Boy, "Yeah, they do. They

actually have one like Star Boy, they have one that's a buffalo, they have…I'd have to pull out the book and show you." Here I believe the educator is speaking of Goodman's (1992) work. So again, despite the lack of specific knowledge there is an understanding of a general connection of the stars and the view of the Lakota that they were a people. I also think that many of the topics raised concerning star knowledge had its origin in Gooding's (1992) book, though I did not verify this. The same educator stated,

> "I actually had the book. I'll probably have to dig it out. But I do have it. It gives you the pictures. Of which time of the season and which stars go with what. That's what we try to teach the kids to. We try to take them to these sacred sites and show them that this goes to this star. Or this goes to a certain one. They even go back so much as to tell you the ceremonies and how we got what. You just can't separate one thing from another, everything is rolled into one. It's just like one big ball of wax."

I asked elders in the community about star knowledge and constellation and oftentimes I received a quick answer, "I don't know. I think that's probably what was used, quite a bit, because at one time, the season, there was probably the Big Dipper, it was probably used a lot to navigate yourself, because at certain times, that's always turning, you know." But there is no real depth of knowledge concerning some of the responses about stars. This leads me to wonder about access to this knowledge. Culturally speaking, it seems these stories were shared within individual families. If you were privileged enough to grow up in a home with Lakota speakers who remembered stories and shared them with you were then able to have a Lakota perspective on many of the things around you. On the other hand, if you did not grow up in a household that spoke the language you were inherently at a disadvantage when it came to knowing Lakota stories, mythology, religion and ceremony.

The schools are now bringing in this information for all the students, regardless of the number of speakers in the home. This can be viewed both positively and negatively for the

question remains is Lakota culture the school's responsibility to teach and if so, is it structurally capable of doing so. In relation to stories I asked an elder when stories about constellations were told she said, "Always at bedtime." Well, if this is the case then how is it that these things can be shared during the day when no stars are in the sky? One elder spoke of one of the original ideas behind gaining local control at Isna-Wica Owayawa. Part of the plan was to allow the schooling to occur at night so that such stories could be shared. "If we had done this we wouldn't be seeing all these gangs around here."

Lakota star knowledge runs deep even though access to it was difficult. Goodman's (1992) allows these things to be available to all Lakota. It is clear that there is room being made in the curriculum at *Isna-Wica Owayawa* along with field trips to sacred sites. Obviously, the stars are important in the view of the Lakota for they provided both spiritual and temporal guidance on the plains and around the Hesapa (Black Hills).

The Pte Oyate (the Buffalo People)

A Lakota educator saw immediately the dependence of the Lakota people on the buffalo when I asked her about the movements of the Lakota a long time ago "They (the Lakota) would just follow the seasons. At certain times of the year they would have to do certain things…That's basically what the buffalo did…they (the Lakota) were following the buffalo. " The Lakota like many plains Indians followed the buffalo. The buffalo provided them with everything. "The 'buffalo Indians' did not wander about the country because they were nomads; they were made nomads by having perforce to wander after the buffalo-to 'follow the cows around' it was termed in 1541- in order to subsist upon the buffalo resources" (Roe, 1951, p.615). The Lakota understood the importance of the buffalo to their life. A look at this connection is obviously important in the mathematical activity of locating for the movements of the Lakota were in large

part determined by their proximity to the buffalo. A look at the spiritual connection to the Pte Oyate is important as well for it is not just the stars above that guided the Lakota but also what was below inside the earth.

As the following excerpt from *Lakota Wohilikeegnapi, Unit 4* (One Feather, 1972) attests, the connection between the Lakota people and the buffalo was on the one hand one of necessity and economy,

> In the period of their early history...the buffalo was the most important source of food for the Lakota. In fact, the Lakota economy was dependent upon the movements of the buffalo, the all-important product. Such an economy was little affected by the changing seasons...A buffalo economy was somewhat stable seasonally. But because the buffalo roamed the plains, the Lakota were forced into a roaming, nomadic way of life. (p.3)

On the other hand, as seen here from the work of *Ella Deloria's The Buffalo People* (Rice 1994) this relationship was preordained and decreed by the *Pte Oyate* themselves:

> "*Kiktapi, Kiktapi!...He le wicasa-akantu wowicunk'ukta ca unk'upi, cas' slolyayapi kin, tokel le nunkapi he?...wicasa akantuala cehupa gluskanskankta un ece anpa can inazin ye...kiktapi, kiktapi!"* (p. 80)
>
> Translated this means, "Get up, get up, we live to feed the men-on-earth, and you know it; why do you lie there?...and man rises with the day but to move his jaws…get up, get up!" (p.110)
>
> *"Heciyatahan ca le Tatank-awicalowanpi kin u ske lo. Na tohanyan tatanka kin el unpi kin hehanyan Lakota kin nipikta keyapi k'un he iyecetu. Canke Lakota oyate kin tatanka-hoksila k'un he etahan wicicaga keyape lo."* (p.87)
>
> Translated: "It is from there that the Buffalo ceremony comes, they do say. And as long as the buffalo were present, the Lakota should thrive they said, and it was true. So it is said that the Lakota people sprang from the buffalo boy. (pp. 117-118).

*"Pte-Oyate kin Lakota wawicakicunzapi na un okiwanzila iglaka woyute igni omanikipi k'un he iyecel...(*p.93)." This means, "The buffalo people decreed for the Lakotas that they should always migrate, following their food (p. 124)."

The Lakota understood the importance of the Buffalo. The buffalo provided them with everything they needed. Their meat provided food and nourishment; their hides were used for clothing and housing; their horns were crafted into spoons. But it wasn't just for food, or the material things given by the buffalo that was important to the Lakota, there was also present a spiritual connection between them and the buffalo. Black Elk spoke of this when mentioning the preparation of materials for the Wiwaŋyaŋg Wačhipi (the Sun Dance), "Finally, you should cut from the rawhide the form of *tatanka*, the buffalo. He represents the people and the universe and should always be treated with respect, for was he not here before the two-legged peoples, and is he not generous in that he gives us our homes and our food? The buffalo is wise in many things, and thus, we should learn from him and should always be as a relative to him." (Brown, 1953, p. 72).

The coming of Woope in the form of a beautiful woman, who after visiting with the Lakota changed into a buffalo calf, left an indelible connection to the Lakota and the buffalo. It cannot be understated that the Lakota felt it was the role of the buffalo to provide for their well-being, both physically and spiritually.

> Skan said to them: "Your names shall be Ate, Father, and Hunku, Mother, and you and your people shall be known as the Pte Oyate, the Buffalo People. You have been created to serve the Spirits, and this will make you happy. If you cease to serve them, you will be miserable, and your children after you. Your home shall be the regions under the world, and the white fruits your food...Thus the *Pte* people were created...These were the ancestors of mankind. (Dooling, 1985, p. 12)

I want to expound a little more on the spiritual connection between the Lakota and the buffalo. The *Lakota Wohilikeegnapi, Unit 4* (One Feather, 1972). "The buffalo was considered wakan by the Lakota. He was the comrade of the Sun, Wi, and in ceremonies in honor of the Sun the buffalo's power was present. That explains the important place the buffalo dance and his

skull, hide, etc. have in the Sun Dance...The buffalo was chief of the buffalo people who lived under the world. They were the people of the Sun..."(p. 18). A connection is made here between the buffalo and the biggest star, the sun; the buffalo being prominent in this connection. A new plane of space is created because of this connection - a connection to what is under the earth. Thus we get a three-fold existence in the Lakota world-view: the stars, the earth and what is under the earth. All three planes of existence coexist and provide life and direction to the Lakota.

The participants that volunteered information about the movements of the Lakota had in their collective memory the buffalo. They knew that the Lakota followed the buffalo for survival and they also knew that the buffalo provided for them spiritually as well. What was lacking in their responses is again the lack of detail or a lack of an overview of these connections. I only received a few responses regarding the movements of the buffalo. Other research provided some help in giving me a better understanding of these connections but questions still remain. How, for instance did the buffalo move? Did they migrate from north to south? Were they abundant in certain areas during certain seasons?

The Movements of the Buffalo

Roe (1951) provides some answers to this question. The buffalo did move, as the resources of the land may have dictated to them. Such massive herds would mean that the grass from a geographical area would be consumed very quickly so movement would seem almost constant. In terms of an annual migration or a migration that was regular Roe (1951) cannot find any evidence. The buffalo moved but only within a certain area and highly irregularly. A migration like that seen in Africa of the Wildebeests is not found historically with the buffalo in North America. Roe called the movement of the buffalo irregular; someone else might call it

roaming. "From this propensity to occasional (and seemingly imponderable) individual or sub-group action, not characteristic of the species as a whole, it has been seen that even the sacrosanct 'regular migration' was not exempt. These movements did not, as historical facts, invariably take place. Neither were they invariably along the same routes, nor even in the same 'strategic' directions'"(p.673). McHugh (1972) and Dary (1974) seem to defer to Roe on the matter of irregular migrations of the buffalo.

Thus the roaming buffalo led to roaming Lakota. However, unlike the buffalo the Lakota had boundaries to their roaming - the boundaries of their own territory. Inside this distinct territory, which itself was ever expanding and contracting as the ability to maintain it dictated, they would hunt the buffalo. Where the buffalo were so too were the Lakota. Despite their dependence on the buffalo, and in light of our look at the Lakota look at some of the constellations and their religious obligations, it is also safe to say that the movement of the Lakota was not entirely predicated throughout the year by the buffalo. One might think of the winter camps alluded to in Goodman (1992) as a time when travel was obviously not a good endeavor and in such a time killing a buffalo might have been more an issue of luck than anything else. So when did the roaming throughout the year occur?

Thus the Lakota lived an uncertain life even though the buffalo were plentiful - herds of buffalo were not always readily available. This aspect of uncertainty bespeaks the irregularity of the movements of the buffalo. Even though the Lakota followed the buffalo at times the buffalo could not be found. In *Lakota Wohilikeegnapi, Unit 4 (One Feather, 1972),* we see a short comment about the gathering of the small bands of Lakota for an annual fall hunt. "During the year the various Sioux bands roamed the country, living in camps of their own. But when spring or fall arrived, the bands all came together for the annual buffalo hunt" (p. 15). This implies a

sense of regularity and planning. A hunt, well-planned and organized, if successful, could bring in meat and resources aplenty for the long cold winter.

In this short look at the movements of the Lakota we see that it was dependent on three entities: the stars, the buffalo and the religion of the Lakota. Thus a combination of star-watching, religious obligations, seasonal influences and the roaming of the buffalo all played major roles in how the Lakota located prior to being imprisoned on reservation lands. Though it should go without saying, there was rhyme and reason to the movements of the Lakota. This mode of existence implied a worldview that was complex and deeply connected to three planes of existence - each influencing the other. The buffalo brought life - as the buffalo went so too the Lakota. The stars brought direction to the Lakota in both a spiritual and physical sense. What was above is below. There was the spiritual obligation since it was the supernatural realm that dictated the movements during certain times of the year. The earth also was factored into their movements since it was viewed that the buffalo came from under the ground - it brought life to the Lakota. All relationships between the three entities, the Wičaȟpi Oyate, the Lakota and the Pte Oyate were reciprocal.

It must be noted that this look at the movements of the Lakota, since it is dependent in part on supernatural cultural beliefs and practices, of which my knowledge is limited, is incomplete. More work is needed to get a better understanding of locating within Lakota culture. The buffalo herds were enormous a long time ago and the free Lakota, who adapted well to the uses of the horse and were expert horsemen, had a wide range of travel open to them. If the Lakota did indeed follow the buffalo, how is it then that there were times of great famine and hunger? If there was any regularity at all to the movements of the buffalo at all shouldn't the Lakota have come to know this and shouldn't they have been able to take advantage of it? Was

there any regularity to the wandering way of the Lakota during the summer months through the beginning of winter (since the above look at constellations and their connection to the Black Hills were concerned with only the time encompassed in the winter months through the summer solstice)? Did the Lakota visit certain other sites on the plains for various purposes? Did they have trading agreements with fur trappers and did these connections to the wašiču also dictate their movements? These questions were not answered in this study.

Lakota Words Expressing Direction

This section deals with the Lakota words used for locating. It must be stated that I have only acquired from this study a few words out of the many dealing with direction. They are generic terms. As I mentioned I am not fluent in the language and feel inadequate when discussing their meaning. Like many words, context is needed to provide meaning. In this section I have also taken a look at the four directions. To say that the four directions are important in Lakota is a major understatement. There are stories among the Lakota about the establishment of the four directions, which I will relay in this section if only to give the reader a glimpse into this importance.

In looking at expressing direction in any language it is clear that there can be many types of terms used: here, there, close, far, left, right, and up and down, to mention a few. Some of these words I was able to have elders and speakers relate to me in the Lakota language.

Above and Below:

"Above" came in the following forms: waŋkal and waŋkata. "Below" was expressed as khuta and oȟlate *(*underneath*)*. Further contexts could include terms like depth in water, which was stated as šmeya, mahela. An instructor commented on measuring depth: "Mahetiyahe," then would be identified by the foot - ten feet…Mahetiya means deep." Up is Wakalkiya. Also

expressed was the word for vertical, " waglatala" which meant the same as "going up." Horizontal was spoken of as "opta glakiŋyaŋ."

Near and Far:

Close in the Lakota language was spoken as ″kiela" and "lečegla" Far away was spoken as "tȟehaŋl" and " lila tȟehaŋl″ (very far away).

Left and Right:

Left is described as čhatka and right is išlata. From the left side is čhatkatahaŋ and from the right side is išlatahaŋ. Toward the left is čhatkatakiya and toward the right is išlatakiya.

Words I did not ask for but found in the BLED included: near - kiela, nearby - lečegla. Lel - here, and hel - there.

I think it is important to take a look at these types of words and include them in the mathematical activity of locating since these types of words are needed for expressing direction. Using these terms is key if we began to use maps or ask for directions to get from one place to the next (which we will see later). In a mathematical sense when we began to use the Cartesian coordinate system we start to use these types of words. For instance, in the expression of slopes of linear functions we typically use the words - rise over run, to describe the number of units we go "up" or "down", as the case may be, and then the number of units we go "over" - left or right, to relocate a point on the line. Again we may use these words in describing translations and reflections. I think it is important, especially if we are concerned with ultimately looking at creating mathematical contexts and curriculum in the Lakota language, to at least begin the conversation in terms of what types of words should/could be used to start talking about expressing "mathematics" in the Lakota language.

Tȟateyetopa - The Four Directions

When Woope came to visit Tate (the Wind) she brought to him a message from her father *Skan*:

> His message is this. Now there is no direction in the world, and your four sons must each fix a direction and establish it so it will be forever known. When each one has fixed a direction, it shall be his dwelling place. The directions must be on the edge of the world and each an equal distance from the one next to it. They must divide the edge into four equal parts and one part shall belong to each of the four brothers. They must go around the world on its edge. From when they start on this journey to when they finish it will be the fourth time, a year. You will govern the fourth time, the year, and shall give as much of each year's time to each of your sons as you want,...When they have established the four directions and made the fourth time, then they will be as Spirits..." (Dooling, 2008, p. 52)

With the coming of Woope the task for establishing order is set. The four sons of Tate are Okağa, Eya,Yata, and Yaŋpa. Yata was the first-born. He was "burly and morose. Eya was good-natured and careless, Yaŋpa was lazy and selfish, and Okağa was kind and thoughtful (p. 45)." The four sons travel a great distance, overcome many obstacles and internal conflicts in their journey and finally establish the four directions. Dooling's (2008) seminal work, *The Sons of the Wind*, attempts to make a coherent whole out of the anthropological work done by Dr. James Walker (whose anthropological work during the turn of the last century with the Lakota is well-known.) regarding Lakota stories and myths. It is from her work that I will rely for a glimpse of the task of the four brothers. With the synopsis of this story I will try to help the reader understand that with the establishment of the four directions there comes to the fore order and a place in which the Lakota can live. The year arises and along with it the seasons, which established to divide the year into four. This conception of the establishment of the four seasons shows, from a Lakota perspective, that time did not exist without direction and that direction and the four brothers were the cause of the various characteristics of each season. Also of import is

the notion that it is the father of the four sons, Tȟate (the wind), who governs the seasons. It is important to approach the establishment of the four directions on a cultural level because it has obvious connections to locating. It is also important to touch on the establishment of the four directions because there is much spiritual connection to the Lakota to the four directions - hence an inherently deep appreciation of the need to locate - the fixing of the four directions establishes order in the world.

Before embarking on aspects of the story of the establishment of the four directions I want to look at the expression of the four directions in the Lakota language. In asking participants in this study about the expression of the four directions we get the following Lakota words: West is expressed as Wiyoȟpeyata (toward the place where the sun falls over, or falls off), North in Lakota is Waziyata ("toward the pine,"). One elder stated, north is pretty much - I think north is where winter comes from." East is Wiyohiŋyaŋpata which means, where the sun rises or toward where the sunlight comes, and finally south is expressed as Itokağata. Itokağata according to a Lakota educator meant "the place where the souls are."

It is important to note the order in which the four directions are expressed in relation to each other. It is not haphazard. In the story of the establishment of the four directions controversy arises between Yata and Eya about who has birthright and thus authority over all the other brothers. Despite Yata being the first born ultimately Eya gains the birthright, due in large part to negative actions and attitude of Yata. "The first direction is fixed by Eya and its occasion was visited by Wazi. Then Wazi said to them, "That rock is fixed there forever, and it marks the first direction. It is placed by Eya, and therefore it is his direction, and he shall have first place in all things. To him is given birthright of the first-born son, and each of you other three brothers shall be subordinate to him" (p. 67). Thus in the expression of the four directions, the direction

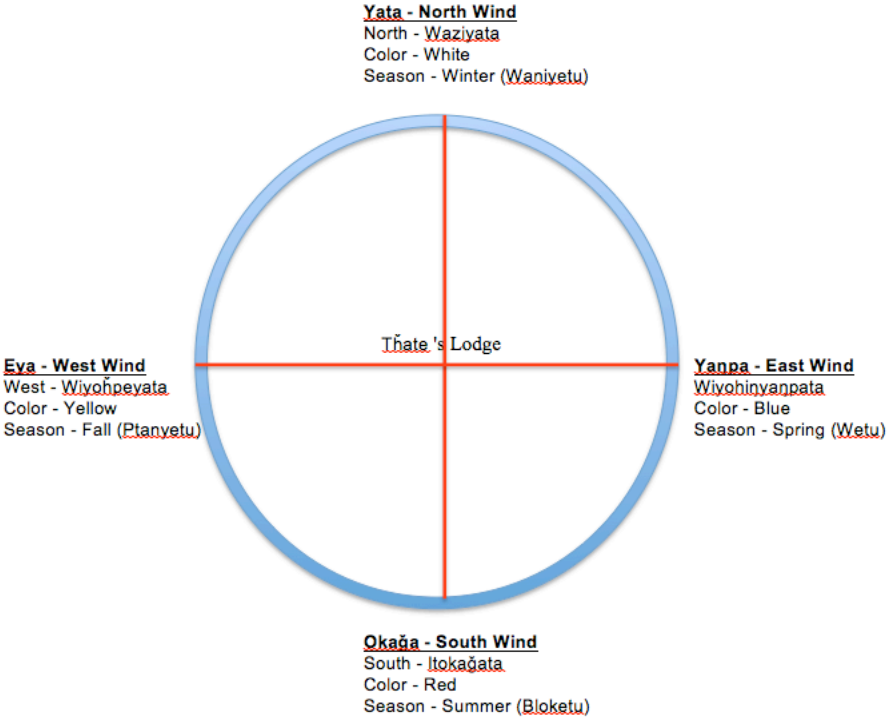
established by Eya (west) always comes first, followed by Yata (north), Yaŋpa (east) and finally Okağa (south).

Before embarking on their journey it is relayed to the four brothers the importance of their mission. "The directions which you will fix will be the only things in the world that are immovable" (p. 66). As the story unfolds we see the personification of the four directions, their personal characteristics and then how these characteristics come to be associated with the seasons that each of the four will come to govern individually. When Yata finally establishes the second direction, his direction, he acts in such a negative way as to incur the wrath of Wazi who then makes it so that Yata *'s* bad behavior is the reason his season, which becomes winter, is cold and impersonal. " Yata grasped a stone to throw at the swallow, but he became like ice and could not move. Wazi said, "Because you are mean and ill-tempered, you shall always be like ice. When you come, things that breathe shall fly from you and all that grows from the ground shall be as if dead." Then Wazi vanished. Yata moved, but everything near him was cold" (p. 75). Similar personal characteristics of the seasons are applied to each of the seasons they govern respectively.

> An interesting conceptualization of the four directions upon the earth arises in this story. It is expressed to the four brothers ""The disk represents the world," said Wakanka "The lodge at the center is the lodge of Tate. The white at the top is where the direction of Yata will be. The mountain on the left is where the direction of Eya will be. The colors of Anpetu are where Yanpa will fix his direction, and the red at the bottom is where Okaga will fix his."
>
> "When a direction is established, a red line will appear on the disk, from where the direction is fixed to the edge in the center. These lines will divide the world into four equal parts. Count the moons from when one line appears until another is shown, and the days from when the Four have completed the circuit of the world (Dooling, 1985, p. 71).

As the establishment of the four directions and the characteristics of each season are set the disk and the associated colors are set as well. Here is a visual representation of it:

Figure 7-2. Tȟateyetopa - The Four Directions



This figure above is one that is seen many times in Lakota art and symbolism. Indeed a name is given to it - a "medicine wheel." What is interesting in this figure is the fact that we have four quadrants and a line moving from north to south and east to west. These lines are framed within a circle. The circle represents both time (seasons) and can also be looked at as the relationship between entities as a result of the passing of time (a year). From the center of the circle (Tȟate 's Lodge) the wind governs relationships around it. He alone dictates to the four sons the amount of time and impact they can have on the whole. A comparison to the Western equivalent, at least in mathematics - the Cartesian coordinate system - can be made. The first thing to notice is that the four "corners" of this system are not "directions" per se in that are not "fixed." They do not stand for anything specific. They are defined by their usefulness. They have not been given any specific name and therefore no personal characteristics. Instead of four

"names" there are only two. Their names are the variables, x and y. These two lines, or axes, are framed not by a circle showing relationships to each other, like the seasons and time but by a square whose figure only shows the axes x and y. This square and x-y axes are useful in that they show relationships to various functions (the input being a value of x and the output the value of y) in the form of graphs. It also shows that y is dependent on x (if we are talking about functions). The intersection of the x and y axes is the origin or the point (0,0). Tate's Lodge occupies the equivalent in the medicine wheel. What impact does the origin have on the whole? It would seem that its importance is merely to establish a starting point.

In the story of the four brothers the starting point was the fixing of the directions. Tȟate's influence on the four directions didn't happen until this occurred. Tȟate's influence can be viewed mathematically thereafter as the independent variable and his input directly impacts not one variable but four, since each of these are related to each other. Culturally speaking the medicine wheel tells the story of the fixing of the four directions and the relationships between them thereafter. From a western perspective, the Cartesian coordinate system rises from the necessity to represent various phenomena found in studying relationships between two entities. Its power is in its ability to include many relationships. Here though the relationship is oftentimes one-to-one and implies an ability to separate the entities being studied from the whole. The medicine wheel has no such usefulness for the whole would be destroyed - there would be no order.

Once the journey is completed and all is set. What they have done and have caused is explained to them.

> To the four brothers, he said that because they had established the four directions and the fourth time, the fourth time would be called *waniyetu*, the year, and would be divided into four seasons of three moons each. One season he gave in charge of each of the four brothers: to Eya he gave the first season, the second to Yata,

> the third to Yanpa, and the fourth to Okaga. He commanded each to govern his own season, all under the control of their father Tate. He said...the four brothers would be as one...and the name of that one would be Tatuyetupa. Henceforth Eya would be known as the West Wind and dwell in the mountains where the sun goes to rest. His color is yellow. Yata is the North Wind; he lives in the cold region of the pines...and his color is white...Yanpa is the East Wind and lives where the great waters are, where Wi begins his daily journey. His color is blue. Okaga is the South Wind, and his color is red. (Dooling, 1985, pp.112-113)

Place Names

> One time a band of Crows came into the land of the Sioux, looking for a chance to steal some horses. As soon as the Crows were discovered, the Sioux gave chase. The Crows were unable to get away by running back the way they had come, and found themselves up against the bluff. With only one direction to run, they took to the steep path that led to the top of the butte...At the end of the chase the Crows had all reached the top of the bluff, but the Sioux did not follow them, for it was late in the day...The Sioux warriors gathered about their camp-fires enjoying their meal, and went to bed...High on top of the bluff,...could be seen the glare of the Crow fires.
>
> When morning came...some keen-eyed warrior saw footprints at the foot of the bluff...Looking up, they saw, some fifty-feet above, the end of a horse-hide rope, fresh and raw, swinging loose in the breeze...around the stump of a pine tree the rope was secured, and down that, one by one, he Crow Warriors had slid as far as they could go. Then they jumped and swam the river. It was a dangerous escape...
>
> Since that time both Indians and white men have called this place Crow Butte. (Standing Bear, 1933, pp. 39-40)

In the short story of how a butte in South Dakota got its name Standing Bear illustrates the history involved in the naming of places. We have seen above the spiritual connection to sacred places within the Black Hills. Is it possible to find the history of the names of places the Lakota deemed noteworthy? Events such as escaping Crows (one of the many traditional enemies of the Sioux) left indelible imprints on places such that the name of the place harkens back to the memory of the place. In this section I would like to take a look at a few places named by the Lakota, and will try to see if we can surmise reasons for naming places from the names themselves. How did the naming of places change once the Lakota were imprisoned on reservations? Do names now associated with various places on the reservation have stories to

tell and do they reflect the changing lives of the Lakota once imprisoned? For this study I inquired about place names from elders because I felt that the names of these places in Lakota are, as Luther Standing Bear stated about names, educational in and of themselves. I asked an educator this question during the study, "How many of the kids nowadays would know the Lakota names of these different places?" The response: "They don't." I then asked about maps of the reservation with Lakota place names. The response, "We used to do that.

As seems to be the case for this study thus far, I was able to gain access to various name places on the reservation from participants. Some of these came with literal translations. In looking for names for places off the reservation (outside of our previous discussion of places named in our look at the constellations and their connections to the Black Hills) I had to rely on some research done prior to this study for more examples. Driving Hawk Sneve (1973) collected a list of place names derived from the Lakota, Dakota and Nakota languages for places within the state of South Dakota. She included some history for some of these places. I will rely on her work for some extra information about Lakota place names on and off the reservation.

Here is a look at a list of names on the Pine Ridge Reservation that I was able to get from participants.

Pine Ridge

The village of Pine Ridge itself was known by two names in Lakota. The first was Owakpamni - which according to one elder meant, "a place of distribution." This elder broke the word down for me to show me how it is translated. " Owakpamni (and that translates to) "Place of distribution." "O" is "place" and "wa" is "Things, way of doing things, "kpamni" is "to pass out things, distribute." So you break the word down that way." This had to do with the fact that the town of Pine Ridge served as a center for the distribution of rations a long time ago. The

second name for Pine Ridge was Wazi Ahaŋhaŋ - which refers to the number of pine trees and their configuration near the village. One elder said that Wazi Ahaŋhaŋ "was the old way of saying it."

Batesland

Other places on the reservation include a place just this side of Batesland (west of Batesland) called Čhasmupaha, which translates to "Sandy Hills." Batesland was also called Čhasmu Wakpa because of a river nearby that contained a lot of sand.

Porcupine

Porcupine is called Pȟahiŋ Sinte *(*pȟahiŋ is the Lakota word fo*r Porcupine,* sinte is the Lakota word for tail).

Red Shirt

For the village of Red Shirt two names were given to me, the first is the literal translation - Ogle Ša. The second name is in reference to the Cheyenne River, which runs just north of the village at Red-Shirt called Wakpa Šte, which is short for Wakpa Wašte (good river). Driving Hawk Sneeve (1973) states this about Red Shirt Table, "...was named for Red Shirt, one of the leaders of fifteen Indian families who banded together under the reorganization act and built a town for themselves on the Cheyenne River bottoms" (p. 15).

Kyle

The village of Kyle is called Pȟežuta Haka. The elder who provided many Lakota place names for me stated this, "Pȟežuta Haka" It's the name that they give it, (it means) "Medicine Root." (And each of these places is named in the Lakota language for a reason? So they say "Medicine Root," so that's a place where they would have gathered certain kinds of medicines?) "Yeah."

Slim Buttes

Slim Buttes is named Paha Zizipela or žaŋžaŋ blaska (Thin Hills, not a lot of trees).

Badlands

The Badlands were called Makȟo Šiče, which is a literal translation.

White Clay

White Clay is Makȟa San, again a literal translation - white earth.

No. 6

I asked about the Lakota name for a place known as No. 6. I was told it was called Ogle Ptečela - Short Shirt. This refers to the fact that the river by No. 6 is closer to Oglala than the Cheyenne River located by Red Shirt. No. 6 is also the name of a school that used to be located there. There are other places on the reservation whose names are identified as numbers. Thus No. 4 is another place located near Oglala. Loneman School was known as No. 5 prior to consolidating some of these other schools around the area.

Oglala

I also asked about the name Oglala. An elder stated this.

> Like the word "Oglala." We were taught to say "scattered their own." But that's not the word. We look at it in a different way. I do. This is how I was taught. "O" is "a place," and "gla" is "to go back to," and "la" is "to ask for those gifts from the creator." So where do we go to get those things? The Black Hills. That tells me that our words - who's closest to the Black Hills? - the Oglala, just by the name. But in English, they want us to say "Scattered so-and-so." We don't have any connection to the Black Hills. (Oh!, OK. I'd always heard the scattered-their-own but I hadn't ever -) See, that's what we were taught. But I grew up learning different.

Additional Places

Other places that were included in my discussions with elders were, Rainbow Valley - Wigmuŋke Wakpa (I am not sure where this is located on the reservation), Wounded Knee which

is Chaŋkpe Opi , "Literally, "Wounded Knee."" Manderson is Oyuȟpe - "A place where they brought and unloaded and distributed there also."

I have provided a map below to show the location of most of these places.

Figure 7-3. Map of Lakota Place Names on the Pine Ridge Reservation

Influences of Government Schools

As I mentioned previously is the existence of places that are referred to as a number. Growing up I had heard and knew of places called No. 1, No. 4, and No. 6. In the course of this study I was informed that these places referred to government schools that were built at those locations. Thus each number referred to a specific school. According to *Tiyospaye, Curriculum Unit Resource 2* (One Feather, 1972) there were 25 such schools (p. 18), all of which were built near the location of *tiospayes* for easy access. Some of these are included on the map. I was unable to find out where all the schools were located. Loneman, as I mentioned, was known as No. 5 prior to its opening in the mid-1950s. When it opened it consolidated many of the area schools including No. 6, and No. 4. The community of *Payabaya* (Pushed Asides) is also known as No. 6. And No. 25 served the *Ite Sicas tioyospaye* (Tioyospaye, p. 20) though I could not find its location on a map.

I am not the first person to attempt to put a map together of the Lakota names of places on the Reservation nor am I the first to see their importance. Recently I was pointed to the Lakota Language curriculum used at Red Cloud Indian School by one my nephews who is currently a student there. In this curriculum is the wide use of many of these place names in the curriculum.

Tiospayes

> Senator Pettigrew. Where were you born?
> American Horse. At the foot of Black Hills there is a hill called Bear Hill.
> Senator Pettigrew. Bear Butte?
> American Horse. A little south of that thee are two creeks and a fork formed. I was born between those creeks.
> Senator Pettigrew. Where have you lived ever since you were born?
> American Horse. Since I was born I have been living about and around the Black Hills and Platte River, running up north, and Tongue River, and Little Big Horn, at the foot of the Rocky Mountains. I have travelled around through that part of the country, and especially around Black Hills, and north and south of that.

> (Statements of Ogallala Sioux Before the Chairman of the Committee on Indian Affairs, United States Senate, 1897).

In looking at place names scattered upon the land of the Pine Ridge reservation and also the names of the seven districts that break up the reservation invariably we must look at the various *tiospayes* among the Oglala. The Oglala traditionally used to travel in family groups called tiospaye. "The word TIOSPAYE, can be broken into two meaningful small words: Ti - a short from of Tipi, meaning house, *ospaye* - group of people separated from a larger or the main body of people. Tiospayes are small groups of persons who are related to each other" (*Tiospayes: Unit* 2., One Feather, 1972, p.3). Each group followed a certain person within the family. These family units used to gather together in the summertime. After the U.S. invasion of Lakota lands things changed. Movements of the tȟiošpaye that constituted the Oglalas became at first constrained to agreed upon treaty lands then later confined to ever-dwindling reservation lands. "Under the Allotment Act of 1887 each family head received a section of land (640 acres). A wife and any single person received a half section (320 acres). Each child under 18 years received a quarter section (160 acres). These sections could be chosen anywhere on the reservation (*Makoce: Unit 3*, One Feather, 1972, p. 19)." Despite the dwindling land base of the Oglalas and the dividing of land into allotments the tiospayes continued to persist. "During the Allotment period people were allowed to choose their tracts of land anywhere. In this way tiospayes and extended families could stick together" (*Makoce: Unit 3*, One Feather, 1972, p. 21).

According to the *Tioyospaye, Curriculum Resource Unit 2* (One Feather, 1972) there were traditionally two tiospayes amongst the Oglalas, the *Kiyuksas,* (the Cut-offs - led by Bull-Bear) and the *Ite Sices* (the Bad Faces - due perhaps to scars left by Smallpox, lead by Smoke - later led by Red Cloud). Later two more family groups were formed out of disagreement within

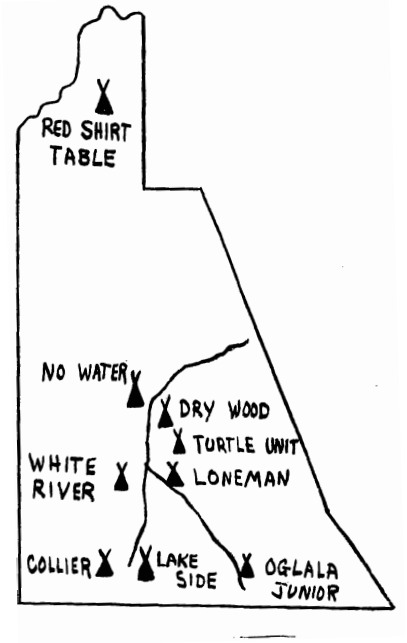
the *Ite-Sica*. The *Oyukpe* ("To break off" - led by Big Road) and the *Payabayas* ("Shove aside" - led by Man Afraid of his Horses). "All of the people belonged to one of these four bands, the *Ite Sica, Kiyuksa, Oyukpe*, and the *Payabaya"* (Tiospayes, Unit 2, One Feather, 1972, p. 14). Later, because of a dislike of Red Cloud's leadership the different tiospaye groups decided to settle in different areas. "They (the *Kiyuksas*) moved eastward until they settled on the Yellow Medicine Root Creek. The *Payabayas* under Young Man Afraid of His Horses moved north along the White Clay Creek. The *Oyukpe*, under Red Dog, moved to Wounded Knee Creek. Red Cloud's followers, stayed at the Agency" (p. 16).

As time progressed and reservation life became the norm there became eight leaders in all, representing different tiospayes on the reservation. These people were, Little Wound, Red Cloud, Young Man Afraid of His Horses, Red Dog, White Bird, Not Flesh, High Bear, and Red Shirt" (p. 17). The dividing amongst tiospayes continued to occur as issues of rations and distributions became political. "Within those five years McGillycuddy had disrupted the system of having one Head man over many tiospayes. Now with everyone claiming Head Chief, there were many tiospayes coming about" (p.16). A list in 1884 shows 20 tiospayes (p. 16).

As time progressed and the distribution of rationing needed to be made more efficient the Pine Ridge Reservation was divided into eight districts: White Clay District, Wounded Knee District, Porcupine District, Wakpamni District, Medicine Root District, Eagle Nest District, Pass Creek District and La Creek District. Each of these districts had many communities in them. Each community could be viewed as a tiospaye. White Clay district consists of the following communities: No Water, Collier, Lakeside, Loneman, Drywood, Oglala Jr., White River community and Turtle Unit Community. Each community had various families within them. I will not list all of the families for all the eight districts but instead will concentrate on the

White Clay District. Tiospaye: Unit 2, (One Feather, 1972) lists the following families in the White Clay District: Good Voice Flutes, Bands, Bels, (No Water), Crowe, Eagle Hawk, High White Man (Collier), Afraid of his Horses (Loneman), Stinking Bear, Jumping Bull, Thunder Club, Brave Heart, Eagle Louse, Little, Hunts Enemy, Tyons and White Bear (Oglala Jr.), High White Man, Bad Heart Bull (White River), and He Crows, Weasel Bears, Loafers, and Blindman (Turtle Unit). Most of these communities had a headman. The following were listed as headmen for each community: Red Shirt Table - Red Shirt, Two Bulls; Lakeside - Good Weasel, Loneman - Loneman, Oglala Jr. White Bird, Iron Bull, Collier - Spotted Elk, No Water - No Water.

Figure 7-4. Map of White Clay District with Communities
(taken from One Feather (1974), Tiospaye Unit 2, p. 33)



The reason I wanted to spend time looking at place names, which then necessitated a look at tiosopayes, districts and communities is that place names have a history behind them. The naming of places on the Pine Ridge reservation was as much a function of the settling of

tiospayes across the reservation as it was an issue of intertribal politics and politics between the tribe and the U.S. government. The presence of many of these headmen are present in the names of families on the reservation. Thus I harken back to Luther Standing Bear and paraphrase him here, there is much education in the names of the people and there is much education in the names of places that become to be named because of those people, oftentimes bearing their very names. The name of the village of Red Shirt and the location of the community of Payabaya speak to the eventual settling of various areas by individual tȟiyošpayes.

Going from Place to Place - Giving Directions

With the activity of locating it is important to be able to relay how to get from one place to the next. What types of words are used and how does one come to understand the information being told to them so that they know of which place is being spoken of or that they can find themselves in the correct place after listening to directions. Prior to asking speakers to speak in the Lakota language in terms of directions I asked one elder to talk about going from one place to the next. It is interesting to note what is implicit in this talk about directions and going from place to place.

When I was having a discussion about directions with an elder she speaks of traveling from place to place during her childhood. There were no roads at the time of her childhood. They traveled near water - Cheyenne River. She grew up in the Red Shirt community. In her story it took a day to get to Hermosa from Red Shirt (whose distance nowadays is measured at 28 miles - roughly a half hour's journey by car.) What is lost now with the roads is perhaps the sense of the amount of effort it took to get from one place to the next either on horse or by wagon. Also lost are the "old trails" used and the need for the water for both family and horses. Here is what the elder stated:

Story from Red Shirt to Hermosa:

> The only one I remember, that was when I was growing up, I was still young then, and my dad used to get $48/month. In order to go to town we took the team wagon ready early in the morning, and we were at the village, we went north across the river. He found old trails. He followed (them) to the top, then he'd go straight to Hermosa, back then those ranchers were good, they even let us dig turnips on their land if we covered them back up (the holes). So he knew a way, he made his own road, down steep hills, he went along the creek. We stopped there at noon, watered the horses, he'd hobble them, mom would build a fire, mom would put some food on, we'd rest there for maybe an hour, then we'd start out again. We made it to Hermosa, back then there were no roads, that last ranch across the Cheyenne River. There was no roads back then...just that far...So he made his own road.

This same elder then talked about going to Rapid City from Red Shirt Table. She mentioned a train station in Fairburn. (A town I really didn't know existed). But apparently it provided a stop-over for the folks who wanted to get to Rapid City. They would catch a train in Fairburn that then took them the rest of the way to Rapid City and back again.

Red Shirt to Rapid City:

> Every month during summer we'd go camp, on this side of Hermosa, there was a railroad track, that's where we'd pitch the camp on this side of the railroad camp. Across the road they had a big corral, water tank there and hay. May dad, he'd keep his horses there. We'd get on the train at 8:00 in the morning, they would go towards Fairburn, at 4:00 we'd catch the train back and then start back again. I used to look forward to that.

It was at this point in the study that I began to inquire about place names and also about how to give directions in the Lakota language using those Lakota place names. The thought occurred to me that direction (using the cardinal directions), magnitude in miles and the roads available would be an interesting context for mathematics and the Lakota language classes. I have included three examples of giving directions in the language.

From Oglala to Kyle:

Oglala to Kyle you'd probably say, Oglala: Oglala etaŋ kiyuksa ki hečiya makhiyutȟab then say miles. Wiyohaŋpiyatakiya tona miles akhiyutȟapi. That's a lot of measurements, when you think about it. In the language you talk so much. English is just short. I do a lot of (sign language). I guess that's in the Lakota way, you try to really describe it. "Makȟa San oyaŋke makhiyutȟab i letaŋ ake topa Owakpamni el unkihunip na hetaŋ wioyahapi tokhiya makhiyutȟab šakowiŋ na hena wakatakiya wazi yatakiya uŋyaŋ na Pȟahiŋ Sinte hena makhiyutȟab ake waŋži.

Rapid City to Oglala:

Rapid City is Mniluzahaŋ. Pine Ridge is Owakpamni. I think you would say - if he asked me in Lakota how to get to Pine Ridge, I would tell him, Mniluzahaŋ etaŋ yau hatanash Hermosa, and then there's a Lakota word for Hermosa, right now I can't remember. Yau na hel yahi hune ki, "You'll get to Hermosa." Hetaŋ he čhanku wan wihinaphe iciyatahaŋ eyab čhanku wan wihinaphe yataŋ han hi cha hel ogna yau na yau na Red Shirt Table. "The Direction is east." "Red Shirt Table, Ogle Luta el yahihuni. "You come to Red Shirt Table."Hecena yau na "Keep coming and you get to Oglala." then čhanku wau hel. Ogala he yahihuni he ake čhanku wan un. That's (Highway)18. čhanku wan hel han he. "You go towards east again.

From Red Shirt to Kyle:

From Red Shirt to Kyle? Ogle Luta etaŋ itokağatakiya (south) wikčemna saŋm zaptaŋ ni nahaŋ čhanku yamni ki hetaŋ akhe itokağatakiya makhiyutȟab wikčemna sel ni nahaŋ ho hel eta akhe wihinaphe ečethikiya wikčemna saŋm zaptaŋ makhiyutȟab lahaŋtan Pȟežuta Haka iyahuni.

(So literally translate it. Say it in English now.)

From Red Shirt, you come 15 miles and ten you go toward the east about 20 miles and the you come to a road an you go south 10 miles and then from there you go east 15 miles and you'll come to Kyle.

Conclusion

Locating for the Lakota historically was based on three things: (1) the movements of the buffalo (and the Lakota relationship to them), (2) the relationship between the stars and the earth and (3) how and when to synchronize the happenings above with that below in the form of ceremonies. Thus a large part of the movements of the people dealt with the mirroring of the universe (and events therein) onto the world the Lakota inhabited. These movements were both spatial/temporal and physical/spiritual. The stars helped guide the Lakota in this process in very practical ways (their movements) - by paying attention to when the sun traversed specific constellations. The stars also were mediators to the Lakota (Woope, Falling Star, etc.). The Lakota also followed the buffalo. As the buffalo were killed off and the conquest of the Lakota at first in full swing the movements of the Lakota became constrained. Finally, these movements became confined when the Lakota were imprisoned on reservation lands. As a result of confinement to the reservation we now see, as evidenced in place names on the reservation, that outside (and inner) political forces dominated the location of tiopayes on the reservation. Prior to confinement on the reservation important places were associated with historical events embedded deeply in the past. Now the names of places reflected US political influences and inner-tribal politics and the education of Lakota children (schools). The names of places on the reservation include the remnants of the movements of various tȟiyošpaye groups, which in turn was affected by government rationing and vying for political capital.

This trend from the spiritual use of the land with the economy of the buffalo upon it to one that is foreign (farming, ranching) and political - with more and more dependence on the federal government for life bespeaks the hollowness now seen in place. The Lakota are now governed by clocks and technology and as such have moved from the spiritual and practical to a

level of political pragmatism. Directions are given in terms of miles and the movements of the people more resemble dominant culture. The land is becoming less and less important as landmarks and hence less dependent upon for survival.

Chapter 8: UMA #5 - Playing – Woškate

All cultures play and all cultures have games. One might think to the many games they participated in as children and then later as adults. From a mathematical perspective it is easy to see connections between games of chance and probability. Indeed, many contexts involving games of chance (using cards and dice) help build conceptual understanding of probability principles in the mathematics classroom. For Bishop (1991) the connection between playing and mathematics runs deeper. Playing provides a sense of structure whereby participants agree to certain rules. In this structure is set an important false reality that allows participants to either imitate a certain behavior or to take chances they normally wouldn't take in real life.

> Clearly playing is a form of social activity which is different in character from any kind of social intercourse which has been mentioned so far - playing takes place in the context of a game, and people become players. The real/not real boundary is well established and players can only play with other players if everyone agrees to behave 'normally'. (p.43)

These characteristics of games and playing are an important precursor to learning mathematics, which itself sets up realities in which students are given definitions, corollaries and postulates to govern their time in these spaces. Bishop (1991) asks, "Could these characteristics be at the root of hypothetical thinking" (p.43)? Furthermore, "Certainly imitation, or the modeling of reality, is a feature of many games, and has much importance for use here. It is another aspect of abstracting from reality certain forms and structures..."(p.45). Games and playing therefore foster an ability to abstract for players for games pull them out of reality and situates them into a new imagined space. "I think that it is not too difficult to imagine how the rule-governed criteria of mathematics have developed from the pleasures and satisfactions of rule-governed behaviour in games" (p. 45).

What games and forms of playing are currently in existence in the community of Oglala? Which of these games stem from Lakota culture? What games did elders play as children and did they witness or play any games that could rightfully be called Lakota? In this short look at games and playing among participants we see that not many games being played would be considered Lakota games. Indeed, elders speak of playing baseball, going to rodeos or playing cards when they were younger. It might not be a stretch to say that their games resembled games seen across the country during their time as youth. However participants did know of some Lakota games and played some as youth, though remembering only vaguely what some of the rules might have been to those games.

As I have done in the previous four sections I combed the research done in the past to find what has been documented about various facets of Lakota culture. For this section I looked at Lakota games in the literature to offer a baseline for comparison with what was shared with me by participants. I found seven sources that offered a glimpse at the games played historically by Lakota people. These seven sources span roughly 120 years and each provides a list of Lakota games known of at their respective times. The seven sources were: Bushotter (n.d.), Dorsey (1891), Meeker (1901), Walker (1905, 1906), Buechel (n.d.) and One Feather (Lakota Woskate, 1972). Later I will compare the games mentioned in each of these documents for the purpose of showing the reader the sheer number of Lakota games that were in existence and to compare Lakota games spanning this time period. (I also want to direct the reader to some artistic representations of some Lakota games painted by painted by Oscar Howe, a Dakota artist of the last century. These paintings can be accessed at the following website: http://www.sfmissionmuseum.org/exhibits/games/howe.html).

With these historical sources in mind, as we shall see, most of what we would call "Lakota games" have gone by the historical wayside. Of the many games listed in the sources above I was able to gather evidence that two were still played. The first game was Kȟaŋsu - a woman's gambling game, which was demonstrated and explained to me by a Lakota educator. The second is the more widespread game called "Hand Games." This game was known as Haŋpapȟečhuŋ, which translates to "hit the moccasin" which is a description of the action used in finding under which moccasin game pieces were hidden. I witnessed Hand Games and also participated in it when it was played in a Lakota language class at the middle-school level. Hand Games is a game that is very widespread among Lakota schools and really around the country among various Indian tribes. Currently there are numerous Hand Game competitions, mostly taking places at powwows. It is so widespread that it could be viewed as a Pan-Indian activity since the competition it offers takes place in many tribes across the United States. One elder commented on the spread of hand games and how it has impacted the powwow scene:

> It got to where some of the dancers and singers were starting to get into hand games. I said, "No, no, no, that's not what this is for. I want dancers to dance, singers to sing, so they don't have to pull double." I wanted to include a lot more children so that they could play Hand Games, too, sing and play that game so that we wouldn't deplete our dancers and singers. I almost went that way. I think it's still kind of half and half. We're losing a lot of our dancers, because they'd rather play Hand Games than dance, the older ones, anyway.

Both *Kansu* and Hand Games are games of chance. Hand Games seems to have been revived in just the past twenty years in Oglala. One educator stated that it was he that brought the games back into the schools in the early 1990s and another told me of a Lakota language camp that his son participated in years ago where Hand Games was taught.

> I think—we worked at a program in the early '90s, and in that program, we would bring in a lot of different games. _____ was the one that brought the Hand Game into our camps. We had camps in the Black Hills in the summer, and all

> these children that came in, we taught ‘em how to play—she taught ‘em how to play. He (his son) was a little guy then. He was there at the camps. He saw the Hand Games. And now, through that, they started to spread and get into the schools and then they'd take part in the school powwows, so that’s one of the things I introduced.

(As a side note I was unaware of the many Lakota games as a child growing up in Oglala. I had never heard of Hand Games until I was a young adult and hadn't heard of Kȟaŋsu until conducting this study. The games we played as children in Oglala in the 70's and early 80's highlights the lack of access (for us anyway) to Lakota games. As children we played the typical team sports games seen in most American neighborhoods. That is, we played basketball, football, and baseball with many of our relatives. We also played many of the board games that were available to us as kids; games like Monopoly, Yahtzee, Sorry, Chinese Checkers, Checkers, Chess, etc. In addition to this we played card games such as Rummy, Black Jack, Hearts, Spades, and a slew of other gambling games. Video games were just coming out and can be classified as games we participated in (though rather infrequently since we didn't own the system) gaming systems like Atari kept us busy part of the time. Finally, we also played typical children's games like hide-and-seek, follow-the-leader, we also went swimming, rode horses and bikes, we played red-light -green-light, red-rover, and sheep-and-the-wolf, etc. We also played games with ropes, high jumped, played pool, fooze-ball, etc. Our childhood games probably did not differ much from most games played across the country by children during that time period. If any game we played could be considered "Lakota" it might have been the times we created bows and arrows out of small willow saplings. We spent many a summer day testing our strength (how far we could shoot an arrow) and competing for marksmanship amongst the brothers by shooting at various targets).

Interestingly enough, even though I stated that only two Lakota games were still being played (that I saw evidence for) after looking at the literature we can probably classify many of the games children now play as Lakota (though they seem to be universal games that children play). As I mentioned we did make and play with bows and arrows, we rode horses, raced them and also conducted our own foot-races. Our female relatives made dolls out of corn taken directly off the stalk (with the fringes of the corn being the hair) and they also played house, which comes up in the literature as Tȟipi Čik'ala. Follow-the-leader and such games were also very prominent. Unfortunately, I did not talk to the students involved in this study about games they currently play (besides video games). So, when I say that only two games are currently in existence, keep in mind that these are adult games, not the games that children play.

Elders and their Playing (non-Lakota Games)

In talking with the elders about games they might have played as youth the talk is invariably about playing cards, baseball or horseracing. Some of them witnessed a few of the Lakota games I brought up in our discussion (from the various sources listed above) but many had only vague remembrances of playing them themselves, if any at all. So what were the games that elders played as children or witnessed or heard about when they were younger? Let's look first at the games elders played that were not Lakota games.

Horses

Horse riding and horses are still prominent within the Lakota community and offer children and adults alike a favorite way to pass the time. I put riding horses in this category of non-Lakota games (activities), but when one thinks about the importance of horses to Lakota culture it can be easily seen as a Lakota activity, especially when analyzing the preferred way the riders ride atop the horses - bareback. Also of note in this activity is not just that people are

riding horses but of the types of conversations had during riding along with the activities available. My brother speaks often of riding with a few of our cousin's cousins when he was a youth who spoke Lakota when they were riding and, who made spears and tested their abilities with the spears as they rode (throwing at targets). So riding though an activity among many cultures, can be classified as Lakota if one takes a look at what occurs when riding and how the riding is done (and perhaps the approach to the horses as well, relationally speaking).

Among the activities done with horses was participating in rodeos. "Rodeoing" was a way of life for many on the Pine Ridge Reservation especially since ranching was the dominant occupation for many. It is not uncommon to see many Indian "cowboys" on the reservation (though this way of life seems to be diminishing). So it is not surprising to hear elders mention horse racing and rodeos as activities they participated in or observed as young adults. "I know they had like races, horse races," and, "As I got older, rodeos and horse racing, like that." One educator made connections to the horse races held a long time ago to the mythological Great Race to put perhaps the cultural importance on racing, "And then there was the Race *Ciyen*...that was the footrace. That had to do with the Race Track (and) the story of the Race Track. That was a game played by all. So all the men competed on foot or on horseback - they started doing horse races, using the horse (later)."

Baseball

Baseball was and is a national pass time. Baseball was huge on the reservation in the times of my grandfather. My aunt spoke of the times when my Grandfather had a baseball team and used to travel all over the place playing games and in tournaments. One elder stated: "Of course baseball, it seems like my dad and all the brothers and brother-in laws played and they said no one could beat them. They played against Hermosa, Spring Creek..." And still another

elder commented: "_____ had us as his team, and we were number one." "They'd even go to Alliance, Hot Springs, (and) play ball against them. They had really good players. ___ were good. My dad used to play." In my youth in Oglala I spent many summer days watching my older brothers playing baseball and my older sisters playing softball. My sisters were on a traveling team called "The Lonesome Buffalos." Baseball/softball was still a very big activity in which many of us participated in as kids in the 70s and 80s.

Cards

Playing card games was another activity in which many elders participated as youth. One elder stated:

> Our family was kind of like the last of the nomadic people. We grew up in a tent, so we would always be moving. Even in the wintertime we lived in a tent. We just didn't play those games. In the wintertime, if we did play games, it was cards. That's all we had. We didn't have Hand Games.

This particular elder is very traditional and to say that he played cards and not Hand Games speaks volumes about just what Lakota games were available some fifty years ago to Lakota youth.

Another elder commented about playing cards as well, "Back in the 60's, when I lived in Kyle, they (elders) played a lot of cards. I don't know what you call it (the game), Queens or something."

Another game was mentioned briefly called Sapa Icu, which seems to have been a card gambling game. "They called it Sapa Icu. They even go as far as to give up their whole cattle. But of course, that was back in the 50's, maybe the 40's."

Skating

Skating was a favorite past time in the winter. Many winter days were spent time out on the ice. One elder stated:

> _____ was telling me...he used to live on Blindman Table. They were all good skaters. They used to go below _____they would skate all the way down to the old bridge...after they got old they hung their skates on a tree down there.

Elders and their Playing - (Lakȟota - Tȟipi Čik'ala, Tȟasihaunpi na Hohuyuhmuŋpi)

For the women, playing house, or in Lakota playing " Tȟipi Čik'ala" was a part of their youthful activities. **"**And the game as a child that I played was—role playing, dolls, tipis...that was my playing." In this category of role playing or playing house the use of bones as figures in the game came to the fore in their discussions. "I remember my cousins, they played the bone games, the horses. He made a whole village of it using bones and things." Another elder stated, "We used to play (with) those bone(s)—I remember that, horse bone or cow bones and deer bones. I remember way back then, Dad made us these bones, and it was a game. I can't remember how (to play it)." As our discussion progressed this elder tried to describe it with the prompting of another elder, "1. Did you jump over it?" 2. "They swing it, I remember that part. But that's a long time ago. I was a little girl. I never did bring it to school." As they were looking through the research articles done on Lakota games that I brought along as prompts one of them stated, "Oh, and it spins around! Bone buzz that's why they would call it buzz, because it would make that noise! 1. You remember a long time ago, we used to play that in our house? We'd get bored, and my mom would give us these great big buttons, and she'd string it." Bone Buzz (Hohuyuhmuŋpi), was the game the elder was trying to recall. Finally, another elder talked briefly about a game while looking at pictures from the articles, "1. I had a lot of cows'

and a lot of horses' bones, and since there was only, maybe, like, five girls where we used to live, all the little boys would come and play."

There were two bone games that these elders were talking about. The first was called, Tȟasiȟaunpi, "the Deer Bone Game" which also was a gambling game played mostly by women. One Feather (1972) describes the materials for the game and how to play the game:

> To play the game, two items are needed: tasiha (foot bones) and tahinspa (an awl or needle). The tasiha are made from the short bones of the foot of the deer or an antelope. There are usually from four to six in a set. Each of the bones is worked into the form of a hollow cone, so that the top of one will fit into the bottom of another. In this way, they could be stacked on top of each other like cups or glasses...To play the game, the player holds the tahinspa in one hand and tosses the tasiha with the other hand. The tasiha must be caught on the point of the tahinspa. If just one tasiha is caught on the tahinspa, this counts one point. If one tasiha is caught, and another falls on top of it then this counts two...If they all fall on the top, the game is over...As soon as a player fails to score, she passes the tahinspa and the tasiha on to the next player. (pp. 13-14)

The other game is Hohuyuhmuŋpi. This is translated as the "Whirling Bones Game." One Feather (1972) offers a description of this game as well:

> This is a toy that is used in "buffalo fighting." It is made from the short bone of the foot of a large animal. It is fastened to the middle of a string of sinews about twelve to eighteen inches long. At the end of each string, a short stick is fastened to serve as a hand-hold...These sticks are taken, one in each hand, and the bone is whirled around to twist the string. The two strings are pulled apart, and this causes the string to rapidly untwist. As it untwists, the bone twirls rapidly. When this is done, the motion of the bone makes a buzzing noise...The buzzing of the bones represents the bellowing of the bulls. They come near each other and strike the bones together. If the bone on any player is stopped from buzzing, he is defeated and out of the game. (p. 17)

Ptehešte (Cow Horn)

Another game mentioned briefly was *Pteheste* which translates into "cow horn," An elder spoke briefly about this game, "My dad took a piece of shingle like that and made an arrow and

put a string on it and threw it up and it took off." I provide a depiction of it below. This game is a game very prominent in the literature:

> This is a game played by young men and sometimes boys. The only item needed is a pteheste (cow horn). This is made from the tip of a buffalo or cow horn. It is usually about three or four inches long. The men trim it down until it is very straight. They, then, put plum tree twigs into the end of the horn or fasten a feather-tipped arrow into the base of the horn. It is then thrown along the surface of the ice. The player who throws his the farthest wins the game. (One Feather, p. 12)

Plumb Game - Kȟaŋsu

The remaining two games spoken of by elders and educators and also witnessed by the author were Kȟaŋsu and Hand Games (Haŋpapȟečhuŋ). These two games are the games I mentioned still in existence. An elder recalled family members playing the women's gambling game, Kȟaŋsu when she was a little girl. "The ones that—especially during the summer is the plum game. It's a women's game." An elder brought up the fact that she had played Kȟaŋsu with her grandmother. (You played that a lot when you were a kid?) "With Grandma." (Would you remember how to play it?) "No [laughs]."

When I interviewed a Lakota educator he had brought along the materials used in playing Kȟaŋsu. (He had been aware that I would ask him about games prior to our interview.) He explained the game and demonstrated it to me. I don't think I can explain the way the game is scored accurately after only one demonstration, so I will include much of my conversation with him below.

He first explained the game and the fact that it has been played among the Lakota for a very long time. He also explained who was allowed to play:

> It's (Kȟaŋsu) a dice game. It's a game well played a long time ago. It's a traditional game. Sometimes an entire camp would come and watch it and bet,

> place wagers, maybe (they'd bet) a horse. Usually two to four women play, there could be three women or four."

The materials needed for this game are six plum-pit dice with various images on them that signify their value. What is also needed are counter sticks, called čanwiyowa. Each woman playing receives six counter sticks. Also needed is a basket, called a tȟaŋpa, from which the dice are shaken up then tossed out upon the playing surface.

Kȟaŋsu Game Pieces

In order to play Kȟaŋsu you needed to have at least three pairs of "die" (the plum pits) and a basket from which to roll the die. Each dice contains a figure on one side, with the other side remaining blank. These die are grouped in pairs being designated as such by sharing a certain design. Two plum-pit pieces were designated the Iktomi pieces, "Remember that symbol (the hour-glass symbol which was on the dice)?" When the Iktomi was face up on the table after the roll its value was one. The next two die game pieces were the Kȟeya, and the Turtle, they each had a value of 2 when rolled "face-up." The last two plum-pit die were the Tȟusweča, the Dragon-fly, whose value was three. The highest score a person could obtain in a single roll was a value of twelve (if all die when rolled exhibited their design "face up." Thus two Iktomis = 1 + 1, two Kȟeyas = 2 + 2, and two Tȟusweča = 3 + 3 for a total of 12 points). When a die was rolled and the design on it was face-down then it was considered a "white" piece and contained no points. However, if, when rolled, all the die came up "white" it trumped all other scores.

Kȟaŋsu Explained

> And then each woman when they start the game, they roll them in the basket, whatever roll is higher (she gets to go first)... Yamni *Yamni* again, but eight's higher, it cancels the two threes....so the eight roller is the starter.
>
> So you got this roll here, šakpe, nuŋpa, šağloğaŋ, napčiyuŋka...(rolls again)...so the next one rolls and so on... another beats her score. She has to beat *napciyunka*, so she beats her with a wikčemna she won, if another beats her with

> ake waŋži then she won, if this one rolled an ake nuŋpa (then she won). (If after a roll) all white (showed up) then she won, now if the starter rolled an all white, it doesn't matter who rolls it, thereafter the next persons have to roll all white, so let's say the starter rolled an all-white, so the next three have to roll an all white, if they do this even if there number's up they still can't beat that all-white, then they have to roll these...so the next one rolls over there, she's got the points so far, (rolls again) there it is, so she ties with her, so the first one has the opportunity to roll high again, (rolls again) the fourth one rolls, (rolls again) didn't make it, so these two have to roll to break the tie, those are the points like that, there's a twelve, so that one's got to beat the twelve, so that one rolls (rolls again) the star's got one point over again so this one has two points, now that they rolled the highest...if somebody had two twelve's and somebody rolled an all-white, this is a high roll...this is a game has a lot to do a lot with mathematics...teach your kids.
>
> They don't put sticks up yet, those sticks represent awls, sewing awls...If they stand up all six sewing awls they are declared the winner.

Kȟaŋsu in the classroom?

The educator who showed me this game commented about the game in the classroom when I asked him the following: (With a game like this can it be incorporated into the classroom?)

> Oh yeah, that's why I encourage it. Learn it and teach the kids. But then, only women used to play it, and the men are not allowed to play it. It's one of the twelve games, twelve games that the mythology, that the spirits brought to the people so this is one that was brought to the women.

I asked two other Lakota language teachers if they taught any of their students these games, their response was, "No, uh-uh." Another former Lakota teacher responded that she did not teach Kȟaŋsu to students when she was a teacher but you could incorporate it into the classroom.

There are a lot of things in playing games that would be good for students, especially the concept of creating a space where rules need to be adhered to. Also of importance is that during the game concentration, observation and, in a game like Kȟaŋsu, figuring comes into play.

Placing bets and understanding probabilities also are an important part of learning how to play these games.

> Yeah, other games you could play. I did have some stuff for the plum game. It is that plum game. I did have that plum game. Somebody took it. I don't know, plum season's comin' up, so you can always get your seeds. But to me, in games, one of the things that I like(in) games is, like, memory. I like that. You test your memory. You test your concentration. You have to know your rules, which kind of applies all over, in everything.

Hand Games (Haŋpapȟečhuŋ - "Hit the Moccasin")

Hand Games was mentioned as well by elders and Lakota educators as a game they either played or witnessed as children. One educator stated,

> Yeah, I remember my uncles, they'd have a community dance or something, there used to be a community building over there, and once a month or I don't know how often they would have—everybody would take food, like potluck, the elders, and they'd have a dance, and then they'd play Hand Games.

An elder commented on watching her husband play hand games in the community,

> I was watching _____ trying to play hand games, and he wiped out everybody. But I paid attention. Once that first stick went, I watched him, and all that time he didn't change, and the rest of the players, they didn't pay attention. So I watched him and watched him and he wiped them out. Then I told him after, I said, "I know what you were doing. I was watching." It means a lot, because these players weren't paying attention. They were just playing. And some of them were older people. But that's what it means to kids. You have to pay attention. We always tell them, "Listen, learn, and pay attention." Which they don't do, you know? And that's part of learning. You have to learn these things. It's a skill."

Again, Hand Games is a game of chance, it is a gambling game played a long time ago by adults. It has become a fixture at gatherings at powwows and at various community/family events. It has never really left Lakota culture like so many games seem to have done. This educator's comment points also to not just playing the game, but the need to pay attention to listen, to observe. If the other players had been paying attention to her husband's strategy he would not have "wiped them out." So in addition to the importance of games in developing a

"made-up" place where certain things occur developing the ability to listen and observe can be added to the list of things games can teach which can be useful in the realm of learning mathematics.

As I mentioned I was able to observe and participate in a few rounds of Hand Games during two middle school class periods. The teacher of these classes had been teaching hand games in her Lakota language class since she started teaching, thus it was part of her regular curriculum. Even though I participated and observed the game I need to play a few more rounds in order to be more confident in relaying the rules to the reader. I will try my best here to get the rules right. For assistance in the description of the rules I looked back in my observation notebook.

"Hand Games" Materials and Rules

What is needed to play this version of hand games are eight bones, four of which are marked, and eight sticks per team. There are two teams consisting of four players each. At the beginning of the game one team is designated the "guessers" the other team becomes the "hiders." The two teams face each other throughout the game. Having music available during the game is an important facet of this game. When I walked into the classroom (the game had already started) Hand Games songs were being played on the cd/tape player. The songs serve to help distract the guessers. Indeed it is the job of teammates to try to distract the guessers as much as possible. I saw much movement to the songs with hands being flashed to the beat of the drum throughout the whole game. Players typically sing along with the songs while playing. The side of the guessers always choose one of their teammates to make a guess. Once the bones are hidden (The hiders each have a marked and unmarked bone to hide in either hand) the guesser approaches the group of "hiders." - two at a time or individually. (The guesser can do a

"group" guess or face each hider individually.) The guesser then tries to guess the hand in which the marked bone is hidden.

The guesser has four "hand signals" that he can choose from to let the hiders know where he thinks the bone is being hidden (in which hand it is being hidden). The first signal is to designate that the guesser thinks the bones are in the outside hands (of two hiders) - this is shown as a thumb up with the index finger pointing upward (like a fake pistol), the second is the "karate chop" motion with the thumb down. This is to designate that the guesser thinks the marked bones are in the middle hands of two hiders. The third is the index finger extended pointing toward the guesser's left hand - which tells the hider to open the right hand (to show what is in it) and finally the fourth is shown with the left hand (with index finger extended) pointing towards the guesser's right hand - letting the hider know to open their left hand.

If the guesser guesses correctly he gets a stick from the hiders. If the guesser guesses incorrectly his team has to give up a stick to the hiders. When a hider's hidden marked bone is guessed he is out of the game momentarily and has to pass his bones to the other team. When all the hiders' marked bones have been guessed correctly the guessers then become the hiders. If the guesser guesses one person correctly but misses the other his team gets a stick and the hider he missed hides the bones again. If the guesser gets the second guess correctly the guessers get another stick and then become the hiders. However, if he misses the second guess then his teammate gets a stick back and the bones back and they try again - same guessers, same hiders. The team that finally collects all sixteen sticks is considered the winning team.

Presented above are the games discussed with participants and witnessed during this study. Lakota games bring with them a connection to the past. Many of these games were played by the ancestors of current Oglala elders and students not-so long ago. Embedded in each game

is also a connection to the belief system of the Lakota for it is believed that games like Haŋpapȟečhuŋ and Painyaŋkapi (Great Hoop Game) have deep historical roots and cultural importance in origin. For example, Haŋpapȟečhuŋ, it is believed, was a game played by the four brothers (Okağa, Eya, Yata, and Yaŋpa) during their quest to establish the four directions and was taught to them by Iktomi (One Feather 1974, pp. 5-8; Dooling, 1984, pp. 77-81). As another example it is believed, that Painyaŋkapi was given to a Lakota man when he went up a hill to fast in order to seek help for his people when they were starving. The game was taught to him during his fast by a buffalo. He taught his people how to play the game soon thereafter and when played later would help the Lakota locate the buffalo to hunt (One Feather, pp. 3-4).

A question arises when looking at games currently being played in Oglala. Why have some games never left the culture and why have others disappeared altogether? Specifically, why is Hand Games so prominent now in Oglala (and indeed in Indian communities across the country) when evidence of other games is nowhere to be found? Couldn't a game like Tȟabkapšicapi (Shinney) be played in the Lakota schools as well and couldn't it find root within the community, along with a host of other games (which we will see below)?

Lakota Games in the Literature

At this point I would like to take a look at the past research done on Lakota games. As I mentioned there were seven sources that I found which discussed Lakota Games. Those seven sources were: Bushotter (n.d.), Dorsey (1891), Meeker (1901), Walker (1905, 1906), Buechel (n.d.), and One Feather (Lakota Woskate, 1972). I will briefly describe what each source contains and then group them together in tables to provide the reader a way of comparing games mentioned during the time these research on Lakota games were being conducted.

Before looking at the sources it should be noted that certain games are meant for certain individuals. As one participant mentioned when speaking of the game Kȟaŋsu - stating at least a couple times that it is a woman's gambling game. In the literature we will see a breakdown of games into five categories: men, women, boys, girls and boys-and-girls. In Lakota culture (or at least it used to be in Lakota culture) there was a separation of the sexes in a lot of social situations. I can recall remnants of this at tȟiyošpaye gatherings as a youth where the men invariably gathered together and visited and the women did the same in another location. A long time ago boys typically did not play with girls; son-in-laws were not to speak with their mother-in-law and daughter-in-laws were not to speak with father-in-law. In playing games we see many times this cultural separation of the sexes, at least a long time ago. How much of this cultural aspect is still in existence today is not clear, though it is my experience that the sexes intermingle much today in play and in social situations than in times gone by. Dorsey (1891) makes note of this fact with his look at children's games along with the observation that certain games also had a certain season in which they could be played.

> Children of one sex seldom play with those of the other. Each game has its special season or seasons, and it is played at no other times of the year...None but girls can play Shkatapi chik'ala, Playing with small things, in which they imitate the actions of women, such as carrying dolls, women's work-bags, small tents, small tent-poles, wooden horse, etc...(p.329)

(Author's note, the spelling of the games below reflect the way in which each authre wrote them, except for Bushotter.)

Bushotter

Among the many topics Bushotther (n.d.) described were some Lakota games. He described eight games. Many of these games were children's games. In his descriptions he spoke of some of the games as activities purely for amusement. For example, when describing

the "Shooting at Bunches of Grass" game he states, "This was a favorite game with us; nobody won any prize by it; but we played it simply as a means of testing the marksmanship of our group, to see who was best in that respect" (Bushotter, n.d.). I have included the names of all eight games described by Bushotter (it must be noted that I did not have access to all of Bushotter's unpublished documents so may have missed other games he might have described). The eight games were: "Following one another" (Follow the leader), a children's game; Painyaŋkapi, which translates to "They make it run by pushing," which is also called "Shinney." "Horse Racing"; "Hitting the Moccasin", Haŋpapȟečhuŋ, which, as I mentioned, is a precursor to the modern form of Hand Games. The last four games dealt with developing marksmanship with the bow and arrow. These games were: "Shooting at the Cactus"; "Hitting the Bow"; "Shooting at the lungs of an animal"; and finally, "Shooting at bunches of grass."

Dorsey

Dorsey (1891) names and describes games played by Dakota Teton children. These games he categorizes into boys games and girls games and also sub-categorizes them into the seasons in which some of them are played. He gives brief descriptions of each game and was aware of Bushotter's writings on games since he is able to makes some comments about what Bushotter said about some games. Interestingly enough he comments on one game in particular. *"Tahuka changlesha un'pi*, Game with a raw-hide hoop," in which he states the following about the existence of the game, "Bushotter says that it (the game) is obsolescent "(p.334). So already, by the time this work was published, some Lakota games were disappearing. I am not sure how much of Bushotter's writings influenced Dorsey. Upon reading this document it seems that perhaps many of the games Dorsey mentions were explained prior by Bushotter in his texts

(though I could only account for eight games - Dorsey has many). I will list the games provided in Dorsey in the table that follows these six sources.

One striking characteristic in many of the descriptions of these children's games by Dorsey (1891) is the amount of imitation that occurred. This should not be surprising, because children, as they develop, imitate the actions of those around them, in words and deeds. The culture in which a child grows permeates the play of children. Dorsey described the boy's game *Maka' shun'kawakan' shkatapi*, "Sport with mud horses" thusly, "When they make mud men they cause them to dance the sun-dance, and sometimes they make soldiers or policemen, whom they cause to engage in a fight" (p. 335). It would seem that if we wanted to see how vibrant Lakota culture is (or any culture for that matter) we need only observe the play of children. What language are they using and what is being imitated?

Meeker

Meeker (1901) listed games and added short descriptions of them. He also provided images of the materials needed to play each game. He categorized these games into four groups: men's games, women's games, boy's games and girl's games. Four games are listed and described as men's games: *Painyankapi* (Great Hoop Game), *Kaga Woskate* or *Haka Heciapi* (Elk Game), another hoop game called *Tahuka Cangleska* (The Bucksin-Hoop), *Hanpapecu* (Moccasin Game). He names and gives descriptions to three women's games: *Takapsica* (Shinney) and says it is a women's game, though as we shall see Walker (1905) has both a man's Shinney (*Takapsica*) and a woman's (*Tawinkapsica*) Shinney game. *Kansu* (Plumbstone Game) is the next game he mentions. This game, obviously, is the game described above. The final women's game is *Tasiha* (Deer-Bone Game) also mentioned above in my findings.

There are many games listed for both boys and girls. I will list a few of the games here because there were so many. (I will list them all in the tables that will follow this section categorized by who is allowed to play and by author. These tables can also serve as a way to compare the games from author to author.) Listed in Meeker (1901) under boy's games are *Mato woskate* (Bear Game), *Can takapsica*, which is translated as "Wood Shinny", and *Can wikiyapi* (Whip Top). The following two games are listed were described earlier: *Hohuh yuhmunpi* (Bone Buzz) and *Pte Heste* (Cow Horn). Finally, the last three games mentioned were *Palso Hanpi* (a game where a feathered bone was thrown on ice), *Hoksila itazipa*, toy bows and *Epahoton* wooden pop-guns. Listed as girls' games are *Winyanta paslo hanpi* (a girls' version of *Paslo Hanpi*) and the making and playing with dolls - what was termed *Tipi Cikala* earlier.

Walker

Walker (1905) and Walker (1906) provide another list of Sioux games. Walker (1906) is a continuation of the work he published in (1905), indeed the first work is called Sioux Games I the second is Sioux Games II. He categorized these games by sexes and age: men, women, boys and girls. Within the adult categories he has two subcategories: games for amusement and gambling games. He has listed four games listed as gambling games for men, four for women's gambling games, five for amusement games for men. He also lists six games for boys (no gambling games) and three for girl's amusement games. In addition to this list he provides descriptions to seven gambling games. Four of these games are men's gambling games: *Painyankapi* (Hoop game), *Takapsice* (Shinney), *Canwiyusna* (Odd Sticks), *Hehaka* (Elk Game) and three are women's gambling games: *Tawinkapsice* (women's Shinney), *Tasiha* (Foot Bone), and *Tapan* (Dice game - Kansu). We have already seen descriptions for Tȟasihaunpi and Tȟaŋpa. I will list the boys and girls games later.

Buechel

Buechel, a Jesuit priest who worked both at St. Francis Mission on the Rosebud Reservation and at Holy Rosary Mission on the Pine Ridge Reservation during the time spanning the early 1900's through 1954, collected game artifacts and provided descriptions of Lakota games. These artifacts and descriptions are still on display at the St. Francis Mission in Mission, SD. The information he collected on games is housed on a website hosted at Creighton University in Nebraska and has also a fairly exhaustive collection of articles and a bibliography dealing with Lakota games. According to the website Fr. Buechel worked on collecting information about Lakota games between 1915 and 1953. In Buechel's collection are not just descriptions of the games but authentic game pieces as well. I will categorize his list of games with the rest below.

One Feather

One Feather provided a list of Lakota games and descriptions as well for the purpose of creating a curriculum unit for use at Holy Rosary Mission in the late 60's and early 70's. In 1972 One Feather, in consultation with Max Blacksmith of Oglala, SD describes Lakota games the unit entitled Unit Six: *Woskate - A Curriculum Materials Resource* (*Woskate* is the Lakota word for game) was published. The games in her work will be included in the list below. In One Feather's work she provides some mythological roots to both the game of *Painyankapi* and *Hanpapechun* (as we saw earlier).

Lakota Games Categorized

Now that I have finished describing briefly the games included in each of the research documents on Lakota games I'll put together a complete list of these games in an organized manner to help the reader appreciate the sheer number of games played by the Lakota. In

addition it is interesting to note the differences and commonalities between games the authors mentioned. It is inevitable that there should be differences in the games reported and described since some authors focused on children's games only (Dorsey, 1891). Another reason for the discrepancies is due in part to the nature of the collection of these types of things since this work depends heavily on the informants and what they were willing and able to share. It is also important to note that the way the authors chose to classify the games, though generally based on differences in the sexes and in age groups varied a bit (some authors made the distinction between gambling games and games of amusement while others spoke of seasons when games were played (Dorsey, 1891). Also, the spelling of the games varied as well. Because of this it is conceivable that I could have made a mistake in classifying one game into another and not have realized I grouped it incorrectly.

To try to accommodate all these variables I created tables to match the divisions of sex and age (men, women, boys (a few tables due to the sheer numbers of games in this category), girls and also added a category in which could be placed games played by both boys and girls.) I also included in the men's and women's games the different games categorized as games of amusement and gambling games. Finally, if there was some added information I thought important (like the season a game was played) I included it in the table and I also highlighted some of the children's games I had participated in when I was a child to give the reader the notion that some these games were still around not-so long ago. I have also highlighted the games I recall playing as a child while growing up in the 1970's and early 1980's to give the reader the opportunity to see what was still played at that time, at least in our community.

Table 8-1

Games for Men

Games for Men	Bushotter	Dorsey	Walker I and II	Meeker	Buechel	One Feather
Gambling Games						
Painyankapi - "they make it run by pushing it" also called Great Hoop Game or hoop and stick game	x		x	x	x	x
Hanpapeconpi "Hitting the Moccasin" - Hand Games	x			x	x	x
Hakakute (Hehaka) - Haka Unpi			x	x	x	x
Canwiyowa (Canwiyusna) chun wiyushann'pi "Odd or even" or "Counting sticks "		x	x			x
Tabkapsicapi (Shinny)- ball and club game			x			x
Amusement Games						
Tahuka Cangleska Na Wahukeza "Game with raw-hide hoop		x a boy's game- in spring	x	x	x	x
Hutanacute - throwing a rib game - "Winged Bone Game"		x	x	x	x	x
Oglece Kutepi (Oglece Cutepi)			x			x
Pteheste		x boys game -Winter	x	x boy's game	x	x

Table 8-2

Games for Women

Games for Women	Bushotter	Dorsey	Walker I and II	Meeker	Buechel	One Feather
Gambling Games						
Icaslohe (Bowls) - a bowling game - gambling game			x		x	x
Tapicapsice (Tawinkapsice?) Ball and club game			x	x	x	x
Cunwiyawa Kansu Kutepi (Tanpan) rolling plum game			x	x		x
Tasihaunpi "Game with hooves of a deer"		x boys or women	x	x	x	x

Table 8-3

Games for Boys I

Amusement Games for Boys	Bush-otter	Dorsey	Walker I and II	Meeker	Buechel	One Feather
Paslohanpi (Autumn) - they shove it along or Itazipa kaslohan iyeya (Winter) echunpi Throwing a stick or bow on snow/ice or grass Canpaslohnanpi		x	x classifies as men's game	x		x
Makakicunpi "They hit one another with earth or Makanapopa - Shooting mud balls Game"		x spring				x
Anakicitaneconpi "Running towards one another" or "Playing war"		x Spring				x
Maka Sunkawakan Waskate "Playing with mud" or "Sport with mud horses"		x Spring		x - classifies as girls also		x
Magakiciyapi "Catching the Goose" or Maghakiciyapi "Goose and her children"		x Summer				x
Ipahotonpi - pop-gun game or epahoton			x	x	x	x
Micapeca Onkiciopi - Throwing Grass Spears" or "They wound one another with a grass which has a long sharp beard.		x Autumn				x
Matokicitayapi "Running from the Bear or Mato-kichiyapi -"Grizzly Bear Game"		x		x		x
Hohuyumunpi or Huhuyukhmun'pi "Making the bone hum by twisting the cord"		x	x	x	x	x
Canwacikiyapi or can wakiyapi (Spinning top game)		x Winter	x	x	x	x
Peji Yuskata Kutepi or Peji Yuskita Kutepi or pexhi yuskiskil kutepi"Shooting at bunches of Grass"	x	x		x	x peji yuskila	x
Tokakiciyutapi or tokeshke un'pi "How they are brought up" or "Following one another" - Follow the Leader	x	x				x

Table 8-4

Games for Boys II

Amusement Games for Boys	Bushotter	Dorsey	Walker I and II	Meeker	Buechel	One Feather
"Hitting the Bow"	x					
Flutes		x spring				
Pezi wokeya kakh ipi "Going to make a Grass Lodge" "Playing grown up men"		x spring				x
Tamniyokhpeye kaghapi "Ball of mud made to float is thrown at"		x summer				
Throwing Chewed leaves into the eyes - chewed sinew across the face		x summer				
Hunting for young birds		x Summer				
Cangleshka Kakhwog'yapi "Hoop that is made to roll by the wind"		x Autumn				
Chun'ksila wanhin'kpe un'pi "Game with bows and arrows		x Autumn				x
They kick at one another		x				
Tahu-shipa kichun'pi "They play neck out of joint - Tumblng		x				
Tachaghu yuha shkatapi "Game with buffalo lights"		x				
Howi! Howi! - Boys assemble and stand in a cirlce		x		x		
Throwing stones at one another		x				
Ichapsil echun'pi "Making the wood jump by hitting it"		x				
Ogleche kutepi - Shooting at an arrow set up		x				
Kichikshanpi - Wrestling		x				
Owan'ka Kichich'pi "Snathng places from one another		x				
Tuwa'tokeya yaila snika? Who shall get there first (Last one's a rotten egg)		x				
Canshung-akan-yankapi "Sitting on wooden horses"		x				
Pretending to die		x				
Inyan Onyeyapi - Sling shot				x		x
Horse Racing	x					

Table 8-5

Games for Boys III

Amusement Games for Boys	Bushotter	Dorsey	Walker I and II	Meeker	Buechel	One Feather
Unhcelatpte "Shooting at the Cactus Game" or unkchela kutepi (Cactus Buffalo)	x	x		x	x Unkcela Pte	x
Taha Kiciyapi or Takhcha kichiyap - Shooting and Butchering a Deer Game or Deer Game		x				x
Hosnasnakicun "hoshashannkisun'pi "Hopping on one foot" or"Hopping"		x				x
Titazipi Hoksila			x	x		
Tate Yourmonpi or Tate Kahwogyapi			x		x Tate Kihwogyapi	x
Wikinil-wichakiyapi - Causing them to scramble for gifts (miniature give-away)		x				

Table 8-6

Games for Boys and Girls I

Amusement Games	Bushotter	Dorsey	Walker I and II	Meeker	Buechel	One Feather
Iyopsil echun'pi "Jumping from a high object"		x				
Wakan Skatapi		x				x
Playing Doctor		x				
"String wrapped in and out of fingers - not string games		x				
Skatapi Tan'ka "Playing with Large Objects"		x				
Hokazunta - sled						x
Old Woman and her dog		x				
Tapa - ball, Tapa Nakapapi - tethered ball					x	

Table 8-7

Games for Boys and Girls II

Amusement Games	Bushotter	Dorsey	Walker I and II	Meeker	Buechel	One Feather
Ptegleska Wanasapi - shooting and butchering a buffalo game						x
Hosisipa - tickling game						x
Capa Onaskiskita "Trampling the Beaver" or "Running from the Beaver"		x not a winter game		x		x
Wayaka Kiciyazapi Skatapi "Capturing Prisoners Game" or "Taking captives from one another"		x				x
Napayuskiskitapi Skatapi - Untangling Game						x
Hinhankaga Skatapi						x
Kignun Kacicipapai Underwater Swimming Game						x
Napeoglece Kutepi - Willow Throwing game or Napoglecekutepi					x	x
Napsiyohli Kutepi - tossing rings on a stick						x
Petegakiciinpi - Throwing fire at one another		x Boys winter				x
Suknaspi "Shooting Arrows at a Bladder" or "Shooting at the lungs of an animal"	x					x
Tabubukaga - monster game						x
Inahmekiciyapi "Hide and Seek"		x		x		x
Makapte -making clay buffalos						x
Napobyapi -lighting firecrackers						x
Okawinhela - merry-go-round						x
Okicicuwapi "tag" another version is Okichiyutasni shkatapi - They do not touch one another"		x		x		x
Wanaphohyapi Playing with Balloons						x
Wak'in'kichichiyapi "They make one another carry packs		x				
Hohotela "Swinging"		x - Autumn				
Wi-okichichiyapi "Counting the Women"		x after sunset				
Hoshishipa - hand play - pinching		x		x		
Wonapa kh'akh'a		x				
Ghost Game		x		x		

Table 8-8

Games for Girls

Amusement Games for Girls Shkatpi Chik'ala (Playing with small things)	Bushotter	Dorsey	Walker I and II	Meeker	Buechel	One Feather
Tipi Cikala - Playing house			x		x cikala Skatapi	x
Hoksicala Kagapi (Hosingagapi) - Dolls			x	x - make dolls, etc.	x	x
Paslohanpi (Hepaslohanpi)			x for boys also	x winyanta paslo hanpi	x for women as well	x

Notes about what is in the tables

A few things to note, women, according to the literature did not have games for amusement but did play gambling games. Hassrick (1964) mentioned the Lakota affinity to gamble, "The Sioux were thoroughgoing gamblers, and scarcely a game was played without bets (p.143)" Boys by far had the most games. It seems that boys didn't gamble much, their games were typically for amusement and the test of skills against one another. "Team games for boys were of a rough-and-ready nature, designed to offer excitement and fun as well as to encourage toughness and physical endurance" (Hassrick, p. 144). There were many hunting games, games in which marksmanship as a skill were tested and refined. Hassrick too comments on the development of certain skill involved in boy's games, "Marksmanship contexts...were games of skill which boys played continuously (p.151)." Girls games resembled the actions and everyday life of women - playing dolls and Tȟipi Čik'ala. Even though there seemed to be a separation of the sexes in these games there were many games in which boys and girls played together.

Also, I was a bit astounded at the number of games that were listed for boys and girls that we as youth played. I highlighted the games in the tables. It is quite interesting that I wouldn't have initially counted those games as Lakota games but there they were. So I will need to restate

my position that only a few games are left. It seems many games that I grew up with were around a century ago. It would seem reasonable that these games would still be played by children in Oglala. It is really the adult games that seem to have gone the historical way-side (except for Hand Games and Kȟaŋsu).

Conclusion

Lakota culture contained many games and playing was something to be taken seriously. Each game provided a set of rules in a made-up reality in which abstraction, risk-taking, figuring and order become second nature. These types of activities in the made-up world of play can be seen as a precursor to 'playing' in the world of mathematics. There are also games for adults in which gambling and chance play a huge part. I did not discuss the probabilities involved in Haŋpapȟečhuŋ nor in Kȟaŋsu, these games will need to be analyzed a bit more before explicitly describing the mathematics involved. What is evident is that with the re-introduction of Haŋpapȟečhuŋ into the community (and more specifically into the classroom) children are playing a guessing game in which they have to use probabilities to help make decisions. Students can become aware of concepts involved in probability by using Haŋpapȟečhuŋ as a context. Similarly, Kȟaŋsu, a dice game, can offer another context into which mathematics can be explained. "The modeling of life's ups and downs is clear in the game of chance, as is the idea of risk-taking. As in all games, this can protect the players, and...enables the players to practice skills of prediction, guessing, estimation, conjecture and wit away from the harsh realities of living" (Bishop, 1991, p. 47). What I have not given much time to regarding the playing of Kȟaŋsu in the classroom (or any other sex-specific game for that matter) is whether or not boys can play girls games or vice-versa. This would be something that would need to be discussed with community members should the need arise.

There seems to be room for more Lakota games to be reawakened in the community. I asked earlier about Painyaŋkapi. What about Tȟabkapšicapi or Hehaka? Could not these games offer students a chance to reach back to the activities of their ancestors and could they not develop certain skills in the process? Playing and games seem to be areas that have huge potential for inclusion as contexts for the development of mathematical ideas and principles, especially since, in the long run, students come to 'play' in the sometimes overwhelmingly rule-bound mathematical world.

Chapter 9: UMA # 6 - Explaining, 'Lie Awake, this is not yet the end of the tale.'

> Almost every evening a myth, or a true story of some deed done in the past, was narrated by one of the parents or grandparents, while the boy listened with parted lips and glistening eyes. On the following evening, he was usually required to repeat it...as a rule the Indian boy is a good listener and has a good memory...(Eastman, 1902, p. 51).

Introduction

Bishop (1991) when analyzing 'explaining' as the sixth universal mathematical activity states, "...explaining is concerned with answering the complex question of "Why"" (p.48)? Implicit in the search for the answer to "Why?" is the use of language to help piece it together. "...one interesting aspect is the ability of the language to connect discourse in rich and varied ways..."(p. 51) The importance of all of this is that a worldview emerges. It is a worldview that answers the question of origin, of importance, of how, and, it does its best to answer the question "Why?" "So, at an elementary level of explaining, the noun, adjective, verbs and adverbs of a language, and sentences which links these, help us in our quest for "unity underlying apparent diversity" (p. 48).

Trying to establish a picture of the way in which Lakota people answer the question "Why?" is a difficult thing to do. Where does one start with such a task? Despite this seeming impossibility I will offer examples of the way the Lakota approach certain things - especially in regards to teaching and learning. It is important to note beforehand that this is not a task that will be complete by any means. There have been authors of the past who would offer the reader a better platform from which to make a judgment on how the Lakota might approach and answer the question "Why?" For instance, reading the body of work by Charles Eastman and Luther Standing Bear can give the reader a first-person account of the Lakota philosophical approach to their way of life in pre-reservation times. Similarly in books written about the Lakota various

authors (Hassrick, 1964; Walker, 1982; Powers, 1975; to name a few) weigh in on aspects of Lakota life. In doing so they provide a more comprehensive look at Lakota social structure, Lakota religion, government and general views on many topics. I will use examples from some of these sources to expound points in this section while realizing I cannot offer their type of overview here.

What I will try to do is start the look at 'explaining' from the perspective of Bishop (1991) as I have done in the previous sections. With his short look at 'explaining' he proffers three areas that can help with an investigation into how a culture might answer the question "Why?" mathematically speaking. These categories are: (1) classifying objects, (2) the use of stories in cultures and (3) the development of astrology - the use of stars to make predictions, calendars, etc. I have already given the reader a short glimpse at the way in which the stars were used as guides in determining location and highlighted the Lakota approach to stars in a spiritual sense as well. I have talked about the various seasons, a look at time, and how the Lakota kept track of the passage of time. Thus, I do not think it necessary to revisit the areas involved in astronomy and keeping track of time (and predictions from stars - though I haven't looked into this at all) in detail. I will only take from these topics pieces that can help make points about the way Lakota explained things. So with astrology taken out of this analysis I am left with a framework based on notions of classifying and stories as a way to look at how the Lakota people explain.

In the context of classification, from this study some interesting topics arose. (1) The way the Lakota chose to handle relationships with entities in the animal and spiritual worlds. (2) Because of their relationships with the physical and spiritual worlds observation and listening/silence became key components to how they lived and survived. (3) In learning and teaching they viewed the time of day and with whom to be important facets. Finally, (4)

participants made distinctions between the way in which the Lakota thought and the way in which the "Whiteman" thought. One elder described this as "Lakota Logic." The use of symbols found in nature to teach and remember things was another characteristic of this way of thinking.

The second area to look at in this section concerns stories. Rather than analyze stories as a context in its own right I will include stories throughout the analysis of the way the Lakota classify. Thus stories will be woven into the topics listed in the previous paragraph. This is justifiable for two reasons. One, stories were used to help illustrate points speakers wanted to make about differences in thought in comparison to the Whiteman's way of looking at things. Two, stories were also told at certain times of the day and during certain seasons in Lakota culture thus they will be included when looking at the way in which the Lakota categorized the day.

I will also try to mesh some of the topics that arose in the look at the previous five universal mathematical activities within these four categories. It is my hope that in doing this, other rich topics will come to the fore in which we can analyze the ways in which the Lakota explain. It is in this section that I will try to bring all of these together by answering the question "Why?" via pursuing answers to the following questions: What are the major themes that have arisen in the previous five mathematical activities? Do they share commonalities? Is there some sort of coherency between the mathematical activities? From these activities can we began to make some generalizations about the Lakota worldview in regards to mathematics?

Classification

The Lakota classify objects as every culture does. I will assert that the Lakota classify to such an extent that it may be the dominant means from which they relate and come to understand their world. Within this view is a classification of the natural world which provides order,

structure and as such becomes the place from which the Lakota can learn, hence survive. Looking at the data I have collected I realize I have a plethora of examples of classification of knowledge and things. We will start first with the look at the classification of animals and the spiritual beings. The result of this classification impacts the way the Lakota approach them.

The animals, the spiritual - listening and observing

Let's start with a look at classifying animals. We can hearken back to the classification of animals in mythology mentioned when I discussed locating in Lakota culture. In the Great Race we saw the two-leggeds competing, essentially for their survival, against the four-leggeds. The two-leggeds, luckily, were grouped with the winged ones (in the end it was the magpie, sitting on the nose of the buffalo that won the race for the two-leggeds). A great example of the way in which the Lakota (Dakota) classified animals is found in the following excerpt from Eastman (1902). Here we get a glimpse of a conversation between Eastman's grandmother and he and his sister about what group of animals the lizard might belong. Eastman's grandmother (Uncheedah) asks him and his sister the question, "To what tribe does the lizard belong (p.77)?" Eastman mentions his sister's (Oeesedah) response, "It belongs to the creeping tribe (p. 77)." He then explains how the question is resolved:

> The Indians divided all animals into four general classes: 1st, those that walk upon four legs; 2nd, those that fly; 3rd, those that swim with fins, 4th, those that creep.
>
> Of course I endeavored to support my assertion that the lizard belongs where I had placed it, because he has four distinct legs which propel him everywhere, on the ground or in the water. But my opponent claimed that the creature under dispute does not walk, but creeps. My strongest argument was that it had legs; but Oeesedah insisted that its body touches the ground as it moves. As a last resort, I volunteered to go find one, and demonstrate the point in question.
>
> The lizard having been brought, we smoothed off the ground and strewed ashes on it so that we could see the track. Then I raised the question: "What constitutes creeping, and what constitutes walking?"

> Uncheedah was the judge, and she stated, without any hesitation, that an animal must stand clear of the ground on the support of its legs, and walk with the body above the legs, and in contact with the ground, in order to be termed a walker; while a creeper is one that, regardless of its legs, if it has them, drags its body upon the ground. Upon hearing the judge's decision, I yielded at once to my opponent. (pp. 77-78)

Not only were animals classified into groups but also the beings that occupied the spiritual realm. In our look at location we came across the Star People, the Buffalo People and the people/beings who played various roles in the creation of the world. What is important to note is that these entities were described with human characteristics. As such they reasoned, were approachable (and indeed, approached the ancestors of the Lakota a long time ago - we are reminded of Woope who left as the "White Buffalo Calf Woman") and they were able to impact the way in which the world was formed. It is no coincidence that in Eastman's recollection of the small controversy regarding the grouping of the lizard that the various groups of animals were viewed as tribes. "The animals are regarded as his (the Indian's) friends, and spoken of almost as tribes of people, or as his cousins, grandfathers and grandmothers" (p. 51). This is important because it sets the tone for the way they should be viewed, approached and respected.

In other examples of taking figures in mythology and applying human characteristics we see Iktomi, who is both the mythical Trickster and also a spider. He is a being who changes form and had the intent to entice animals and people alike into foolish behavior for his amusement. In yet another example we see the human representation of the Four Directions, the sons of Tȟate (Okağa, Eya, Yata, and Yaŋpa). I think their importance cannot be understated in that through their efforts to establish the four directions the Lakota inherit a world that they can relate to. The course of action of the natural world is determined by the wind (Tȟate) with the coming and going of seasons being classified as a struggle between the brothers. In the

other examples we saw that the ancestors of the Lakota came from the Pte Oyate who lived underground. In these stories there is an interplay between the three worlds -the above, the below and the surface of the world. The Lakota were able to access these areas and use them for survival.

The need to attach human characteristics to beings (animals and the spiritual world) is a function, I believe, of the importance the Lakota place on being able to approach them on a personal, relational level. Approaching animals and the spiritual beings as human-like allowed the Lakota to gain knowledge and as a result offered ways in which the Lakota could survive and structure their own culture. Two examples of how to learn from and approach animals surfaced in my discussions with elders. The first dealt with the way in which an elder taught his grandson to observe the actions of turkeys while out on a hunt for deer.

> I take him huntin' with me, and it's not just the huntin', either. He and I were sittin' along a creek, and this bunch of turkeys came through. I told him, "Watch how these turkeys eat the seeds off of the grass." So he watched and he'd look at me. Otherwise he'd just watch 'em as bein' animals, but he didn't watch their mechanisms for gettin' all of the seeds off of the—you know, a turkey will grab that grass and he bites it, but he doesn't bite it hard enough, and then he pulls it, and all the seeds fall off, and he and all the younger turkeys comin' in back, they eat. So he took that right away to heart and he said, "Let's get out and chase 'em." I said, "Why do you want to chase 'em?" He said, "We'll just chase 'em. We won't shoot 'em, because if we shoot 'em, they're not gonna be here any more.

The interesting point here is the comment: "Otherwise he'd just watch 'em as bein' animals." If he thought of them as just animals he wouldn't believe he could learn anything from them. In doing this, approaching the turkey as a being, he could gain some knowledge for himself. The turkey has a way of approaching things and therefore something to offer. In coming to understand this, the child grew to have greater respect for them. His wish to not kill the animal soon afterwards, but to chase them off (essentially to move them out of harms way),

was an important step in the development for the child in how he should approach 'animals', i.e. the turkey is not just an animal. He should be accorded respect.

Observation played a key role in the way the Lakota approached the world around them. We saw this in the way they paid attention to the stars, which in turn guided them from place to place for various ceremonies. Eastman (1902) provided many examples of the way he was raised to pay attention to the world around him. He recalled his father asking him questions about his environment each day, hoping to get the child to pay attention to his surroundings:

> "What do you think of the little pebbles grouped together under the shallow water? and what made the pretty curved marks in the sandy bottom and the little sand-banks? Where do you find the fish-eating birds? Have the inlet and outlet of a lake to do with the question? (pp. 53-54)

The second story shared with me by an elder in the community surfaced as a result of asking the elder to explain his thoughts on the current social structure in Oglala. Before he commented on the current state of things he offered a look at the origins of the social structure in regards to keeping the young safe:

> Our way of life was modeled—we're a buffalo nation, Pte Oyate. There were four circles. Within that circle was the inner circle [drawing] with the children. The next circle was the elders. The next circle is women. The outer circle (that's where) the warriors, the men (are). If you watch buffalo, if they sense any kind of danger or anything, this is how they'll circle up. All the bulls will be out here, (then) the cows, the older ones, and the calves will be in the middle. And once there's no danger, usually it's like a teen. The buffalo that are in their teens will come out and start to check it out. Our teens do the same thing. So this provided three layers of protection for the children.

Here the elder implied four divisions among the people: the men - the outer circle, the women, who occupied the next circle, then the elders and finally the children in the middle. (The male teenagers occupied a space outside with the men since they were the first to see if the

danger that caused them to circle and protect had disappeared.) He continued with the way these groups interacted with each other:

> The men, they were the protectors, the providers, even as far as providing safety. They made it so that there was a lot of independence within these three circles. And these circles were not scared of them (the men). They made sure that there was relationship within these. They had ceremonies to do that. So the women were never scared of the men. That's why they lived in balance and harmony. The same goes with the elders. That's why the warriors listened to the elders. This is why the children knew they were protected and provided for by the warriors. And also, they had great compassion. This is why a warrior— they had these warrior societies to hold each other accountable, so that they didn't abuse the inner circle.
>
> The other part of that, the warrior had great compassion for the creator and for life. This is why they would count coup rather than kill the enemy. That's why, as one of these guys said, a warrior rode through the cavalry and just whacked him with a stick and the cavalry said, "Did you see that crazy Indian? He just whacked me with a stick! He could have killed me!" He knew that he had great respect for life. He let him live. He had compassion for life, for creating, for his people, the inner circle. This is how it was set up.
>
> The women had their own ceremonies, their way of doing things, and the elders did, too, and the children were taught these things as they grew up. One of the greatest crimes you could do was to abuse women, elders, or children, especially children. Doing this inflicted the most capital punishments and banishment (upon themselves). They talked to you about it. They showed you why, they'd chew you out, and if you still didn't listen, they'd take you out and they came back without you. So this is how the warrior societies that they had held each other accountable.
>
> (So nowadays, because these things aren't in existence any more—)
>
> I think it's kind of like turned inside-out. The men are in the middle. They're really selfish, you know? They lay around in bed all day and they want the women to come and get in bed with them and have sex. Here, they used to hold each other accountable. It was up to the woman when she wanted to have sex, to have children. It was up to the woman. That was her independence - they make that decision. Also, the elders, they looked out for the girls and even the boys. They taught the boys certain things so that they'd have that respect for women. Girls were taught to do certain things so that they don't fall victim. They kept 'em out of the victim role. Nowadays our women are always victims. Even men do the same thing. A lot of 'em are raised by women, so they fall into the victim role. "Poor me, poor Lakota man." They walk around like that. They're in the middle. They're really self-centered."
>
> The next one is the women. They're so busy chasin' the men around, they forget the lessons that they learned from the elders. So the children are out here.

> They're exposed to drugs and alcohol, to violence, suicide, disease, STDs, all these things. You wonder why these things are happening to our children? 'Cause they don't have that three layers of protection any more. How we did this, we put the circle out there. In Wanbli, we actually did this. We took a lot of the men, we just left a few men, to show what's going on. All the spaces (that opened up in the circle once these men left). The same thing with the women. They were so busy chasin' men around, they forgot about the children. We'd tell 'em, "Hey, men can come and go, but the children will never leave you." They forgot about that.

In explaining the collapse of some social aspects in Lakota culture between the four age groups, in relation to each other, the elder shows an example of very complex reasoning. We see a social-structured ideal based on the behavior of the Pte Oyate. By watching the way the *Pte Oyate* protected their own, the Lakota imitated it. Again, in approaching the animals as not just animals but as teachers - they believed they could learn from them, they adopted some of their ways in which to structure aspects of their own society. The Pte Oyate provided a way to best protect the child. He then explains the relationships between the various "layers of protection." He sets up ideals in each layer, - the respect for life and the creator, the observance of moral codes and reprimands for not adhering to these behaviors. He reminds us that there were checks and balances within the structure and between layers and groups of people. And finally he contrasts the ideal with the current order of the day - the Lakota are currently not paying attention to the teachings crafted over so many generations and instituted as the way of structuring behavior and social norms - at least in relation to protecting the young. "We took a lot of the men, we just left a few men, to show what's going on. All the spaces (that opened up in the circle once these men left)." There is cause and effect in his story and there are consequences. The level of reasoning is salient (if not painful). Since we are looking at the way the Lakota reason, this explanation, offered by an elder, provides an excellent example.

The animals, the stones, the trees, the wind and the stars provide guidance for ways in which we, as humans and societies, can interact with each other. Learning from the environment, the animals and the spiritual world, is something that comes to the fore in conversations with elders and community members and it is something that saturates the literature about the Lakota. We have seen the adage when we explored the ways in which the Lakota located - "What is above is below," to this we can add another adage - "what is around teaches." With these two sources for thought - the above and around - it becomes clear that sources of knowledge are vast and inexhaustible.

> That's why when we look at ___, it's so vast, so open, that the education system, and even our religion, they limit you to this—maybe there's a ceiling here...Ours is so open that— [drawing] our teepee design, when it goes out, it's open to the universe. But everything that we do down here is tied in spiritually right there. So in math, in anything that we do, the possibilities are there. It's so vast. We're sittin' here talkin' and just scratchin' the surface.

Living in the sphere that we do, with the above and the around everywhere as sources for learning (they could be classified as teachers) there is no guarantee that learning will occur. There are two important things that have to occur if one is to learn from his surroundings, (1) in order to learn from your surroundings, you have to pay attention, which means you must put yourself in a state in which you are able and ready to observe. And (2) you can only learn if you listen. Elders in the community spoke to this in detail. One elder stated:

> We have to start listening. Our children have a lot to say, but we don't listen. I always break down that word, anağoptaŋ, [writing] which means "to listen," but if you look at it, "*a*" means to pay attention, "*na*", something's gonna give it to you, "ğo" is to mark it in your mind, "ptaŋ" if you pay attention to the gift that's there to mark it in your mind, ptaŋ is to turn over to change. If you listen, not only to yourself, your children, your relatives, the creator, it can change that. A lot of our people are *iyuwasicu*. They're really mouthy, boy, they can talk, tell you off, all this stuff. But they don't take time to listen.

Taking a look back to the example of the man with his grandson who went out hunting together we can see the impact of observing and listening. Look at how the boy's perception of the turkey changed because he was willing to not only observe closely but to also listen to his grandfather. In the passage above when the elder broke the Lakota word " anağoptaŋ" into parts, it shows that a willingness to listen impacts the behavior of the child thereafter - especially in his approach to the turkey. A gift was given from the speaker to the listener. Words have power to change but will only do so if they are received in listening.

Eastman (1911) in discerning the profound effect of paying attention to silence (which goes hand in hand with listening) mentions this:

> He (the Indian) believes profoundly in silence - the sign of a perfect equilibrium. Silence is the absolute poise or balance of body, mind, and spirit. The man who preserves his selfhood ever calm and unshaken by the storm of existence...his, in the mind of the unlettered sage, is the ideal attitude and conduct of life.
>
> If you ask him: "What is silence?" he will answer: "It is the Great Mystery!" "The holy silence is His voice!" If you ask: "What are the fruits of silence?" he will say: "They are self-control, true courage or endurance, patience, dignity, and reverence. Silence is the corner-stone of character. (pp. 89-90)

So within the categories in which animals and the spiritual realm is placed is a call to approach them as one would approach a close relative. This in turn is important because it is from these beings that we can model our lives and learn how to survive. In order to learn you must observe and listen. "Somebody's got to listen. My boys listen, my children listen. As long as somebody listens and hears these things, they can't say, "I didn't know." I taught a lot of those things at the jail. I was workin' with a lot of young men that were incarcerated. All of 'em said, 'Gee, nobody told me these things.' Especially the buffalo concept."

Categorization of who to teach when

Observation and listening are cornerstones to teaching and learning. It seems that there are also certain times in which learning is optimal for the different age groups, according to some of the Lakota educators I interviewed. One of the things that surfaced in my conversations with participants was a break down of the day into four parts - the morning, the day, the evenings and the nighttime. They took this common breakdown of the day a step further by attaching each of the four parts of the day to four groups of people based on age and sex: children, males, elders, and females:

> Also another thing that I learned was that the morning belonged to the children. They have to get up early so they can breathe in the fresh air. It's not happening now. A lot of our children or young people are sleeping late, and they don't get that new air to start their day. The day belongs to the men. They're out there working. The evening belongs to the elders. That's for all the storytelling and all the education. The nighttime belong to the women, the moon time. The moon belongs to them. The sun belongs to the men. The sunrise, the morning time belongs to the children. The evening belongs to the elders.
>
> (That's interesting. Let's say you could start your own school to teach kids the Lakota way. It seems to me the best time to have school would be around the evening time, if you're gonna be having stories and teaching the children.)
>
> That's been proven scientifically. I don't know how much money they spent finding out when was the best teaching time, just before their children went to bed. We knew that. Huŋkaŋkaŋ.

Another elder, a former Lakota language teacher, had this to say about teaching during the morning versus the afternoon. In her thoughts, though it is not made explicit, we see that she understood that the mornings were the best times to teach the children:

> And I don't like afternoons. Being a teacher, I don't like afternoons, because by then they (the students) are restless. They're sleepy. They're tired. I like mornings. And sometimes I have to fight for my time in the morning. And I would get up there when we start scheduling and I would get up there and tell the teacher, "I want my time in the morning. I don't want them in the afternoon." And a lot of times Lakota is put in the afternoon when the kids are tired, and I know that they are...And in the morning, more time in the morning overall. We need

> more time and in the morning, ‘cause afternoon is bad. I know that. I’ve been here too long.

She also spoke of the activity of reading to her child at night. It had not dawned on me until analyzing this data that we have "bedtime stories" for a reason. It is the best time for the child to listen, hence learn. He is ready to do such. The rest of the day he is playing (learning in different ways - hands on activities, games and interacting with kids his age). Nighttime comes and he becomes tired. But his little mind does not want to stop learning. Thus it is the time for stories. "But now, me and my granddaughter, we read every night. That’s the last thing she does before she goes to bed. “Grandma, I’m sleepy, you have to read to me.” And I have oodles of books."

In Lakota there are many examples of stories. One type of story in Lakota culture is called the *Hunkaka* stories. These stories were mentioned when I was discussing locating. They were mentioned in the context of learning about the constellations. In a quote above the elder ended his comments about the times of day and who they belonged to with the Lakota word *Hunkaka*. This is nothing new or earth-shattering for in Lakota culture it was customary - Eastman (1902) stated this when talking about various stories he had heard from his grandmother, *Uncheedah*,

> Now grandmother, tell me the story of the bear's fat. I shall be so happy if you will," I begged.
>
> "It's a good story and it is true. You should know it by heart and gain a lesson from it, she replied" (p.150).
>
> I was sleepy by this time and I rolled myself up in my buffalo robe and fell asleep." (p.153)

And again Bushotter spoke of this process in his own upbringing:

> We stood that way long, and then sprang up and got into bed. Then my father would give us good advice or relate a myth for us, or tell about old-time war

> parties, and whichever we asked for, that he gave us....or if he completed a myth, then the next night he would have us repeat it, taking turns, till we had related it all, and so we learned many myths. (Bushotter, n.d.)

The important part here is the fact that it seems that only providing a space to learn and materials from which to learn is not enough. The Lakota paid attention to aspects of the day and observed that children function best in regards to learning in the morning and evening - and perhaps this was a function of the day anyway when all the family would be together in the tipi. So this was the best time to relate cultural teachings on morals, history and mythology to the children. Elders recalled this in their own upbringing. Their parents would tell them *Hunkaka* stories as they drifted into sleep. It is when the learner (the child) is ready that he is able to learn. If he can calm himself, be in a position to observe and also be ready to listen then the learning will come much easier. "...and Ohiyesa must learn that there are many secrets which the Great Mystery will disclose only to the most worthy. Only those who seek him fasting and in solitude will receive his signs (Eastman, 1902, p.22)." What better time to take advantage of the nature of the child than in the morning and the evening? And who better to include in the education of the children in the evening than the elders who have had a lifetime of experience and who heard these stories from the lips of their own grandparents as they drifted off into sleep?

Use of Symbols - turtles, spirals, logic and feathers

In the course of the discussions I had with elders, language instructors and community members invariably when our conversations turned to teachings of Lakota culture the explanations of them would include a symbol - either an animal or a hearkening to a concept that would show an integrated attachment to the concept itself. For instance, when discussing the calendar and the number of moon cycles in a year educators would talk about the back of a turtle shell, which they claimed contained thirteen sections - one for each moon of the year. Another

example of this occurred when looking at the number line. As you may recall one person stated that the number line in Lakota was not a straight line, like that seen in Western mathematics but instead resembled a spiral, with the beginning (zero) at the center. The spiral design surfaced again when looking at how the Lakota kept track of the passing of time - with the use of Winter Counts, which allowed for one symbol per year. Many of these Winter Counts were fashioned the same way the Lakota number line was described. The beginning of the Winter Count started with the first event in the middle and then as time went on spiraled outward. (Below is an example of this. It must be noted that not all Winter Counts were drawn in this fashion.) So the spiral number line offers a visual of a way of looking at the world in regards to time and numbers.

In asking this elder about the meaning of the spiral he spoke about the beginning of it, the center as a circle, a place where you learn. And if you stayed in the center and kept going around in a circle then you did not grow – you became "crazy-making." The spiral outwards represented growth. This form of growth – the spiraling outward can be seen in many natural phenomena – but especially if we think of celestial objects, the Milky Way galaxy or the movement of the moon away from the earth as time passes. This is in stark contrast to the way the Western world looks at growth as either linear or exponential.

Figure 9-1. Lone Dog's Winter Count
(taken from Smithsonian National Museum of Natural History)

In looking at the spiral of images on a Winter Count we obviously don't know what happened with each Tȟiyošpaye prior to the first symbol on a Lakota count. If we look at the "Lakota numberline" in relation to the Western mathematical numberline the same thing is true, the Lakota language is silent on what comes before zero (no way of expressing negative numbers). Catlin (1973) spoke of the Mandan approach to history that I think is pertinent here. He wrote, "I am not yet able to learn from these people whether they have any distinct theory of the creation; as they seem to date nothing further back than their own existence as a people" (p. 180). This begs the question what happened to this tȟiyošpaye, indeed all tȟiyošpayes who had winter counts, prior to the first marking of the first symbol? The correct answer is that nobody knows. This may bother some. For the Lakota it seems that not knowing is not be a big deal. How else do we explain the lack such things as negative numbers in the language? As an elder put it, "Really, I didn't - I never came across that in the language." when I asked him about

negative numbers. My initial thought was, "Hasn't anybody ever tried to find or create a Lakota equivalent for a negative number?" But this is perhaps where my Western bias is prevalent. One elder spoke to me about the need for white people to know everything. According to him the Lakota don't think that way. We shall see below the fact that sometimes what is not answerable is something that doesn't cause the Lakota much consternation - rather it is okay - perhaps it is best to leave it alone. As one elder stated, ""They (white people) want an explanation for everything. We leave a lot of those things to mysticism." He provided a story that is amusing and expounds his point:

> I always tell the story about when they (astronauts) brought the moon rocks back, they were tryin' to break 'em open, and they couldn't break 'em open. They tried hydraulics, explosives, lasers, everything. They couldn't break them open. But this man, one of the scientists, said, "I know Sundance, some of these medicine people said spirit was in everything. They may look at a rock and say it's an inanimate object, but they know that there's something so small that's moving, but it's moving so slow that we can't see it. These people know that they can find that spirit of whatever it is and break it open." So they asked them to bring a medicine man.
>
> They brought the medicine man to NASA and went into that room where this rock was. They heard him in there. Pretty soon the door opened and he said, "I found out what was inside the spirit of that moon rock. I found it out and I asked it to open up, and it opened up." The scientists were all amazed. They went in there and they were lookin' at it. "How did you do that? How did you find the spirit of whatever it was in that moon rock? What is that spirit that was in that rock?" "That was the spirit of a calf." "How did you know it was the spirit of a calf?" "I don't know, maybe when the cow jumped over the moon—" [laughs]

Sometimes answers don't come. That is okay. We cannot know everything no matter how hard we try. The Lakota seem okay with this notion. They understand that perhaps the knowledge will come later.

Nature seems to provide a way for the Lakota to explain things and to model their own culture after. This is evident in the use of nature as conceptual models for teaching various aspects of culture. I want to provide another example here of the use of nature (with numbers) to

help create the *tipi* and the *inipi* - sweat lodge - as explained by an elder. In the elder's explanation of the creation of these things he describes what he termed as "Lakota Logic."

Lakota Logic

The first part of this elder's example below dealt with a categorization of the wisdom of the way the Lakota built a tȟipi versus the white man's way of looking at things. He attaches the Four Directions in the aid of putting up the structure. Not only do the Four Directions come into this discussion but also Tȟate the Wind. Even though he doesn't explicitly make the inclusion of Tȟate specific it is really the effect of a powerful wind that tests the wisdom of the design of the structure:

> It's what we call Lakota Logic and how the poles come together and are put in there one at a time with a rope, where Western logic says you put a tripod up and fill it up in between with all the poles. In physics and math, that's a weak structure. If wind comes, it's gonna blow over. Where ours was placed in a way using not only physics but mathematics in a way that that structure is strong and it's tied in together and makes a circle on the bottom. It represented a structure within that home. These are things that—and it's always—again, in four directions, the way that the structures are put up.

In talking about the building of the inipi (sweat lodge) he tells the story of guiding the construction of one with those who hadn't had the experience. He shows the process from which to determine the number of poles needed in making an inipi. He shows some common sense - logical Lakota thinking, in this process. It starts with a concept from nature - either the design will reflect one of two concepts - the "Star knowledge" type whereby the opening on the top of the lodge ends up being a certain star shape. Or it is going to reflect the shape of a turtle. Once the shape is determined the use of sacred numbers and multiples of them help to determine the number of poles needed to get the correct shape of the opening in the inipi. He prompts this

group of people with questions and then speaks to the practical aspects of the number of poles once multiples of them are considered:

> There's numbers that we have that are real sacred. We were working with men that didn't understand the structures, and we were creating the "inipi ". How many poles do we use? How many willows? Think of the numbers. What sacred numbers do you have? Four. Seven. Multiply 'em. That's too many. You have too many willows then. Let's think of another one. Four times four, 16. That sounds more logical, right?
>
> So they put their poles, and they said, you want the turtle type or the star knowledge? They said, Let's try the stars. So they put their willows in and they put all the willows in tight and you could see the star..."

Once the structure was built he used it as a way to remind and teach what he termed as the sixteen wisdoms.

> And also some of the things that I learned was that each point, whether it's up there or here, they said the 16 wisdoms are in that. I don't know all of the 16 wisdoms. But you get those as you go along in life.

This in turn led to discussion of more of the sacred numbers. He ends this point by wondering about the sacredness of the number thirteen. He attaches its significance to the number of moon cycles (this is seen in the quote below). This is a point I wish to make in this discussion about symbols and things found in nature. It seems that the observation of natural phenomena provides the context from which to teach about Lakota culture whether it be in the stars, from animals or entities that occupy the spiritual plane. They can be used as physical conceptual models to relate teachings to others.

> And also, 13 is not a bad number. A lot of times in the ceremonies, there will be things like, one, two, three, four, five, six, seven, and then one, two, three, four five, six. So there'll be six on this six, six, and that one in the center. A lot of times—I've seen people who had feathers that were pierced into their back, 13 of 'em. That's how it was used. So 7, 44, 16, 28, 13 also. 13, maybe it comes from the cycles of the moon.

A Lakota teacher also used this kind of reasoning - the use of symbols, in this case the of twelve tȟipi poles to remind students of the number of sacred teachings in Lakota culture. Each tȟipi pole represented a teaching.

> Yeah, there's fours and sevens, everything's in fours, like four seasons, four directions, and then in seven too, seven also…like sacred meanings, ceremonial type, and then twelve because along time ago they used to have 12 tȟipi poles, and then when they had the seven council fires each tȟipi pole had 24 teachings and they had to go through every single one of them in order to make sure the tribe was going according to each one.

The use of symbols in Lakota culture is extensive. Not only are conceptual models - the turtle shell or the spiral - used in explaining ideas but the use of symbols. They are relied upon heavily to signify to others various things about objects and teachings. As an example of this I would like to center our attention on the ways in which Lakota warriors were able to signify their status as a warrior to others through the use of symbols and attire. Since the Lakota culture was a warrior society, status was important and was something that was made known through symbols (much like the earning of stripes in the U.S. military). When I was observing the teaching of the Lakota class in the fourth grade the Lakota language teacher spoke to students about the markings on a war-horse and what they meant to any that would be following that particular warrior into battle. "If the horse contained a hand-print on the back of his rump it signified that the rider was a fierce warrior. If the warrior had a red mark on his scalp it meant that he killed somebody." Eastman (1902) adds to this conversation when asking his father about the different feathers he had seen and what they meant and whether they were appropriate for him to wear:

> "The eagle is the most war-like bird," he began, "and the most kingly of all birds; besides, his feathers are unlike any others, and these are the reasons why they are used by our people to signify deeds of bravery...any brave who would wear the eagle's feather must give proof of his right to do so. (pp. 143-144)

Eastman's uncle continued:

> When a brave is wounded in the same battle where he counted his coup, he wears the feather hanging downward. When he is wounded, but makes no count, he trims his feather and in that case, it need not be an eagle feather. All other feathers are merely ornament. When a warrior wears a feather with a round mark, it means that he slew his enemy. When the mark is cut into the feather and painted red, it means that he took the scalp
>
> A brave who has been successful in ten battles is entitled to a war-bonnet; and if he is a recognized leader, he is permitted to wear one with long, trailing plumes. Also those who have counted many coups may tip the ends of the feathers with bits of white or colored down...(p.144)

In relation to learning, symbols were used extensively to help find structures to help learn and teach Lakota values. Though this is not uniquely Lakota it seems to be a dominant way in which learning is accomplished in Lakota culture. If it is in nature and is observable perhaps there is something to learn from it. Oftentimes, in my discussions with participants they displayed attempts to classify teachings into structures (like the tȟipi or inipi) as we saw with the calendar and the turtle shell. There was also illustrated a way in which sacred numbers and multiples of it were used to help makes sense of building structures. If a number ends up being one of the sacred numbers then perhaps there is a connection between it and a certain natural phenomena. These notions were illustrated in what the elder deemed "Lakota Logic." In the section below I would like to focus a little on the thought process used in explaining things especially when it came to contrasting the "White" way of thinking with the "Lakota Way." This, in turn, offers points of comparison that tell us something about the way the Lakota explain things.

The "White Way" and/or the "Lakota Way"

> On the other hand, I had heard marvelous things of this people. In some things we despised them; in others we regarded them as *wakan* (mysterious), a race whose power bordered upon the supernatural. I learned that they had made a "fire-boat." I could not understand how they could unite two elements which

> cannot exist together. I thought the water would put out the fire, and the fire would consume the boat if it had the shadow of a chance. This was to me a preposterous thing! But when I was told that the Big Knives had created a "fire-boat-walks-on-mountains" (a locomotive) it was too much to believe. (Eastman, 1902, p. 280)

I asked a Lakota educator the following question: "If you could classify the differences between the White way of looking at the world versus the Lakota way what would those differences be? He responded by saying:

> I think our ancestors have looked at the world as they saw, heard, smelled, touched and tasted the world around them, and through ceremonies were guided in their everyday lives. There were no written books to read about the world, nature was their teacher (and) verbally they taught each other.

In his response, though there is no explicit statement about differences we see that this elder viewed the Lakota way as being grounded in the senses - experienced physically. "Nature was their teacher." and the spiritual was used as a guide for living life - these I've highlighted already. This is important especially in light of the fact if we take a look at some of the things I have discussed in the counting system that are not accounted for in Lakota culture there seems to be an omission of things that exist only in the mind.

This elder also commented at one point about learning mathematics from his grandmother when he was growing up.

> When I was just growing up my grandmother would teach us numbers/colors by using beads (pšiṫho). She told us the basics of math, and I don't know if there were very many uses to teach in large numbers, or to tell the year in thousands. I agree that grouping is used like telling about winter- waniyetu taking two or three months to represent that period, or age, the four ages of a person's life to represent where that person's stage of life is. I think that teaching math for addition, subtraction, division and multiplication, fractions, percent, etc. needs to be done in writing, reading and orally.

These statements are informative. Learning mathematics in this way implies a context that is tangible. Beads provided a context for learning numbers (and colors). Large numbers were excluded because there just didn't seem to be many contexts that could be used to teach them. What is missing perhaps is a way to ground the teaching of mathematics with the use of the language - a creation of words and phrases that can tie the abstract concept into the concrete tangible. Was not one of Bishop's thoughts on explaining, brought forth at the beginning of this article, centered on the use of language to unify various concepts?

As I continue to try to answer the question "Why?" from the Lakota perspective I am drawn into the comparisons between the white way of doing things and the Lakota way. We have seen this throughout this look at the Six Universal Mathematical Activities - one way, the white way of thinking is linear, with the Lakota it is more broad, spread, out, spiral shaped and not closed. The second aspect concerning differences is the perceived need of White people to know why something occurs. There also seems to be a lack of faith in the spiritual to provide answers. In looking back at measuring I talked about the lack of precision in Lakota language to handle some of the measurements done in English. Eastman (1902) mentions another characteristic as well when speaking about white people: "They are a wondrous people. They have divided the day into hours, like the moons of the year. In fact, they measure everything. Not one of them would let so much as a turnip go from his field go from his field unless he received full value for it" (p. 283). So here is the need to measure very precisely and also to place value on everything - monetary value. In measuring it is not just measuring for measuring sake but it is done with a need for greater and greater precision.

A Lakota elder in this study talked about what he called the "collective subconscious" of the people that used to exist to help the Lakota solve problems or come up with new ways of knowing that seems disjointed and non-existent nowadays.

> It was all collectively. During the day, when people lived in a collective way, the men and women really worked hard. The men were out 10, 12 hours a day hunting, doing things. Women also worked 10, 12 hours a day, doing the things that they needed to do for the home. So a lot of times, that's where they spent a lot of time, with the elders. Our elders were the school, the day care, kindergarten, elementary, high school. They learned a lot. But at the same time, it was reinforced from the mother and father.

This collective subconscious was rooted in self-sufficiency and interdependence. Each person had a role to play in the maintenance of life. He points to boarding school as a time when this shifted. Parents became dependent on the schools for the rearing of children.

> "Boarding school took care of our children, the school can take care of mine." They may not really know that they're doing that, but subconsciously they're doing that. The unconscious thought process is doing that, because they learned it. Consciously, if they really thought about it, they'd say, "Hey, this is what I'm doing." But it has been passed through the generations. All of our answers used to be in the collective subconscious. Now it's not. It's all ritual now, Sundance, sweat, all these things, they're all just rituals, something that I have to do. They're not something that's spiritual any more.

And again the thought about things that they had no answers for were not fussed over but thought that in time answers would come. "Just let it be. Leave it to mysticism. That's what Lakota people do a lot. If you can't explain it, we just leave it to mysticism. Again, it's so vast. Maybe one day we'll come to an understanding through the—in our ways that we're all born knowing, throughout collective subconscious that we can find those answers."

He also mentioned the classification of thinking in terms of the whole brain rather than the right/left brain dichotomy.

> The thought process, they always say, either right brain or left brain. But when they live in balance and harmony, they understand that. When they think, they use the whole brain. This is why woman gets the home on this side and the man gets—so when they live in balance and harmony, they think together as whole brain. So a lot of these things that were created within our culture were whole brain. These things, the right and left brain have to work together. So this is why the circle is very important in our culture. A lot of times we're taught individual and linear, where you're on that side or this side. Here, everything was in the middle.

Explaining the Lakota Way and Mathematics

This short look at the white way and the Lakota way of thinking, as expressed by elders is important because we can't forget that a person's or culture's worldview is important when looking at something as innocuous as mathematics. It is from this very foundation they can either chose to adapt or discard something from another culture. It is true, that Western culture has brought to the world some amazing things through the application of mathematical principles. The computers of today, which are so integral in our daily lives, are built on a mathematical language of zero's and one's. Western culture has put an emphasis on precision, has looked for ways to analyze cause and effect, and assume linear one-to-one relationships in many areas. And they place a monetary value on everything. So much so that not even a pinch of flour goes by without it being weighed, tracked, sold and purchased. Measuring, figuring and counting all play significant roles in the expansion (and contraction) of Western culture.

I have tried to find how the Lakota approach some of these activities within their own culture. Measuring is done in Lakota culture, albeit, minus the high degree of precision deemed necessary by Western culture. It has a counting system minus negative numbers and most fractions. It has names for geometric shapes, uses symmetry in almost all artistic creations - so much so that we can apply the notion that what is above is below in the design of bead and quill work. They had a very sophisticated system of locating from place to place and understood time

in a very complex manner. Spiritually they were in tune with various spheres of influence. And they played to such a degree that one might wonder how so many Lakota games went by the wayside.

It is my opinion, after looking at what is and what isn't available in Lakota culture regarding mathematics that culturally, like Eastman when he first encountered the strange white man, that Lakota is still marveling at the wondrous things that border on the mystical when it comes to mathematics. Mathematics can expand vast horizons. It seems to go as deep as you want to dive and as high as you want to climb. Yet if we look at how it has been incorporated, or in this case, how it has not; if the language has not invented ways in which to deal with negative numbers or fractions or has ignored the teaching of very large numbers and has not spoken of the abstractions of rates what does this speak of knowing of the power of mathematics? Bishop (1991) spent time thinking about the role of language and concluded "All cultures structure their language, all classify, all have explanatory stories, all have their ways of connecting ideas through discourse, and all have some ultimate source for validating explanations" (p.54). The connection of the various terrain of mathematics is not present in the Lakota language.

Certainly the Lakota possess the important ability to observe, to categorize and to make assertions based on these actions. And certainly they were stupendous students - taking from what they saw in nature and applying this to the structure of their culture - oftentimes in very complex ways. This approach to mathematics, in certain regards, is still waiting to occur. This is illustrated, perhaps, with the need to continue to develop the language to incorporate aspects of mathematics not yet explainable in the language. An example of this is the thought I had given previously when looking at the Lakota counting system. All arithmetic operations are expressible in the Lakota language, however, not all results of these operations are. The next

step to demystify the mathematics, from a cultural perspective, is to find contexts for such things as the answer to 3 - 9. Again, this is not a tangible thing, on the surface anyway. But what needs to happen if we are going to take the relationship between mathematics and Lakota culture seriously is to find the holes where the Lakota have not yet spoken of these things and invent ways in which they can become tangible i.e., we need to know what happened before the first symbol was placed upon the winter count and also what exists on the other side of zero. Thus a completion of the Lakota number line and the invention of names to deal with concepts that have not yet been dealt with is imperative.

One might speak to the impossibility of this. One Lakota speaker told me rather emphatically that, "This cannot be done!" after I had presented my research ideas to a group of teachers during the initial phases of this study. One might suggest that this way of thinking is not the "Lakota way." And still someone else might ask, "What damage would an incorporation of such cultural views found embedded in mathematics do to the Lakota culture? My response is must we assume that damage will occur? Did not the gun and the horse become useful in Lakota culture even though both were considered mysterious? Were they not viewed as "wakȟaŋ" (gun in the Lakota language is maza wakȟaŋ (mysterious metal) and horse is šuŋka wakȟaŋ *(mysterious dog*). Did these two entities make life easier for the Lakota and did they not change the way in which the Lakota lived ever since?

I understand that Mathematics is not innocuous (even though I stated it as such earlier), rather it carries with it two millennia worth of cultural assumptions which in turn reflect a very unique view that, in my estimation, is vastly different than the Lakota way of looking at the world. The question should not be "Should the Lakota incorporate mathematics and develop its language in response to it?" but rather "How should the Lakota language speak the universal

language of mathematics?" Taking a look at this is part of the reason for looking at the six universal mathematical from a Lakota perspective in the first place. What can be done? What should be done in regards to mathematics? From a cultural perspective mathematics is earth shattering and borders on the wakȟaŋ. It is the language of the Lakota, in how they categorized and learned, that can make it make sense.

Conclusion

The Lakota have a very distinctive way of looking at the world. They have classified various aspects of it on both the physical and spiritual realms. The classification of entities in these realms with human characteristics impacts the way they approach them. This classification of them as essentially relatives allows the Lakota to see their inherent value and dignity. This in turn allows them to view them as teachers. Indeed we have seen how the Lakota have adopted certain characteristics/behaviors from different animal groups (the Pte Oyate, for instance) found in the way they structure their society. They also have very complex ways which incorporated physical entities to help explain their teachings and philosophical approaches to the world. They place a high value on observation and listening in the way they approach beings and rely heavily on symbols to explain status. They have a reliance on the supernatural to bring answers. They use stories in many ways to teach their way of life. This is especially true with Huŋkaŋkaŋ stories told to children in the evening. They also believe that there is a best time of the day to teach children and that different parts of the day are reserved for different age/sex groups.

An aspect of the Lakota language is that it is very descriptive and relies on the physical senses in order to relate phenomena. This is a very positive thing about the language and can be used in the explaining of mathematical concepts. However, in regards to mathematics, if we were to rely exclusively on the Lakota language to explain it, we would find it to be incoherent.

The use of the Lakota language to explain mathematical phenomena, not just pieces of it, is the next step, I believe, in the relationship between and integration of the culture and the understanding of mathematics.

I want to close this section, the sixth and final universal mathematical activity with a look at Eastman's (1916) glimpse into his "crossing over" into white culture. He offers thoughts about the effect and trouble he had in all of this that is rarely seen from an "outsider". He understood his world was ending and a new one was opening up as soon as he chose to enter into the education of the white man. And yet he went into it.

> Aside from repeating and spelling words, we had to count and add imaginary amounts. We never had any money to count, nor potatoes, nor turnips, nor bricks. Why, we valued nothing except honor; that cannot be purchased! It seemed now that everything must be measured in time or money or distance. And when the teacher placed before us a painted globe, and said that our world was like that - that upon such a thing our forefathers had roamed and hunted for untold ages, as it whirled and danced around the sun in space-I felt that my foothold was deserting me. All my savage training and philosophy was in the air, if these things were true. (p. 47)

Eastman (1916) talks of this struggle and the problems it caused between his father and grandmother if he was going to adapt the Whiteman's ways. His father figured that it would do Eastman good if he adapted this new life, his grandmother was unsure as he. His father argued: "Besides, one would be like a hobbled pony without learning to live like those among whom we must live" (p. 25) His grandmother responded, ""It is not a true life," she often said. "It is a sham. I cannot bear to see my boy live a made-up life!"" (p. 28). In Eastman's initial thoughts upon trying to learn in the school's he states, "They might as well try to make a buffalo build houses like a beaver as to teach me to be a white man, I thought" (p. 24).

Are not his struggles our struggles within the Lakota community? How best do we navigate the space between being Lakota and living the Lakota way without thinking it is the end

of Lakota culture - and meaning perhaps that we are not Lakota anymore? I believe the answer to this lies in the language. However, not just in the language but also in the ability to reason and adapt and also in the amazing Lakota ability to observe and the ability to innovate. The animal peoples didn't just survive they lived, created and were complex, the Lakota learned from them and structured their lives accordingly. It is time, I think, for the Lakota language to tackle the issue of mathematics, to bring into the Lakota way of looking at things mathematical concepts and words which describe rates, algebra, calculus and the like. This means, in essence, to classify natural phenomena in new ways and to learn from them just as the Lakota learned from the world above and around them. Anağoptaŋ. If we listen we will turn over and become - what is above is below and what is all around teaches. Both the gun and the horse transformed Lakota culture, so too can mathematics.

> And then he would tell us of this and that, customs and ways of the past, and of evenings, instead of roaming about we sat inside, and either my father or grandmother would order us to get to bed. And if we did so they would relate legends, and we would lie listening; But gradually we would fall asleep. Then father often said this: "Lie awake, this is not yet the end of the tale." And then we would make an effort to stay awake again. (Bushotter, n.d.)

Lakota Mathematics

In the previous six sections the effort was made to come up with a description of what I had termed "Lakota Mathematics." With the aid of local Oglala elders, educators and anthropological sources written in the past hundred and sixty years and by applying Bishop's (1991) six universal mathematical activities I was able to describe some aspects of each of the following activities found in Lakota culture: counting, designing, measuring, locating, playing and explaining. None of these descriptions are complete by any means, however, they, as a whole, can be used as a springboard for further discussion about what constitutes the intersection

between Lakota culture and mathematics. For the purposes of this study this framework can now be taken and applied to the local K-8 classroom as a way of determining whether or not there is any evidence of Lakota culture or Lakota language present therein. It is also my hope, that in the future, this framework can be used by Lakota educators to aid in the development of mathematical curriculum in the Lakota language. It may also be of use for other Indian tribes to aid in the bridging of their own distinct cultures and languages with the most widely ignored content area (when it comes to cultural integration) in Indian education - mathematics.

At this point I have only described and answered the first question of this study: What is Lakota mathematics? We will now move on to the description, history and integration of self-determination and local control within the Oglala community, *Isna-Wica Owayawa* and the K-8 mathematics classroom.

Chapter 10: Part II - Self-Determination, Oglala and *Isna-Wica Owayawa*

Loneman School Corporation Mission Statement:

Loneman School in partnership with the Oyate will:

Recognize the uniqueness of the whole person and empower each to achieve a vision in a life-long circle of learning.

Loneman School Corporation Vision Statement:

It is the desire of Loneman School to provide students with the most effective and supportive learning experience possible. As we look ahead and live out our mission we see...

- The school building is utilized by the whole community
- State-of-the-art technology is found in each classroom.
- Students are portraying the Lakota values on a daily basis
- Students are fluent in both Lakota and English languages
- Parent and community input is a part of the decision making process
- Students are working at problem solving individually and in groups
- Fun/laughter and a sense of well-being is everywhere
- Students demonstrate respect for themselves and others.

The Genesis of Local Control in Oglala

Before looking at the impact of self-determination and how it is conceptualized in the local community I would like to give a brief synopsis of the history of local control in Oglala and its impact on the Oglala community. A look at the influence of the American Indian Movement is included since it was a related force in the community at that time. The period encompassing the late 1960s through the mid-1970s was a pivotal time in Oglala history. The Indian Self-Determination and Education Assistance Act (PL-93-638) was passed in 1975 under President Nixon which allowed tribal entities to manage programs through contractual agreements - these entities included schools - for services. Loneman Day School became a contract school at that time and also chose a new name to fit the new identity, Loneman School Corporation. Locally,

the community and family dynamics changed as well during this time. Change was occurring and not all of it for the better.

After talking with the older participants for this study it was apparent that some had worked for Loneman Day School in the late seventies, many served as school board members and so were around when local control occurred. However, not many of the people who were around for the initial push are still alive. In the late 1960s a small group of Oglala residents traveled to the Rough Rock Demonstration School in Arizona to observe its structure and how it operated. This group came back very enthusiastic about the possibility of wresting control of the schools away from the BIA.

When I asked participants about the reasons why some in the community wanted local control most mentioned two things, funding and control of curriculum. The funding issue was centered on the need to get the BIA out of the way, that is, to have direct access to the funding that normally had to be funneled through the BIA. "I think why they really wanted local control here was because of the money part, because they wanted to employ more people. They didn't want the BIA to be taking over on everything. You know how BIA was...You could only just do certain things." Another elder echoed this: "You know they talk first of all the money that went to the BIA then here...they got the money directly after that...that seems to be one of the main issue that people dealt with at the time."

The second topic dealt with the control of the education of their children, which manifested itself in the implementation of the type of curriculum that they saw fit. The inclusion of the Lakota language and culture taught within the school soon occurred. "I think because of BIA regulations. They wanted to implement bilingual material and culture during the seventies."

Not all in the community were supportive of the move towards local control of Loneman Day School. Some of the community members who opposed the move to local control were employed by Loneman Day School and had an obvious reason to push against it. However employment wasn't the only reason given in opposition to the move to local control. Those that opposed the move to local control felt that the community was not capable of handling such a large responsibility, that they didn't have the expertise to do so and that by taking this on locally it forced the government out of its treaty responsibilities. When local control did finally occur it split the community and fears of losing jobs expressed prior to the gaining of local control among employees proved true; many of the people who were employed by Loneman prior to the coming of local control ended up losing their jobs. One elder who was on the school board after local control occurred reported that it was deemed best to fire all the teachers at the time and replace them with new ones. Part of the reason, she said, was that it was viewed that they were not doing a good job teaching the students. Despite some local opposition Loneman Day School was the first school on the Pine Ridge Reservation to gain local control in the mid 1970s.

The Impact of the American Indian Movement

Coinciding with the push for local control at this time was an outside influence which began impacting the social structure of the Oglala Sioux Tribe. The American Indian Movement (AIM), a movement that spawned from urban civil unrest in America, found a foothold within the boarders of the Pine Ridge Reservation. AIM had a profound effect on the community and depending on whom you ask within the community was either positive or destructive. AIM came as a way to help protest the injustices and ill treatment many felt by either the federal government or in the racism around the reservation: "One thing that I know, when AIM came it was because of the way our people were being treated. I think at that time I was young, too, I

was about 19, we were tired of being treated mean." Many of those I interviewed saw some positive aspects that AIM brought with it. One elder stated:

> The good part of it is that it was a time that brought a lot of pride of who you are. Before, you always had that mentality of the "End of the Trail." This lifted your head. “Hey, I can sing. I can dance. I can do these things. We have these things. Why are they saying we’re no good? We can grow our hair. We can be proud of who we are.

He continued showing perhaps how this impacted the schooling of the children.

> We can stand up and say—with education, we can say, ‘This is valid in our culture ...’ It brought on a pride to where a lot of young people went on to do good things.

Still another stated:

> But it brought changes in the other areas. We were freer to do what we wanted in the Lakota way, which brought—there’s a lot of Sun Dances, and they brought back the ceremonies. We are free now. That gives our kids a chance to express themselves in their way, not only in ceremonies, but who they are. They can go out into the world and be proud that they’re Lakota.

It was just not cultural awareness that was deemed a positive it was also an awareness of the corruptness within the way the federal government dealt with the Lakota,

> But I think there were probably benefits. The government started to see deep unrest that was probably boiling for some time. One of the headmen of our tribe, years ago, they went to Washington and they went to address just that, the dissatisfaction with the federal government at the time, and not getting their rations and their meat and all of what was promised to ‘em from the federal government. And one of the men said, “Trouble springs from seed that was sown long ago by the federal government not owning up to their promises.” And that’s probably what brought about a lot of that civil unrest back then, people not listening to people, people going up and sayin’, “I own this piece of land here, and somebody’s cows are grazin’ on it,” and nobody payin’ attention to ‘em. So that dissatisfaction kind of started plantin’ that little seed in their mind. Or maybe a sliver in your skin, and it started to fester and it started to hurt, and then finally it led to things like that. I think that awareness, it probably brought a lot of awareness.

So AIM helped bring back a sense of cultural pride. It brought attention to the many years of frustration felt by members of the tribe in relation to its treatment by the United States government. It also helped indirectly impact some of what was going on in the push for local control at the educational level - providing perhaps guidance in the curriculum, to include the Lakota language and aspects of the culture within the schools.

> It had to happen because cultural awareness came about...before that time...people were studying to be clergy...everybody was striving to compete with the white man, barking up the wrong tree, there was nothing that was culturally relevant at that time, then came in cultural awareness and that's all it took (to gain a foothold within the schools).

However, not all that came about from the AIM phenomena was positive for the Oglala community. There were two things expressed by participants that AIM brought that were destructive to the community. The first was a level of divisiveness that arose and which later spawned violence. One former Lakota teacher mentioned, "I have a brother and I have cousins, they were killed at that time and they (their murders) remain unsolved." An elder spoke of the divide between employees of the BIA and non-Employees: "It was more the BIA than being Lakota. That's how I looked at it. Like, in Manderson, that was really strong. The ones that had BIA jobs, government jobs, tribal jobs, they were really with the BIA. Where a lot of us that didn't have jobs at that time, we pretty much were with the ideals of AIM." Yet another elder commented on how the influx of AIM reminded him of the Ghost Dance movement that preceded the Wounded Knee Massacre of 1890. The impact of which lead to violence and divisiveness:

> ...it was probably history repeating itself, because from what I heard of the Ghost Dance craze, that was the same thing that happened with AIM coming here. It wasn't turmoil within and our own people getting involved and trying to straighten things out, it was a lot of outside people coming in and instigating the violence. I see probably the dissatisfaction with the government, like I talked about, the government bringing self-determination because they probably got tired

> of hearing all these complaints and stuff, and so they said, "You run your own things according to the way you want to." But I think that AIM probably would have been a whole lot more effective if they leaned away from a lot of the violence, because then it separated families, it separated the tribe.

The next thing mentioned that came from AIM that was negative was a certain anti-authoritarian attitude. It was not just the treatment by the United States government that ended up being protested but a push against established laws on the reservation - tribal laws.

> The other part, the negative part, is that some of the young people, it really brought out this anti-authority. Disrespect for law and order and the laws we have. So a lot of our people, when they go out to a reservation, they obey all the laws over there. As soon as they cross the line, they forget. They don't even have respect for the laws here. So they have that kind of mentality. Even as far as education, too, a lot of the ones that were, say, anti-white will say, "That's the white man's education. You don't need that. You don't need to go to school." So they deprive their own children of a future. They don't know that 638, they have a choice of how this thing can go. Instead they have all these excuses of why their children shouldn't have to go to school. They don't have to learn that.

The push for local control started in the late 1960s in Oglala. It seemed to have its genesis in what was occurring at the Rough Rock Demonstration School in Arizona. In the early 1970s discussions were had within the community about the possibilities this might hold in the education of their students. Part of the push was to get the BIA out of the educational process. This meant that funding would go directly to the community and that the community could determine the curriculum for their students - this manifested in a push to include Lakota language and culture. The American Indian Movement influenced indirectly the shape of local control. Things changed drastically as far as the schools and community were concerned thereafter. Residents of Oglala gained local control of the operations and direction of Loneman Day School by the mid-1970s. It was a time of great change.

Prior to the Age of Self-Determination - Self-sufficiency

What were some of the things older participants had spoken about regarding life prior to the coming of the age of self-determination in Oglala? Many remarked about life back then as a time when community members were self-sufficient; they provided for their own and were able to depend on each other for aid. They also spoke of the time when the language was spoken in the home and not in the schools. There was an absence of Lakota culture as contexts for learning within the schools. All of the elder participants I had spoken to except three were bilingual - which speaks to the use of the language in the homes at the time as well. One commented,

> We lived like that. We were self-sufficient. I was raised by my grandparents. My grandpa was always in politics. He died a vice president. His name was _____. But I know that we were self-sufficient. We did everything on our own. All my uncles and my aunties, they did things. I knew that this change was comin', but I didn't know that it involved school, because I was in high school then, and I didn't really know. But it was happening here.

Another elder commented on the self-sufficiency of the community - the ability to lean on family and extended family in times of need and how that has changed over the course of forty years.

> Yeah. One of the basic things that I remember in my life was not looking for anybody to provide for you. You know, when you had a death in the family, your family got together and your family fed at the wake, your family fed everybody, or you did it yourself. You didn't look to the tribe for anything. And that's one of the big differences that I see. Nobody does anything for themselves any more. Bein' self-sufficient back then was one of the things that they kind of took pride in, but now, self-sufficiency is, if you do it, they make fun of you for tryin' to be self-sufficient any more.

I had asked an elder to describe the times when she was growing up in Oglala in the mid-1950s. I will include a snippet of our conversation.

"Growing up here, I remember the Oglala store where we'd go and buy pop and groceries. Once a year we'd go to John Linehan's (Oglala Trading Post), we buy shoes, usually one pair of shoes a year, mostly groceries, food."

(They traveled by wagon and cars?)

"We—my great-grandparents raised me, so we walked. I remember walking from our house, where _____ used to live, back there, all the way to Pine Ridge, me and my great-grandma. I can never do that (now). I can't even walk to that trailer any more."

(How old was she at the time?)

"She had to be in her seventies. She'd be packin' water and bread, knew where we were going....So we'd walk. It took us a whole day, walk up the hills, sit and rest and drink water and whatever she had to eat, and go on."

(Did you have to plant gardens?)

"Oh, yeah. We had to get up real early in the morning, before sun came up, and pull weeds. That was for the winter months. She'd dry some - dig potatoes. We had, like, a cabin, and inside there was a cellar, to keep the potatoes so it stays fresh."

(Did you guys dig thimpsilas and pick choke-cherries?)

"Oh, yeah, uh-huh. Choke cherries were—she had this, like, a tablecloth, but it's a canvas, and she had this round stone and this other one like a handle, and she'd sit there and pound them and put 'em to the side and make patties and dry them. She'd put 'em in a sack. That was for winter. Corn the same way. Parboiled."

In this conversation is the resourcefulness of the people of the time. There was still a thought to the future - planting gardens and storing food for the winter. There was a level of poverty mentioned. The walk from Oglala to Pine Ridge is no small feat - roughly fifteen miles.

Another aspect of life that is not seen in Oglala is the employment of the local people to do farm work in the summers. Many families in Oglala used to go to the farms in Nebraska and Colorado and work the fields during the summer months. They saved their earnings and used the money throughout the rest of the year - again preparing for the months ahead. One Lakota educator spoke of those times:

> When school was out in May our folks would pick us up. They always worked somewhere like Nebraska, Colorado…we grew up in all those places. They always had ranches or farm work or something. And even then we were out there in the White community so we had to speak more English and we went Sunday school with all these little Mexican and white kids so (laughs) so we spoke more English.

One elder commented on a different form of pride that was around, not necessarily cultural pride but a pride built from self-sufficiency and also in being who you are and in taking care of what was around the area, that in his mind, is not around any longer. I asked him the following: (I've talked to a couple people about AIM, and they mentioned that AIM was good in one way because it brought pride back into the culture. Do you see that?)

> I don't think so. Because from there—I remember the ditches weren't like they are now. There was a lot of things that was—we had a park down here in the creek here, and it had a kind of amphitheater there, and things were working good. And if that was keeping things to where people would see 'em and proud that you had it, then it probably wasn't the pride that they brought back. A lot of times, a lot of our people take our own religion for the wrong reasons. A lot of them brought—the wrong reasons is to show 'em that we're Indians. I don't have to show anybody I'm an Indian. Heck, I'm an Indian. I live it every day. I see those little Indian kids going to school. I see people givin' somebody a bowl of soup. A lot of times that's just as much as bein' an Indian as anything is.

The reason I wanted to take a look at the rise of self-determination in the Oglala community is because it, coupled with a rising tide of indignation and promise, brought about much change in the community in the 1970s. It was a pivotal time. The schools in the area

began to incorporate Lakota culture and language in the classroom. Community members began to see that the Lakota way of life need not be ignored any longer. Yet at the same time that a rise in cultural awareness and pride was surfacing something else was happening. With the move toward the Lakota way aspects of Lakota culture began to disintegrate. We have seen above a push back from the younger generation in which an attitude against tribal laws surfaced. We also see a decline in self-sufficiency; a decline in doing for oneself and a growing dependence on the tribe for the most basic needs. This decline was also seen, ironically, in the number of speakers of the language. In the older generations a vast majority are bilingual. In the generations that follow, despite the push to get the language and culture in the classroom a decline in the use of the Lakota language continued.

It is important to note this decline because there is a deep irony. During the push for self-determination we have a decline in self-sufficiency. I will stop short of saying that self-determination was the cause of the decline in self-sufficiency, since there are many factors such as an influx of technology and a rise in drug use within the community. It is also around these times that some very important vocational training that occurred at all of the high schools was being dismantled, this may have had an effect on the lack of self-sufficiency seen later. Yet it is interesting that prior to these changes families had fairly healthy tȟiyošpayes units from which they could depend on for help and support. Within the span of a couple decades we see families and community members that used to depend on each other within the community now approaching the tribe for that help. There are other instances that I can personally point to, especially in my own family's history where this is true. In one of my conversations with an elder I had mentioned the remnants of irrigation ditches that used to service the families in the area who used to grow crops and raise cattle and horses. These ditches were no longer given

water by way of the Oglala Dam in the mid-1970s (we used to swim in those ditches as children). I inquired to this elder what had happened to them having not known the history. It turns out that the tribe diverted those water resources and was going to grow and sell hay in the field south of the old Oglala Trading Post. Nothing came of it. An elder in the community commented on those times:

> I knew that. I kind of grew up in that era, when my aunties and uncles would leave and I would be home with my grandma and my grandpa...So the rest of us would be home, me and my brother and Grandma, and we would take care of the cows, the chickens, turkeys. We had everything, goats. And even that, kids don't know that.

She continued:

> I was thinking back to that. I told my granddaughter we're gonna plant pumpkins. The kids are always lookin' for pumpkins. And then flowers. We're gonna try strawberries and tomatoes. They hang 'em upside down. I thought about that, how about along the walls instead of on the ground? I read a lot, and I did read that somewhere in Europe they plant things so they'll grow along the wall. We could do things like that. Trees. Look around here. Homes with without trees. They need to plant trees. And how to get to them, these youth. They say that there's nothing to do. There is lots, lots, lots.

This relationship, self-sufficiency in a seemingly inverse relationship with a gain in local control, should not be taken lightly. Doing for oneself and helping each other are very important cultural attributes for in doing for oneself one finds a sense of dignity and self-worth and in helping others one finds wealth (we have discussed this idea in the look at Lakota mathematics). It seems also important to note that one does not get without giving - there is a sense of reciprocity that needs to be honored. If the tribe is taking over the giving in what ways do its members give back? Is that cultural requirement now nonexistent? Also, culturally speaking, what is lost in the relationships that might have occurred in raising food in a garden especially when we think about a context for learning the language?

The kids not knowing

Part of this decline can be seen in the lack of fluency in the language in the younger of my own generation and the generations that followed. I asked many of the participants in this study to give me a percentage of Lakota speakers among the K-8 school children at *Isna-Wica Owayawa*. Few would venture a guess but many acknowledged that it was very low. One Lakota instructor mentioned that of the twenty kids in her classroom only three or four could speak it. But when I asked about whether or not the kids in the schools were able to state various things in the language educators and elders were quick to state that the kids could not. In asking about the number of speakers among the children I got this response:

> That percentage is very low. I taught pre-K, K, and first and second when I was here, and I'm the first to know when the kids come from Head Start that very few, maybe 10%. Very few can talk. But sometimes that is not the real picture. Once I know where this child is from, once I know the background, the family, then I know that this child may have some, and even then, they're reluctant to talk. Even the kids are reluctant to talk. If I know the family, then I'll know that maybe they'll know words.

I asked two Lakota language instructors the following question: (How many kids nowadays would be able to give directions in the Lakota language?) One replied "Not much." The other stated, "'Cause they forget. You can teach 'em, teach 'em, teach 'em, and Monday you come back and ask, Itokağata toketkeya he? They know it's the direction, but they start guessing."

Each had an opinion on why the language was not being picked up by the students even though it was being taught in the schools. Many pointed to the fact that the language is no longer spoken in the home like it used to. "So why can't our children learn the Lakota language? It's because I guess the parents don't speak it." A former Lakota teacher had this to say:

> It has to happen at home, too. They need to bring that from home, too, which doesn't happen. Our parents are young and they don't know. Sometimes I tell my kids, "Go home and teach your parents." [laughs] Which happens! "Say it to them. If they don't know it, tell them." ___ said that. She didn't know I had her grandkid. And she went home and told her grandma it was snowing. "It's a snowy day, Grandma." She told her that in Lakota. But it has to happen.

And still another elder stated this,

> Now? I think it's OK, but to me, I think it starts with the parents at home. If the parents want their child to talk the language, they should start teaching 'em at home, teaching 'em how to talk it. But they don't. There's more parents your age that speak English and they don't speak the Sioux language.

Others pointed to a lack of coherency and direction in the curriculum. One current teacher even expressed that she has to make up her own curriculum as she goes. A former educator spoke about the lack of curriculum as well:

> One of the things that we still lack is a curriculum. And then the other thing that I didn't like about that was, we have to go by state standards, and when Lakota Language Consortium first started, all these people, language teachers, would get together at different schools and we talked about, how are we gonna teach, what's been done, all those questions. And it always ends up with us disagreeing with one another, because each district, even each community, they have their own way of teaching. And one word may mean something here which would mean somethin' else in another place. And that's why we have trouble developing curriculums. And we do have to abide by the state standards. And I thought if the men or someone would advocate to the state, maybe they could change that. Maybe the college, the OLC, would be our guide and get us qualified for state standards in our way. Which never happened.

This same person spoke of something that she sees as a detriment to the push for fluency in the language:

> All the things that I thought of, it's not working. Nobody seems to want to help. And I do realize now...one thing is, we're lazy. Lakota people are lazy. They don't want to share that language. I think that's the main thing. And when I taught here, I taught—one of the things that I wanted was a curriculum based on the seasons, because Lakota people live by the seasons. Just like this weather. How many of them realize we get bad storms in the first quarter and the last quarter?

> Always because of the calendar. There's 28 days, there's 13 months. Our way is different, no matter what. No matter how modern we are, we are still Lakota. We still have our things out there. And that's my belief, that we still have our things and we just need to teach. We need to share.

One elder pointed to the inability of the community to handle such a large responsibility - which harkens back to one of the reasons for not wanting local control in the first place:

> I don't think it was as effective as it was portrayed that it was going to be back then. And maybe the planners didn't have all their ducks in a row to where they had the curriculum all in line. Like I said, it didn't go like they planned it. A lot of—our people, if you don't include 'em in anything that starts up, then they're gonna turn and they're gonna stay away from it. They're not gonna say, "I want a voice in this because I want to be a part of it," like other cultures, they'll fight to get in. Our people, they'll just turn the other way, walk away and stay away from it. That's where you lose everybody's input. There was a lot of people who were fluent in both—You know, there's something that they've tried, and you can't get somebody who is just fluent in our own language to teach it, because they don't know enough of English to bring 'em together. So you have to look for those people. They got a lot of the people that just spoke one language. And I've tried it. There's been a lot of times I asked one of these guys from around here or somewhere else, "How do you translate this English word into Lakota?" And they'll sit there and they'll say "I don't know."

Another pointed to the fact that there is a man's way of speaking in Lakota and also that standards need to be put in place reservation-wide and that by only having women teachers it might hinder the development of the language in the male students. At *Isna-Wica Owayawa* there were no male Lakota teachers - men need to be involved. One female educator acknowledged this stating: "If we had a man teaching in Lakota studies…' And still others pointed to a lack of time with the students - 45 minutes per day was not enough time to foster an understanding and fluency in the language.

In my own discussions with students in the middle school and elementary regarding some of the mathematics topics and general topics surrounding the language I was a little shocked in their inability to state Lakota words or phrases. I have already mentioned the inability of most of

the students to state the Lakota numbers from 1 to 10. Below are two excerpts taken from my conversations with two 8th grade students.

Student 1:

(Did you hear the language a lot in your home?)
At my grandma's house.

(Did you figure out how to speak it?)
Parts of it.

(Do you understand it?)
Not really.

(Not really? But do you know different words, phrases and stuff?)
Yeah.

(I am going to run a few words by you...The first one is hot.)
No

(Cold)
Osni

(zero)
?

(How would you say clock to tell time)
Ah I forgot

(Mazaškaŋškaŋ?)
Oh yeah

(How about if something is going fast?)
?

(slow?)
[Laughs] nope

(old?.....young?)

(How about above?)
nope

(How many shapes do you know? What is a circle?)
"Mimela."

How about a square?
no

(Rectangle?) "No."

Line? "No."

(You went to school here since kindergarten right?)
Yep

(Do you remember taking some of these things in the Lakota class? They tell you the colors and the shapes and the numbers?)
"Yeah."

Part of the second 8th grade student interview is included below:

(Do you speak the Lakota language?)
"No, not that much."

(Do you understand it when you're spoken to?)
"Every now and then."

(You can pick out words and phrases and stuff?)
"Yeah."

(Would you know the word for "big"?)
"Yeah, _tȟaŋka."

(How about "small"?)
"Forgot."

(How about "cold"?)
" Osni."

("Hot"?)
"Bloketu?" (Note, bloketu is the Lakota word for summer)

(How about if you were gonna tell time? Do you know what the word for "clock" is?)
"No."

(How about Mazaškaŋškaŋ? Does that ring a bell?)
Unh-unh.

(How about if you were gonna say "fast"?)

"I don't know."

("Slow"?)
"z."

(How about zero?)
"Forgot."

(How about dog?)
"šuŋka."

("Circle"?)
"Mimela."

(How about "square"?)
"I forgot."

I can include conversations with the elementary students I interviewed but the results were about the same. There was knowledge of a few things, that is, bits of knowledge of some words, for example, being able to say a few of the Lakota numbers, but it was typically incomplete. In my look at seeing what the students were able to express in addition to counting I asked them to count change (money), name shapes, state their ages, and express some arithmetic in the language. I state these things about the lack of Lakota language knowledge among some of the studetns at *Isna-Wica Owayawa* knowing full well that the context of our conversations was contrived and that some of the students I interviewed didn't know me well. A story comes to mind that my father told me concerning trying to discern whether or not a child could speak "Indian." He and one of my uncles worked together as plumbers for the tribe in the early 1970s. On one of their calls they went to a house. At the house my uncle asked a child who was playing outside if he spoke Indian. The child responded "No." Then my uncle began speaking to him in Lakota, the boy answered back to him in Lakota! My father laughs at the story, but it illustrates

that sometimes you can't get a good idea whether or not a child speaks the language because he/she may not want you to know.

The look at the fluency of the children at *Isna-Wica Owayawa* adds to this notion that even though local control occurred and the Lakota language and culture were included in the classroom, teaching the students for fluency has not occurred. In fact, less and less of the younger people speak the language. In the context of declining self-sufficiency, which I have spoken of earlier, can we put the decline of the Lakota language? I have already mentioned a certain free-fall from dependence on family and community members for help in times of need now taken on by the tribe. Could language be a function of this also? That is, if the schools are going to teach culture and language does it then mean that community members relinquish that right and responsibility? One elder alluded to this in the context of the schools: "Some of that boarding school mentality has been passed on to generations, where, “Boarding school took care of our children, the school can take care of mine.”

Ways it could work

Despite all the perceived difficulties - ranging from laziness to a lack of effort at home to a lack of standards and resultant lack of fluency in the language it was still viewed a good thing by community members at large that the language and culture be taught in the schools. One elder went so far as to say that teaching the language through the schools was the only way to keep the language alive left since it is not spoken in the homes anymore:

> To me, right now at this time, probably it’s about the only way, because a lot of the children’s parents don’t even speak the language. Those parents, their grandparents speak very little. Our age group is probably the biggest group of language speakers. I know these guys are all taking the language. I help ‘em as much as I can. My grandson, too, he’s really learning the language. They’re doing a pretty good job in Little Wound High School teaching the language.

Another elder offered the idea that the structure of the system itself needed to change in order to be successful. This harkens back to some of the original ideas put forth by early local control advocates. The suggestions back then were to teach a half-day in English and a half-day in Lakota and to extend the schooling into the night hours. "Not quittin' at 4:30, you know? Thinkin', "I'm gonna take these kids out tonight. I'm gonna show 'em the different constellations in the sky and what they mean." You look at the Dipper over here and in our hemisphere here, that's one way that you can tell the direction that you're going."

Another suggestion would be to teach the Lakota language class using only the Lakota language, immersion:

> Again, it's like lookin' at what's out in it middle from a circle. We say *hekaga*, it means "Build it. Build that for me." In the language, we look at things in different angles. It's always out in the middle, not to the right or the left. If I said, "Build me that," I'd say " hemečeğa". And we would be looking at something that's out in the middle. I think when they use the English structure to teach Lakota language, it doesn't work. To me, that's how I came to learn the language I grew up with. It was there every day. Everything around me was Lakota. And then when they wanted me to speak English, when I went to boarding school, they took everything away that was Lakota, so I was able to pick it up. That's immersion.

I look back to my own experience in learning a language and can see the difficulty in trying to learn it in an academic setting. Immersion seems the best way to learn the language since it mirrors natural conversation anyway. One elder thought about the way he learned it in the home as a child. "It just happened naturally." I think immersion has to be given some more thought and perhaps be implemented structurally if gaining any form of fluency is one of the educational goals at *Isna-Wica Owayawa*.

Why spend so much time looking at the language and culture?

Having looked at the literature on Indian educational self-determination it became clear that it took a certain form regarding curriculum within the classroom. The curriculum impacted

by self-determination principles included the teaching and use of the native language. It was also to include culture in which to teach the content. It was also supposed to give the students an appreciation of their own culture hence impact their self-perception, i.e. raise self-esteem. Vivian One Feather's (1972) work during the late 1960s and early 1970s with the development of Lakota curriculum materials reflects these principles. Her curriculum materials included a collection of Lakota history and understanding of the following areas: *Ehani Ohunkakan* (Legends), *Tiospaye* (Family Group), *Makoce* (Land), *Lakota Wolakegnapi* (Economy), *Itancan* (Government), and *Lakota Woskate* (Games). It is not until we see the purpose of the development of these materials - explained in One Feather (1974) entitled "The Change in Self-Image of Oglala Sioux Ninth Grades Students Through the Development and Testing of an Indian Culture Curriculum, Final Report" that we realize it was really the purpose of these materials to better the self-image/self-esteem of Lakota children.

All this work undertaken by One Feather (1972, 1974) and community members took place during the initial phases in the local push for self-determination in Oglala. I want to argue here that perhaps the need to raise self-esteem, though deemed important at the time, was somewhat misguided. I say this in hindsight and with no offense against the planners and participants of these efforts. It seems if self-esteem was the central focus of all the educational (hence societal?) ills of our native students then the forms of curriculum established at that time would have helped stem some of the social issues and high educational drop-out rates. Yet they have not been impacted greatly with the inclusion of culture and language in the schools. We continue to see a decline in the speaking of the Lakota language in the meantime and a decline in the visible pushes for individual self-sufficiency.

This prolonged look at the rise of self-determination in the Oglala community, which, educationally speaking, means the use of culture and language in the classroom, has shown that these goals were expressed in the 1970s and were implemented into the classroom at Loneman. Fluency in the language is a one of these reasons for gaining local control. I argue here, especially in light of the fact that the first part of this study was to look at uses of mathematics in the Lakota culture and the expression of mathematical terms within the culture, that the language, if it is to be taught for fluency has to permeate not just the Lakota walls and language classroom but has to be used in the teaching of content areas not yet included in the push for self-determination - especially the mathematics classroom. I also argue that the inclusion of Lakota culture and language has to become academic in nature. That is, it has to be opened to analysis in all disciplines. It also has to become not only the topic of discussion but the means by which discussion occurs. Attention also has to be paid to the form by which these educational goals are to be met.

The elder who spoke of learning Lakota as a child as a natural process because everything around him was Lakota alludes to my point here in the use of the language in teaching mathematics. In addition, Lakota educators and community members alike realize something very naturally, if we are going to continue to teach Lakota language and culture and push for fluency and an understanding in each the form of the educational system must become more fluid. Why not teach at night? Why not use a half-day (or a full day) in which the language is taught in an immersion setting? Why not use the land around you for the context of course material - not just historical or spiritual sites but also for such things as geology, biology or a study of the eco-system around the area?

How is self-determination defined?

We have seen the rise of self-determination in the local Oglala community in its push for local control. We have seen the impact of AIM and an increase in cultural content and Lakota language courses in the school. We have also seen a decline in the language and an increasing dependency upon the tribe for basic needs. What I haven't done yet was ask how self-determination is it now defined by participants in this study?

In light of what I had expressed above one elder's definition strikes a stinging chord. His definition equated self-determination with individual self-sufficiency: "To me, self-determination is helping yourself to be more self-sufficient, to do things on your own, not to rely on the government or anybody else, like the old days." His definition provides a springboard towards a responsibility found only in freedom, which comes as a direct consequence to self-sufficiency that an educator suggested: "I guess probably that it has a lot to do with the language, the culture incorporated back into the people…a long time ago our laws and stuff were the final say so, now we have to go through the federal courts off the Rez…everything's like the government is trying to take care of it. If we as a tribe are sovereign now…that they can actually change laws…its possible as a nation to do that…" Thus self-determination is not just a push for inclusion of language and culture in the schools but has bigger implications, that is, it contains within it the ability to change laws, to become responsible for continuing the push for independence - to know and be responsible.

Similarly the attachment of self-determination to cultural continuance, not just in the form of language but also in religious ceremonies, i.e. maintaining a way of life, all within the bounds of the community, are realized in these thoughts:

> We can just go to school right here and do the cultural things that we need to do. We could do them now without being afraid of anybody. I know that ceremonies,

> a lot of them went under. I know that much. Things were kept—ceremonies were kept, but they were guarded, because you're not allowed to do them. Which is wrong. Those are our ways, and being prevented from doing those things, it was wrong for our people. How are we going to maintain our way of life?

Again there is a perceived independence from the government and the BIA : "they became independent of government…they are not BIA anymore..."

Interestingly, if we look at some characteristics put forth by Adams (1974) in the JAIE, concerning self-determination we see a couple of them omitted from the responses of Oglala participants. He mentions three characteristics of self-determination in Indian education (1) "the curriculum in the Indian schools should reflect traditional Indian cultural values" (p. 22). (2) "Indian schools should be responsive to the needs of the surrounding community; that where possible the community should take an active part in the school program" (p.23) and (3) "Indian schools should be run by Indians" (p.23). The participants' views speak to the inclusion of the Lakota language and cultural contexts in the curriculum, but do they include cultural values? What might that mean? We will see that indeed the "Lakota way" of looking at the world is included in the Lakota Studies curriculum standards (to follow). Participants did not mention the school being responsive to the needs of the community (even though it is in some regards - a place for funerals, dances - social gatherings.) and perhaps in excluding the schools to be run by Indians they already understand that this is the case. (The school board is comprised of local community members and is run by a Lakota principal.) Two of the three characteristics put forth by Adams (1974) were not mentioned but were part of the normal operations of the school and its leadership. So the expression of self-determination by participants seem very general and centers on direct funding and control of curriculum but means, at a deeper level, greater things,

including an understanding of the basic power in self-determination - an ability to change laws and be self-sufficient.

The administration's view

We have seen the community/educator view of self-determination. How does the administration, which guides the school, view self-determination? I asked an administrator the following question: (What do you see as the purpose of educating students here at Lone Man?)

> What do I see as the purpose? From a historical standpoint, the treaties tell us that we have to make sure that the children have an English education, and then from public law 95-561 and public law 100-297, it talks about self-determination, that in doing that, local control gives the community the opportunity to have input as to what's being taught at the schools. So that provides an opportunity to incorporate language and culture into the curriculum. Also from a historical standpoint, there has been a lot of research going back to, like, 1928 that shows or indicates that by incorporating language and culture and identity into the curriculum, that it improves Native children's ability to learn and be successful."

Here, again, we see that self-determination at the local level was/is really local input into the direction of the schooling. This meant language and culture in the classroom, as part of the main philosophy in the teaching of the students. She also is the first one to point to a "bi-cultural" education and how this is not an easy goal to accomplish since it assumes that culture and language be looked at as secondary to English.

> However, since that time, the things that are recommended, like, in the Merriam Report and the Kennedy Report and the White House Conference on Indian Education, none of those things have been fully implemented the way that's been described in that research. So what I have always had a desire to do is to be able to do that, what has been indicated in that research that says by having culture and language—it's easy to say, but it's very hard to do, because it's really hard to find a balance between that English education and the culture side of things. We've gone through an era of time where from the early 1970s to the late 2000, around that time, and even more currently, where a lot of what we did was from a bilingual, bicultural perspective.
>
> The route that we took as Native people was to look at ourselves, our identity, our culture, from a secondary perspective. And I've come to the conclusion that we need to look at it from a primary perspective. We need to treat

> our language, our culture, our identity as a primary type of thing. Whatever we're doing from an educational standpoint, we need to look at that and say, "This is the first thing we need to focus on, and then the English education is secondary to that." Even in having that perspective, it's still hard to do, because, the English education with the cultural education, it's really hard to do, being able to blend the two.
>
> So my role right now is trying to figure out how to put those things together, and right now, one of the things for us, the school is really under a lot of pressure from the last authorization of the Elementary and Secondary Education Act, which is currently called No Child Left Behind, and there's really a lot of emphasis on the English education stuff. So it's a real struggle.

The issue then, from this administrator's perspective is to continue to push forward with self-determination, the teaching of culture and language, as a guiding, if not the guiding principle. As time has passed, with the coming of NCLB, the task is much more difficult. When the push for standardization and proficiency in Math and English the effort to include culture and language now has a very formidable hurdle to jump.

How can it work?

Regarding self-determination as a guiding principle in the schooling of the children most community members felt that it was inherently a good idea. One elder stated, "Right now, a lot of the students, they can't speak the language. [laughs] But I do know that they're teaching it, and I believe it's having some positive effects." Yet there remains a sense that there should be better results in the education of the children. That if notions of self-determination were successfully implemented there wouldn't be the continued language loss or that there would be a greater sense of individual responsibility. Part of the failures is that "the right people " need to be involved in the mix: "I think it would work as long as the right people are in place. If we get the right people in, I think that we could handle the—what's the word I'm lookin' for? I want to say "burden," but it's not a burden. Handle, be able to handle the situation. But I don't know if we can get the right person in there." A teacher echoed this:

> Local control all over. Oglala having local control of this, as long as the right people are there. And that's the key, getting the right people. I've heard a lot of stories about when AIM and the goon squad were here, that it ran a lot better because BIE was here, it wasn't the local police. The BIA didn't care what your name was, who you were. If you did somethin' wrong, you were gonna pay for it. The way it sounds now is, if you have the name or status, you can get away with some stuff. And that type is bad, because you can get away with pretty much anything.

The next thing mentioned is that community members have to listen to each other and have the best interest in the education of the children:

> I think local control, the positive thing is that we can—if we listen to each other and sit down and decide what's good for our children and develop it, we can really grow in a good direction, whether it's culturally or academically. We can do both. The possibilities are there. It opened it up. They're there. But we're just not seeing it. We have to really look at it and not—to think in a collective way to do this. If we don't think collectively, people are gonna have an agenda of their own, whether it's to get a job for their relative. That's the negative part, to keep people working there because it's their relative. But to think collectively and think of the children and education and bring culture and academics together and move ahead in this direction, I think we'll go a long way. There's hope for that. But we've got to get the people to start listening and not elect people that are just whiners and complainers or just lookin' out for the best interests of certain members of their family that work there. But to put people in there for a good reason, and that's a good education for our children."

The Tribe and Isna-Wica Owayawa and Vice-Versa

An educator commented after I asked about the influence of the tribe on the school's direction. "I don't get a sense that the tribe really has a say in what goes on here other than signing off on the contract." (The tribe doesn't provide any kind of vision to Lone Man?) "I haven't seen it." (You don't know of any kind of connection between the school and the tribe?) "I don't. I know that we have to conform to some of what they say, 'cause that's where we get some of the money.

In the grand scheme of things what responsibility does *Isna-Wica Owayawa* have to the tribe outside the community and what responsibility does the tribe have regarding *Isna-Wica*

Owayawa? What do graduates from *Isna-Wica Owayawa* owe to the tribe - is it just that they need to be vehicles for cultural continuance - the next generation to pass on the language and culture? Or is there some kind of civic responsibility involved as an outcome of their education at *Isna-Wica Owayawa*? What of the tribe? Do they set goals and visions that can be given to schools to direct their efforts? Is there a long-term vision set in place, like a tribal "Goals 2000" that gives direction to the curriculum at *Isna-Wica Owayawa*? The answer seems to be an emphatic "No!" An elder gave a little thought to this:

> "That's why when you talked about the tribe gettin' involved in some of the curriculum that is taught, they should get involved in that history and the language in our schools to where it's standardized. Because, you know, I don't know if a lot of those people who are teaching it now, there's a man's way of talking and a female's way of talking, and so if this man teaches all these kids and he's telling them these words of reference to your little brother and your little sister and your cousin, then all of them kids, even the girls, are gonna talk like a man. Then it's not standardized. There's no say, "I'm a man, so I'm sayin' it this way, but when you girls talk, you're gonna talk different and you're gonna say this." I don't think that's being done."

One elder spoke to the possibilities inherent in a 638 contract (since the Indian Education and Self-determination Act (PL-93-638) Indian schools have been able to contract with the BIA regarding direction funding and implementation of their educational systems) and the power that stems from it:

> This is there. ___ 638 ___ there for us to do. It's open, and we can't let BIA dictate our 638. They've been doing that again in the last 10 years, since '98. What they did was, they put our own people in those positions and they indoctrinated them. They really want to control things according to what BIA—'cause BIA people, they just do what they're told. And our own people that are in there are just doing what they're told, and they're sabotaging our self-determination.

Some would argue that getting the tribe involved would not be a good thing considering its history in mismanaging programs. It might be a cultural trait to allow the individual communities to continue to develop the schooling as they see fit - hence the tribal government's

hands-off approach. Yet this current form needs some retooling and perhaps some rethinking. What is important? Whose standards need to be met? How does the goal of self-sufficiency, something looked upon so fondly by elders and educators alike, become part of this educational push? Can teaching the language so that students leave the 8th grade able to speak and understand Lakota happen in the current context? By both markers, state standards, and as we shall see, Lakota Studies Standards *Isna-Wica Owayawa* is coming up short. Is there something inherently unstable in terms of teaching bi-culturally? Who are the right people that need to be put in place and what does listening constitute? There are many questions that remain unanswered as a consequence of looking at self-determination within the Oglala community. Thirty-five years is a long time for an educational philosophy to be implemented and achieved. It seems that the goals of self-determination have yet to be achieved especially considering a lack of direction from the tribe in the purpose of *Isna-Wica Owayawa* and a lack of language expressing the need to produce "qualified people to fulfill meaningful leadership roles."

The implementation of Self-Determination at Isna-Wica Owayawa

Having taken a look at self-determination at the community level as expressed by participants let's focus our attention on *Isna-Wica Owayawa* and see if we can find how it is being integrated into the education offered to students in its daily structure and operation. For this first part I would like to answer the following question: What is present in the physical structure of the school, such as symbols, literature and pictures that might speak of the integration of the Lakota culture at *Isna-Wica Owayawa?*

Viewing the physical structure of *Isna-Wica Owayawa* does not give the impression that the school is situated within an Indian community. That is, the school buildings could be placed anywhere in the country and not be associated with any Indian culture. However it is what

decorates the walls of the building that would lead one to conclude that they are not just in an Indian community, but that they are in the Oglala community.

There are many murals and paintings on the walls of the building. The gymnasium has two large circular murals - one recounting the Great Race and another that illustrates the Lakota Creation Story. The gymnasium also has some geometrical Lakota designs on the walls that have been there for as long as I can remember. I do not know when those might have been painted.

Walking from the gymnasium towards the office space one is confronted (indeed when they walk in the main entrance of the school) by a gigantic mural of a Lakota village scene with tipis, a man on horseback, with people doing essentially daily chores in the background. Eagles are seen in the sky. The Lakota artist Ed Two Bulls was commissioned in the 1970s to paint a series of paintings depicting aspects of Lakota culture. There are probably seven of his paintings hung on the hallway walls and in the library. His paintings commemorate the coming of the White Buffalo Calf Woman among the Lakota (when she met two Lakota men prior to coming into camp from scouting for buffalo), the Sun Dance, the Ghost Dance, a buffalo hunt, a moonlit scene of a Lakota riding back into camp, a Lakota man praying and holding a buffalo skull with lightening and eagles in the background. He also painted a portrait of Edwin Fills the Pipe, whom the library is named after. (Edwin was instrumental in the push for local control in the mid-1970s.) There are also many geometrical designs on the walls in the library including a chief design and circular designs.

In addition to the designs, paintings and murals the walls are littered with bi-lingual phrases and community postings. The most apparent bi-lingual phrase is actually the name of the school, *Isna-Wica Owayawa* instead of the English name, Loneman School. I am not sure

when the name change occurred, but it attests to a reclamation of the school by the community. From my journal I noted the following:

> I wanted to describe Loneman again. Driving into the school there is a concrete school sign in blue writing on concrete foundation (in the form of a fat T-shape) in it is written "Loneman Day School" . Directly above it is a wooden plywood sign painted white with writing on it that says" Isna-Wica Owayawa" with an eagle (Loneman's mascot is the "Eagles") and a pipe at the bottom right. The front of the building does not have any writing on it…only a number (don't know what that signifies).

Walking into the school, at the front office is a sign that reads, "Lakota word of the Day" followed by the word itself. The library has many bi-lingual phrases including the name of the Sundance in Lakota around Ed Two Bull's painting where on one side it reads,"Wiwang Wacipi" and on the other is written in English – "Sundance." There is a flag up on the wall opposite the door to the library commemorating Sam and Angie Loud Hawk who died tragic deaths around 1997, who were prominent member of the Oglala community. Other sayings in the library include "Tiwahe - Tȟiyošpayes - Oyate." There was also a huge mural covering the wall under Sam and Angie's flag – of a lake in a wooded area – with a lone Indian on horse facing the lake – away from the viewer. One building besides the main school building had a Lakota name - this was a building in the back of the school with was named " Mato Tipila" (Bear Lodge).

Besides these physical structures and the murals, paintings bilingual phrases and designs on the walls there are every where on the walls student work which seem to emphasize Lakota culture. The Lakota classroom is an obvious place to see Lakota culture, especially in regards to bi-lingual material, posters, designs, etc.

Self-Determination and Curriculum at Isna-Wica Owayawa

After looking for physical evidence of the local culture in the schools I want to focus on the curriculum at *Isna-Wica Owayawa*. There are two categorizations I have named when

looking at Lakota culture in the curriculum. One is what I have deemed the "formal curriculum" found in the Lakota langauge classes which every student participates in (from Pre-K through the 8th grade). In these classes students learn about Lakota culture and the language itself. The second category is an "informal curriculum" where aspects of Lakota culture are found outside the classroom, especially in activities offered through the school. For example, at the beginning and end of every week a morning prayer followed by the singing of the Sioux National Anthem (Lakota Flag Song) are conducted (offered after breakfast in the gymnasium). The drum group that sings the flag song consists of the Lakota Curriculum Specialist and a group of middle school boys. Also present in this "informal curriculum" are the sweats that take place periodically and the occasional trips to Lakota historical and sacred sites. Taken as a whole it is evident that thought and direction has been given to students at *Isna-Wica Owayawa* regarding Lakota language and culture.

The Standards

The formal curriculum is determined by the focus and direction given in the Lakota Studies curriculum outlined in the Lakota Studies Standards. These standards were created by the Lakota Studies Department. During the teacher and staff orientation at the beginning of the year this standards packet was given to each staff member. In the standards packet was a list of six strands that outlined what the Lakota Studies Department deemed important for students to learn regarding the Lakota language and culture. These strands included: 1. Spiritual Ways - (way of life); 2. Culture - Lakota; 3. History; 4. Communication - language standards; 5. Lakota Speaking - oral proficiency and 6. Lakota listening and viewing. Embedded in these content strands are benchmarks and indicators. The benchmarks essentially are vague statements meant to focus the topic of each strand. For example, the "Spiritual Ways" strand contained the

benchmark for all pre-K through elementary students which stated, "Students will become familiar with various aspects of Lakota spiritual practices." For the Lakota culture strand the benchmark for middle-school students was "Student will understand various aspects of Lakota culture." Further in these standards were "Indicators." Indicators spelled out the goals of the benchmark and also how the students were to be assessed regarding the standard. For instance, an indicator for the previous benchmark mentioned above was, "Student will understand the use of games in Lakota recreation and become familiar with recreational games of various American Indian groups."

The standards placed an emphasis on both academic goals in teaching about language and culture and also on topics that might not be viewed as "academic" such as the learning of songs (flag song, honor songs, social songs and sacred songs) and dance. The learning of some topics in Lakota typically took place outside the classroom, the "informal curriculum." Students not only learned songs but also the difference between types of songs and dances and also differing aspects of dress relating to dance outfits. Students also came to know Lakota stories and about the places the Lakota called their own. They learned about the Lakota family structure about forms of trade, and about historical Lakota leaders, and Lakota legends. Many aspects of Lakota culture were presented for students to see and experience. Some of these topics were adapted into the classroom setting and some were integrated into the vision and workings of the whole school.

It is true that a major point of emphasis in these content standards is the push to get the students at *Isna-Wica Owayawa* to speak the Lakota language. In the standards it is stated that the students will come to recognize the types of Lakota speech (formal and informal), found in the language. They would also come to understand the structure of language, they would be able to introduce themselves in the language, and would understand the gender differences in the

language, etc. A major point of emphasis spoken when the Lakota standards were being discussed was that proficiency in the language was geared to oral proficiency rather than written proficiency. Thus students would be assessed orally in a one-to-one fashion.

In another document that was given to the staff at the beginning of the year it is stated *"Isnawica Owayawa* has included the Lakota language as part of the curriculum. We have been teaching Lakota language for many years and teaching the Lakota language includes culture, history, communication, spirituality, etc." Here is an explanation of the various content needed to make the teaching of Lakota language and culture complete. Also stated is the fact that even though efforts have been made to teach these things, especially the language, it still has a long way to go in terms of actually getting students to an acceptable level of fluency, "The number of students leaving *Isnawica Owayawa* speaking the Lakota is minimal. Students learn what is taught in the classrooms (to them) by the Lakota Language teachers. Students know the colors, animals, arts & crafts, sentence structure, shapes, etc. being taught to them and yet there are few speakers or no speakers leaving the 8th grade."

In relation to mathematics I was able to find the presence of mathematical concepts embedded in the Lakota standards. I have already mentioned the push to understand the use of games in Lakota as an indicator in one of the content standards. There were a couple other hints at the use of mathematics within the Lakota Studies Standards. In the oral proficiency standards is an indicator for the 3rd through 8th grades which states, "Student will respond to oral math problems in Lakota." This is one of a few connections I have seen in any Lakota educational materials that stated explicitly a connection to mathematics. Another indicator in this strand is the following: "Student will answer in Lakota to money problems in sums up to but not to exceed $1,000.00." Finally, under the Lakota Listening/Viewing strand for 3rd through 5th grades is the

additional math reference, "Student will calculate orally presented single and/or double digit numbers in addition, subtraction, division and multiplication.

Isna-Wica Owayawa has devoted both time and resources to implementing the Lakota Studies Standards and has provided space within the school to try to meet that end. The Lakota Studies Department at *Isna-Wica Owayawa* has a place within the organizational structure of the school and also houses the department within the school. The Lakota Language department consists of five individuals, the Cultural Resources Curriculum Specialist (a male elder) and four Lakota Language teachers (all female, three of whom are elders). The Curriculum Specialist acts as a guide for the teachers. Each Lakota language teacher is assigned in the following manner to four different groups of students: One of the teachers teaches the pre-K students. Another teaches the kindergarten through second grades. A third teacher teaches the 3rd through fifth grades and finally one teacher teaches all middle school courses.

The Lakota language curriculum and classes

I was able to observe the teaching of the Lakota language at both the middle-school levels and at the elementary level (in the kindergarten and fourth grade classes). In these observations I noted the setting of the classroom, the contents of the materials on the walls, the conversations in the classroom and the content on the board that would be covered by the teachers. I want to focus this section on what was going on in these classrooms to give the reader a glimpse at how the standards were being implemented in the teaching of the language to the students I will give three descriptions from my observation notebook below. Here are some comments made during my observation of the middle school Lakota class:

> I also sat in ____ class today. Her room is full of Lakota words with their English translations. I was unable to write all of them down as I observed her classroom.
>
> She had students take a look at the Lakota alphabet and taught them the correct pronunciations – gluttoral stops etc… In the alphabet when the students

> came to the letter "z" the word "zica" came up – it means squirrel -she explained the word is really a description and it literally meant– yellow– stretch – the color of the squirrel and the action it does when running. Just as banana is zišcopa – "crooked yellow." One student asked to get a drink of water "Mni yatkapi waci he?"
>
> Her Lakota language work book is interesting. The personal introduction for individuals was on the board. I wanted to copy some of it down. I think I should be sitting in on her class since I am not a speaker of the language. Her workbook has listed all of the shapes, directions, and numbers...Some of them are obvious ones – others not so..._____ had also mentioned that she was not allowed to speak Lakota at school a long time ago (when she was a student) which is why it is such a privilege for her to teach it now.

In another observation setting I had written:

> I also sat in on _____ 6B Lakota class during the math teacher's prep time. She went through a "how many" exercise or a "what is this" exercise. _____ has her method of writing something on the board, having students write them in their journal with answers and then has each student read each question aloud one by one. Once that is done she provides them with a worksheet and they do it – today was a number sheet - she got to talk to the kids as time went by, talking about horseback riding, and how she grew up. Some of the kids gravitated to the conversation. They also talked about Hand Games and some of the kids talked about how they played. There were two in the class that play for Loneman (they have a hand games team) and they will be going over the rules and playing on Thursday in her class, so I will observe that in her classroom. She also mentioned that she will be teaching how to build their tȟipis and will be getting started on that shortly.

As can be seen above the content of the classes varied. There is typically more than one subject covered in classes. In one setting, towards the beginning of the year the content was geared for students to be able to introduce themselves in social contexts. However conversations occur, such as seen in the snippet above, where the topic switches from topic to topic - Hand Games, riding horses, etc.

On the walls and on the board in the classroom are phases and words written both in Lakota and English. I will provide comments from my observation notebook about what I saw on the walls and on the board in the middle school Lakota classroom.

"On the board was the date: Canwape Gi Wi (Sept), Anpetu Yamni (wed), Sept. 2, 2009.

On the board was also the word the following:

"Yesterday's work: "Write an introduction of yourself, your *tiwahe* (family), both maternal and paternal. Next week you will introduce yourself in class in Lakota.

Mitakuyepi (all my relatives)

Le Anpetu Kin cante waste,

iyuskiyan nape ciyuzapi (Today I shake your hand)

Chaze _____*emaciyapi*

_____*ematahan*

Tiwahe mitawa kin _____,--number goes in here - (my note.)

Lenakicapi yelo/kisto

male/female

big brother - *tiblo*_____*pi*

little brother - *mishunkala* _____*pi*

Big Sister - *Chuwe kin* ____..."

This was the main lesson of the day. The students were to commit these to memory and were to be assessed individually orally on correctness of pronunciation. On the walls of the room were many bi-lingual phrases. The walls were littered with many Lakota cultural posters and phrases. Some of these included the directions and their respective colors which were:

Itokagata (to the south), ska (white);

Wiyohiyanpata (the east), zi (yellow);

Waziyata (the north), sa (red);

Wiyohpeyata (the west), sapa (black)

Wankatakiyata (upward)

Makatakiya (to the earth - downward)

On the walls were all the months of the year, the seasons, the stages of life and names for the sexes and ages and names for various moods/emotions....Also on the board was the request to go to the bathroom, " Otaŋkaye ble wacin yelo." and to get a drink of water, " Mni yatke wacin."

It is my hope that by including some of the content that was being taught and also the materials on the walls along with literature in the classroom that the reader would get a better glimpse of the how the goals of the Lakota Content Standards might be achieved. In the push for oral fluency in the language, at least in the middle school level, is a broad inclusion of bi-lingual conversation and cultural images both in and outside the classroom.

I will include a snippet of the observation and content that I viewed during a fourth grade Lakota class below:

> I also was able to observe the teaching of _____ today. She came in and the kids became more intoned…you can tell she had control over the class. They sat in their desks while she at first handed out a paper to each student, then a student took over passing them out – as soon as she took them she said "*Lila waste."* And then said "*Pilamayaye*."

Then she continued:

"Today we will be bilingual, *ohan*?"

The class responded "*Ohan."*

"_____read, rearrange the sentence to make it sound better in Lakota."

"I want you to be quite – *inila….inila yankape*."

Oh, I forgot to go over the word list.:

Inazin – it has two meanings, stand or stop
Inila – quiet
Yanka – sitting
Psica – jump

*Lech*i – over here
Anagopta – listen
Iyanka – run
Epaka – touch
Iyuha – all of you
Wana – now

"_____, *nish'aha owaye*." Which I gathered to mean "You read it."

_____, *icitopa*

U = come

Lechi – come over
Lechi u – come over here

Inila na anagopta

Sakowin –
"*Taku he?* what is it?"

"Let's say *psica* the kids all repeated it *psica* - then she said, not pizza and laughed (made me laugh as well)

In Lakota the "I" and the "e" are prounounced "e" = "e"h and "I" = "e."

She then handed out another paper and said, "*Le sunka wankan heca."* I don't want a *wasicu* answer.

Ho hu cha wanke – bone saddle

> She then went on to talk about the war plume and the fact that only warriors who have achieved lots of feathers could wear one…the great warriors – something your ancestors used to do…they were great warriors.

What about the hand symbol painted on the horses butt, what does that tell anyone who sees it?

Students answered – it means the warrior is a leader. – he's a fierce warrior.

> She says again, "*Ho hu cha wanke* – Nowadays you have a leather saddle back then they had to bone saddle. Can you imagine riding around on a bone saddle? They were excellent horsemen…How many of you have horses? A lot of the students raised their hands.

Toka – enemies.

> What does the red mark on the forehead and scalp signify? It means that the person whose forehead and scalp are painted red is a warrior who killed a lot of people. Dancers nowadays do this and even women dancers, they cant' use that, nobody tells them these things. Crazy Horse was a warlord.
>
> A student asked the teacher if it was true that he was the great-great grandson of Sitting Bull? She said yes and that many of them were descendents of great warriors…and then added. Whatever *unci, kaka* (grandma and grandpa) tell you , it's true…

Mato Nashni – band of great – tiospaye.

Again, within this short session is found various Lakota words, grouped together in categories - the first were commands, the second dealt with the horse and the meanings of symbols related to their warrior's achievements. Also present were the names of dances, and how they should pay attention to their grandparents "Whatever they say is true." and a connection to the past - Sitting Bull. I was able to sit in on one other 4th grade Lakota class. The topic of this session was the weather:

"_____came in to do the Lakota class. Here is what they covered...weather was the topic of the day:

First the date was expressed:
Ista wicayazan wi - March
Ake sakpe – 16th
Anpetu numpa – Tuesday

Then she spoke a phrase they were to recognize "Lakol Wichoiye" which meant - "Lakota word."

And she proceeded to mention words that dealt with the temperature outside:

Thankal – outside
Thankal maste – sunny outside
Thankal hihila – muddy
Thankal opichake – pleasant,
Thankal okalaye – it's warming up.

Then she shifted the topic, asking one of the boys in Lakota what his name was and how to express it in the langauge.

Taku iniciyape he? Hoksila says hwo. – What is your name?

His last name was New Holy - so she translated it in Lakota for him:
"Teca wakal – New Holy"

She asked another student her name, she said Brown Eyes - The teacher then translated it for her:

Istagi – Brown Eyes"

"Omaciyapi"

The topic then switched again, this time to how one is feeling emotionally:

Tayan waun na nish – I'm fine and you?
Omakisni – I don't feel good.
Mable hecha – I feel better.

Inikakiza he? Do you have a problem?
Imakizize – I have a problem.

Finally she asked them:

"Tukte hetan." – Where do you come from?

A person who worked in the cafeteria then walked in with snacks for the students. The Lakota instructor said

"We even had a word for snacks - *unweya* – goodies , back then it was only buffalo jerky and *wasna*.

> One kid was wearing a t-shirt that read: "*Techa Wacipi Okolacice*" and the teacher asked him what that meant and that they had gone over it before…no one knew – she said "New Dance Organization."

Then the students watched the film Into the West – the portion that dealt with the Sand Creek Massacre.

What is of note in these observations is the way the teacher connected what they were discussing to the students - the weather and how it might impact the moods of the students along with their names and a connection again to the language - for the names were originally given in Lakota - each kid's name has a meaning and an origin. Finally, the snacks were also expressible

in the language - I think it was/is important for the teacher to connect the activities of the day - something tangible - to the culture and language - it is still around and vibrant.

The last observation I did in the Lakota classroom was at the kindergarten level:

> The teacher held up pictures of various objects and the students gave the Lakota words for each object or color, pencil – *wicazo,* school – *owayawa*, book – *wowapi*, owl – *hinhan*, black- *sapa, ska* – white, *thozi* – green, *zisa* – orange, *sa*- red, *zi* – yellow.

"*Le wicazo hecha*…" This is a pencil.

Ista wicayazan wi. - the month (March)

> She also talked about the weather, *magazu, osin* , sunny, rainy, and then when the kids were not behaving, she said "*Nunge wanice*" – "no ears. " and explained this meant they weren't listening.
>
> *Inila* – quiet. She then read a story about Crazy Horse, the same one that was read at the "Healing Circle" – that was held with the 4th and 5th graders today…She read it in English."

Informal Curriculum

Besides the teaching of the Lakota language and aspects of Lakota culture in the schools there was a focus on history and spirituality found in the places in which the school took students - the school took students to different historical and sacred Lakota sites throughout the year. During my study three such trips occurred (I was able to participate in only one of these trips). These trips included a buffalo hunt for the middle-school male students in Allen, SD, a trip to Beaver Wall, SD (the supposed burial place of Crazy Horse) and a trip to Bear Butte near the Black Hills. In a document report by 21st Century Program for the previous academic year trips to Devil's Tower, the Gore Buffalo Jump, Bear Butte, *Inyan Kara* (by Sundance, WY), and the *Isnati* Rite were taken. During the academic year of this study other places were visited. These included Medicine Wheel, Hudson Ming, Cascade Springs, Harney Peak, Crazy Horse Monument, Wounded Knee Massacre site, Little Big Horn and the Rosebud Fight site. Many of

these sites, as we saw, were concerned with religious sites which correlated with the movement of various constellations. The other sites dealt with major Lakota historical events.

Another way in which culture and language were included in the informal setting was the weekly morning prayers held the first and last day of the week. I observed a few of these occasions and took notes of them in my observation journal. I included the descriptions of a couple of these below to give the reader an opportunity to see the use of prayer, songs, and the use of the school drum group in the teaching of Lakota culture and language outside the classroom:

> I went to the bleachers and sat down a row behind _____, who seemed to have been consoling a child. Oh, yeah, when we walked in we could hear the sound of the drum being beaten and someone singing Indian songs. I walked in and smelled the air...realized that some smudging must have occurred in the gym. Anyway, I sat down on the bleachers and surveyed the scene. _____ had a group of about 8 boys – presumably 7th/8th grade boys around a drum, they were not singing but holding their drum sticks, the music I had heard was coming from a loudspeaker…in the interval, between songs, a voice describing the spiritual significance of the pipe – the *chanunpa* – could be heard. As a student at Loneman I had never witnessed anything like that. I asked _____when they started doing this, he said that _____ had instituted the prayer days back around 1992.
>
> When all the students were cleared from the gym floor the gym teacher and the principal moved the podium up to the front of the bleachers and began speaking. "*Hihanni Waste*," she said. All the students in chorus responded "*Hihanni Waste."* Good morning she said, good morning was said back.
>
> Anyway we got done and _____ took over again and told the students that a prayer song was going to be sung and then the flag song. _____ had his group sing the flag song and a prayer song. Everybody stood for both songs. A young boys voice could be heard in that singing. Also, before the songs started four young females walked up to the drum and stood around it, reminiscent of how women gather around the drum during powwows. Then afterwards _____ stood up together with the other Lakota Studies staff, including _____. They told the students, that starting with the pre-school students they would line up each class and they would get a handful of corn-*wasna* and a drink of choke cherry juice. Teachers in line also got a bundle of sage and a pine branch wrapped in red yarn. We all went through the line.

There were many cultural symbols included in this morning prayer (the first of the year). The use of music, explanations of the *Chanunpa*, smudging, and the sharing of *wasna* and choke-cherry juice along with the giving of sage to staff members all speak of cultural roots within Lakota culture. The use of the language in addressing the students and the flag song at the end all give the casual observer explicitly that this was indeed a Lakota school.

On another morning I made notes of the morning prayer:

> _____ walked in with a group of students – one was carrying the drum over his shoulder the others laid the wood that the drum sat on - on the floor in the form of a cross. The boy laid the drum on it…others climbed under the stage to grab a few chairs to put around the drum…Three seventh and eighth graders got up from the bleachers and walked down followed by three girls. There was the sound of some drumming.
>
> _____then said an inaudible prayer and the students did a rendition of the Flag Song. The verse was run through three times…

It is the use of settings such as the one listed above that continues to impact students in learning about the culture. Many students "Dance Indian" and are part of a dance group at *Isna-Wica Owayawa*. Many participate in the sweats and learn the songs around the drum. I was a participant in the back-to-school powwow where the staff and community members were fed. Each staff member was introduced and was encouraged to dance during an honor song at the beginning of the powwow. There was even a healing ceremony held prior to the powwow to help those in the community who were grieving the recent loss of a loved one.

Conclusion

The teaching of the Lakota language and aspects of Lakota culture are deemed important at *Isna-Wica Owayawa.* All students take a Lakota language class. In the language course the structure of the language is studied, attention is paid to male and female speakers along with formal and informal speak. The course is geared towards oral proficiency. The Lakota language class also focuses on cultural values, cultural activities, like Hand Games. It also focuses on

Lakota family structure and an understanding of relationships therein. In addition to what occurs in the classrooms students are taught informally about Lakota history and religion. All students have the opportunity to attend field trips to sacred and historical sites. Some students participate in sweats and become members of the drum group and dance group. Taking the Lakota studies as a whole we see that it is just not the language that is taught but also spirituality, the Lakota way of life and history.

Given all of these factors we can say that *Isna-Wica Owayawa* has been greatly impacted by the principles of self-determination - that is, the local community controls the education of the students, which in turn includes the teaching of culture and the Lakota language. Community members have devised a Lakota Studies department that oversees the teaching and learning of Lakota culture and language and also provides informal and formal direction. What about the teaching of mathematics?

Chapter 11: Part III - Self-determination and Mathematics at *Isna-Wica Owayawa*

We have now completed what I have deemed as two necessary precursors to looking at the impact of self-determination on the teaching of mathematics at the local level in Oglala. The first was to define "Lakota mathematics" by way of cultural contexts/activities and verbalization of mathematical concepts within the Lakota language. The second was a look at how self-determination was verbalized and implemented into the schools by way of activities, mission statements, direction provided by administration, curriculum, images and designs in the school. Let us now turn our attention to the third portion of this study: How has self-determination impacted the teaching and learning of mathematics at the local level in the Oglala community, specifically at *Isna-Wica Owayawa?* It is in this section that we can answer questions about the use of the Lakota language, cultural activities and the local geographical context and local community topics in the mathematics classroom.

What reasons were given for how the mathematics curriculum chosen?

Regarding the reasons for choosing the *Saxon* curriculum, which I described briefly in the methods portion of this study, I talked directly with an administrator who was in charge of determining the mathematics curriculum. The first question I asked centered on the importance of mathematics. (In the scheme of all these things, how important is something like mathematics?) Her response stemmed at first from theory, then by practical daily uses of mathematics.

> I guess looking at it from Mazlow's Hierarchy of Need - You need to be able to make sure that those basic needs are met: food, shelter, clothing, water. But in order to do that, you have to figure out, "How much water do I need? How big a space do I need for my family? How much food do I need to have? How do I access that?" So people don't think that they're using math skills in doing that, but they do. In your everyday life, everything that you do in your life, there's math skills, and people don't see it that way because of how we teach math. We teach math from a book perspective, and a work page perspective, a worksheet

> perspective. You do these problems. You go through the page left to right, top to bottom, doing those, and then you turn around and when you ask somebody about doing math, they say, "Oh, I don't want to do math! I had to do all those worksheets! I didn't like the textbook...When you take it back and relate it to life and talk about those things from a life perspective, they use math every day. So I think we need to change how we teach math so they see it from that perspective.

This was an interesting response given that the curriculum choice was *Saxon* Mathematics, which is notoriously problem-set driven with an emphasis on repetition. So I pointed out the apparent lack of cohesion between how she viewed mathematics, as embedded in daily activities (needing only to be highlighted in order to be appreciated) versus the *Saxon* philosophy. I stated,

> (Interesting, though, you chose to go with *Saxon* all of these years. What's the reasoning behind coming with *Saxon*, which seems to come from the repetition, rote-type of mentality where you're going to get 30, 39 problems a night, and you're going to see some of the same problems over and over and over again. What was the reasoning for *Saxon*?)

Her response was telling in many regards. First, when she started in her current position the choice for *Saxon* had already been made and to try another curriculum would not have made practical and monetary sense. The second issue she points to is the influence of state standards and accreditation - *Saxon* aligned well with state standards.

> Well, originally, before I was the _____, it was decided by the previous administration that that was what the school would use, and the textbook aligned itself with the South Dakota content standards. And that comes back to that English education of being able to be in compliance with that, those requirements of being accredited. So we choose South Dakota accreditation, and in choosing South Dakota accreditation, we've got to follow their content standards. We need to—and they assess from that perspective, so we need to have our teachers teach from that perspective. So that's where the *Saxon* Math came in.

She added:

> The school spent pretty near $100,000 buying all of the curriculum, that particular math curriculum. That was a huge investment. No sense in changing it when you just bought it.

She makes the distinction here that not only is it the materials that are needed to try to better student scores on the state assessments but to also teaching a certain way - the *Saxon* way. This is part and parcel to the *Saxon* philosophy. Deviating from these modes of operation, it is viewed, lessens the effects of the curriculum. The rhetoric of research done with Saxon curriculum touts a tentative correlation between better state scores on the CAT (Resendez & Azin (2007) and the Texas Statewide Assessment (Resendez et al., 2006). I am not so sure that the same kinds of correlations can be made about the use of *Saxon* at *Isna-Wica Owayawa* and better test scores especially regarding what we have already seen with students' math assessment scores as measured by the BIE. However, the assumption persists - an assumption that maintains fidelity to a certain curriculum and teachings style would benefit the learning of mathematics at least in relation to test scores.

"Fidelity to the program" is something I heard often when it came to teaching mathematics during my short time at *Isna-Wica Owayawa*. Fidelity to the program stems from this notion that curriculum coupled with teaching style and a need to follow its protocols will lead to better test scores. In several conversations with the math teacher about the requirement to teach a certain way and to stay faithful to a certain curriculum because of restructuring we see first that this is made very explicit:

> Well, we're under the restructuring, so according to the restructuring, we have to follow our math and our reading program exactly the way it's supposed to go, so that if the government comes in and says, "Your test scores are still too low, why?" we can say, "We're using the *Saxon* Math program." It's proven that it works. And if I can't say that I'm not doing it exactly, I'm not following the program, then the school's liable. So I have to do it exactly to the T.

In a letter from the School Board President, concerning restructuring, it was stated,

> The school has been placed in Corrective Acton status for the past two years and prior to that time period, the school was placed in School Improvement. This occurs when a school fails to make Adequate Yearly Progress (AYP) as a result of low standardized test scores in Language Arts/Reading, and Mathematics, low student attendance in Grades K through 8. Adequate Yearly Progress is the progress needed each year to have all children proficient and advanced by the year 2014 according to Public Law 107-110, the No Child Left Behind Act.
>
> In this same letter it was stated that "Isna-Wica Owayawa/Loneman School uses the state of South Dakota's Accountability Workbook to determine Adequate Yearly Progress. Therefore we are required to use their standards.

Here it is the requirement, made explicit, that deviation from content, pedagogy and assessment, is not to be tolerated since it is a way of proving that *Isna-Wica Owayawa* is not at fault for low test scores (should they occur), at least in the math classroom. From my journal notes, which were written towards the first week of my study, I noted the following:

> I asked him (the math teacher) what curriculum he was using - he mentioned he was using *Saxon*. He also allowed me to see a computer math program designed to supplement *Saxon*. It was a diagnostic program - to help pinpoint a students math abilities and to help place their grade level...He was wary of the software but felt like he was obligated to use it. I asked him about his goals for the year...he said he wanted the students to be proficient...

Again, being proficient overrides other reasons for teaching and learning mathematics. So, here the goal is to satisfy state standards. This may not be a surprising result but it implies that an inclusion of other ways of teaching or other materials used to teach mathematics are to be left out. This precludes having principles of Indian educational self-determination impacting the math classroom. That is, using Lakota cultural contexts and language in the teaching of mathematics, since it would deviate from the curriculum and the methods used therein, cannot be

a part of the mathematics classroom. The administrator in charge of setting the curriculum added to this. She did see issues with it but it seems, her hands were tied as were the math teacher's.

> And then, in order for it to be successful, research says that you're supposed to maintain the fidelity of the program. However, that's been a struggle for our teachers, to do the fidelity of the program, because our students struggle with reading, and there's a lot of reading required in math. We got to a point where we were so far into this, it was hard to back out of it. So that's where we're at and that's what we're doing.

I want to include a little more of my conversation with the math teacher concerning the use of *Saxon* curriculum materials and its impact on his teaching - especially in light of the fact that the school was under a period of "restructuring" whereby fidelity to the curriculum was non-negotiable. I talked to the instructor first about what he viewed as important in teaching mathematics at this level:

> So I think it's important that we get those foundations down. That's part of the reason why I wanted to be in the lower middle grades, just to make sure that they had that foundation, because some of the stuff in algebra, some of the stuff in geometry you don't use most of the time out in the real world, depending on what job you get. But your basic multiplication, division, subtraction is really what I wish that I could get 100% mastery for.

(What do you think of the *Saxon* curriculum you are using?)

> There are some parts that I like and some that I don't...I like the review that they do on the assignments. But I wish they would spend more time with certain concepts. Spending one day for...this class would be long division.. should spend more time on it. I don't like that part. They do jump around too from topic to topic. The flow is not that good.

(So what do you like?)

"The practice is great. I love the practice...the more the merrier. "

(How do you find it impacting the way you decide to teach students?)

"Most of the time it doesn't bother me much. But sometimes I am just like you know I wish we could cover this topic before we cover this topic."

(Do you think it is beneficial to the students to be using *Saxon*?)

> Tough call. Yes and no. I know it seems to be a lot...30 problems a night, a day...plus the practice you know its...it can be very easy to go whoa I am so overwhelmed, especially the students. I don't know...

(What are some of the other types of materials or activities you would be using or doing in class if you'd do things your way, rather than havin' to be faithful to *Saxon* all the time?)

> I've done units with kites for geometric shapes, triangles. I've also done units for Pythagorean theorem for measuring heights of rooftops, towers, buildings. I've also done a lesson dealing with—like, for the frequency tables and graphs using M&M's, Skittles. That food gets 'em, that candy gets 'em sucked in.

(Do you wish you could incorporate some of these other things, especially at this grade level?)

> "Yeah, I do. I think the kite one is a lot of fun for the kids, or at least the kids had a blast doin' it, but that was at an algebra level, and we don't have an algebra level here. We do have a couple units where we do touch with the geometric shapes, but it just touches. We've discussed, but it doesn't go in depth.

So essentially the requirement to be faithful to the *Saxon* text is constraining in some regards, especially in incorporating other ways in which to get concepts across - the use of candy in distributions, for instance. However, the teacher appreciated the extra practice especially since the practice allowed students to continue working at what he deemed - important developing good arithmetic skills.

I mention the things above with a caveat - I was not around during the discussion of what it meant to maintain "fidelity to the curriculum." This could mean different things to different teachers. I was under the assumption, after talking to both the math teacher and the administrator, it meant that any deviation from the lesson plans -from the order in which the material was presented and the use of assessments not offered from the *Saxon* curriculum materials - was not to occur. Clearly a teacher could use manipulative in the classrooms - such as candy, in creating an understanding of frequency and statistics while doing a lesson from *Saxon*, i.e., other sources could have been used to supplement the materials - this would seem not to violate fidelity. Having taught with *Saxon* as a high school math teacher I used supplemental

materials to try to help students gain a understanding of the topic at hand. Given this I did make note of a conversation I had with the math teacher about three weeks into this study centering on his concern of his student's math abilities and his frustration in not begin able to teach to some of their weaknesses,

> It seems there is too much thrown in together in the texts and it seems discombobulated. I talked with ____after school today and shot some questions by him. I asked him first about his take on the situation of some of his students. He felt they were at the third grade level. That he wanted to deviate from the *Saxon* text but that he was explicitly told by the _____ to be faithful to the curriculum…do all problems A through whatever, and numbers 1 through 30. You are talking about roughly 40 problems a night. ____wants him to do a lesson per day. He said he was able to barely get through 3 lessons last spring. I feel like he has his hands tied on this one - coupled with the fact that he is a first-year teacher doesn't make it any easier.

The elementary grades I observed all were taught directly from *Saxon* texts from my journal:

> _____ was teaching class today – straight from the *Saxon* Book – examples and all. Students went over PEMDAS and named line segments. The more I look at *Saxon* the more I think it is not a good fit – I taught it when I was at Chinle but I was not dedicated to it, I supplemented it with other work, I can't imagine teaching it the whole year to such young students.
>
> I don't think sitting in the classrooms is going to give me what I am looking for. There is obviously a disconnect between Lakota and mathematics both in the classroom and in the language…this isn't to say that there isn't mathematical activity in the culture, it is just to say that most people (all that I have talked to) have not thought about how to express the mathematics in Lakota. What does this say? What does this mean?

I observed both the Lakota class and the teaching of mathematics at the kindergarten level. Prior to the class I asked her what curriculum she used – it was *Saxon* all the way from Kindergarten through the 8th grade.

The choice of *Saxon* as curriculum was pragmatic. Research has shown that it has the potential to raise standardized test scores, it aligned itself with state standards nicely, and it was

what was in place when the administrator first started - why purchase a whole new set of curriculum materials when so much money had just been spent in bringing these materials in? What was not taken into consideration was the impact of *Saxon's* rigid philosophy on student learning (outside of test scores) and whether or not it was a good fit in the classrooms at *Isna-Wica Owayawa* and also if it was flexible enough to allow Lakota culture to be taught in conjunction with the text, if it was so desired.

Self-Determination and the Mathematics Classroom at Isna-Wica Owayawa

Despite the expressions of self-determination within the community of Oglala, among the administration, Lakota teachers and community, coupled with the copious amount of cultural contexts and Lakota language available for use at *Isna-Wica Owayawa* I found no evidence of inclusion of self-determination principles within the mathematics classroom. That is, there was not present any use of the Lakota language in the classroom nor was there any use of designs/concepts nor attention given to what the Lakota culture has embedded in it that would pertain to mathematics. There also was not present any form of the six universal mathematical activities as they pertain to Lakota culture. There was one instance that I observed where I saw a local context used in the math classroom. It occurred when the teacher inserted Rapid City in place of a location in an example he was doing to illustrate a type of problem. I noted this because it was one time local context was used:

> _____ had finally gotten around to doing some math with this group of students. He was still doing problem solving with four steps. He used the same initial problem-type but instead of Island and mainland he used "going to Rapid City" so he adjusted and tried to make it a little more relevant to students.

Outside of this there was nothing within the mathematics classroom that would have told me I was in the Oglala community let alone on the Pine Ridge Reservation. This includes

posters, phrases, books, literature, numbers, etc. I can recall as I sat in this middle school classroom that I could have been anywhere in America except for the fact that I had students in the classroom who reminded me that I was indeed in Oglala.

One goal of this study was to find evidence for the inclusion of culture and language in the mathematics classroom and then to try to explain its inclusion (and how this was accomplished) or to look for reasons why it was not yet included. Having found no evidence of Lakota language and culture in the math classroom the purpose now becomes to try to explain why it is not, especially given that there are indeed many ways in which it could be included. As it stands, there are some reasons for the complete absence of Lakota language and culture in the teaching and learning of mathematics at *Isna-Wica Owayawa*. The first rests in the teacher himself. He was non-Indian, not from the community, and a first year teacher. The second is a lack of influence between those of the community (including Lakota language instructors and administrators) with content in the mathematics classroom. A function of this was a lack of dialogue between the Lakota Studies Department, its teachers and the teachers of mathematics. The reason for this lack of communication, I posit, rests on a general view of mathematics as something distinct and not stemming from culture. Lakota language instructors had not viewed many of the things they were doing in their classroom as mathematical in nature until our discussions commenced. Once this became apparent a new perspective began to develop. The Lakota Studies Department could have been (could be) a huge resource to the mathematics teacher in the push to include Lakota culture and language in the mathematics classroom. The third is the stringent guidelines placed on the teaching of mathematics that results from not meeting AYP.

The Teacher

It is too much perhaps to ask a first year non-Native mathematics teacher to integrate what he is teaching in the classroom with Lakota culture especially if he has had minimal contact with the culture. It is hard enough as a first year teacher to teach, to figure out how to assess students, to establish methods to discipline students, to become versed with new school settings/expectations, and to develop a teaching style with strategies in which content can be taught effectively. Teaching, with all that is involved, is enough for a first year teacher. Being a non-Native teacher, new to the Oglala community hinders the inclusion of Lakota culture in the classroom even if it was a goal of a new teacher to do so. What should he include? Does he have a good enough understanding of what he is including if he does it? If he has no knowledge of the language then it becomes a mute point to try to find cultural comparisons in Lakota expressions of mathematical terms and concepts. In short it is something a teacher could do over an extended period of time with interaction and guidance from the Oglala community and the Lakota staff at *Isna-Wica Owayawa* but something a new teacher, new to the community, would not be capable of doing.

As we have come to see over the course of this study, there are myriad possibilities for local/cultural contexts in which to teach mathematics. This holds true especially after the teacher becomes comfortable in his new skin as a teacher. Once he begins to branch out from focusing on learning how to teach and eventually on what to include then the process of integration can occur. In talking with the teacher he was already curious about aspects of Lakota culture and had given some thought to including certain things. " I want to learn how to say the numbers. _____ (has) given me some stuff. (or how to say) “I want to go to the bathroom,” stuff like that, so that I can link it that way, because...now I am gettin’ a lot more interested in the Lakota

culture..." The math teacher was also enthusiastic about and open to the idea of eventually incorporating Lakota culture in his classroom. I asked him: (As a math teacher, and being fairly new, would you like to have been given some of the information so that way you could have connected the Lakota culture to the mathematics?) "Oh, yeah. Oh, yeah." However, in order to do so, those who are capable of teaching him aspects of Lakota culture and guiding him in this process have to shoulder the responsibility. Both the local administration who guides the teacher in what he needs to do as a teacher and what to teach by way of curriculum materials has to make it explicit that this is what needs to be included if they are concerned about integrating Lakota culture and language in the classroom. From there the responsibility falls on the Lakota Studies Department.

One of the possible ways of getting this information across to math teachers new to the community is to host a "cultural" orientation. In this orientation making explicit the connections to mathematics and Lakota culture could occur. I had mentioned the possibility of having an orientation for staff members coming into the Oglala community with an administrator. She had already thought of the idea since it had been brought up in the community.

> Having a cultural orientation has been something that has been brought up many times. My struggle, and it's not just me, the money that we get, there's strings attached to it. So we have to comply with those. I come back to where we talked about the primary language. My hope is in putting some emphasis on proficiency in the oral language, and over a period of time, we'll be able to reach that point of helping people who teach in these different content areas come to the realization of, "Hey, I can do this a different way. It doesn't have to always be this way." And I can't change everything overnight. It takes a long time.

Bradley (2000) documented this sort of thing was when the American Indian Science and Engineering Society (AISES) held summer Science Camps during the summers from 1997 to 1999 in Fairbanks, Alaska. In these camps elders taught students crafts and were used as cultural

resources to help guide students in their study of science. It was viewed with much enthusiasm and success. Something like this can occur with new incoming teachers at *Isna-Wica Owayawa.*

No interplay or communication

The second factor that hinders the integration of Lakota culture and language in the teaching of mathematics is a lack of communication and interplay between the Lakota Studies Department/staff and the teachers of mathematics. Some of this can be traced to a certain view of mathematics as "just numbers" whereby it has its own place and its own contexts, that is, in the math classroom. Many times I felt when talking to elders, community members and some teachers about mathematics that they viewed mathematics strictly as an in-school/in-class activity. It really had not been looked at as something they did on a daily basis and therefore something left to grow on its own. Thus perception of mathematics was an important factor in the lack of discussion between Lakota speakers and mathematics teachers. Lakota teachers concentrated on teaching the Lakota language and culture and math teachers concentrated on, well, teaching mathematics.

Math seen as just numbers, something to be woven arithmetically into the already existing mathematics fabric (only) and neither as a language nor as a tool nor something that is culturally dynamic seemed to be the view of the mathematics teacher as well. His description of mathematics as "concepts," which did not give a clear description of mathematics, leaves more questions than answers pertaining to what his view of mathematics was. From his perspective mathematics is "...the use of numbers and concepts. Not necessarily numbers, it's the concept. Once you learn the concept, you can put any number you want in that concept and it'll work." What this means exactly I am not sure. To try to glean meaning from his answer, I also asked him about his goals in teaching mathematics at the middle-school level. He stated his goals were

to get the students to be able to understand how to do arithmetic and also have good number sense. His words were, "...some of the stuff in geometry you don't use most of the time out in the real world, depending on what job you get. But your basic multiplication, division, subtraction is really what I wish that I could get 100% mastery for." From his perspective, if I can get understanding from his comments, once an understanding of the basic arithmetic operations and number sense was put in place then effort could be made to look for connections outside of the classroom in daily life.

From my observations I believe I was able to see that he did emphasize understanding in arithmetic and he did try to help students come to understand number sense, yet the connection to the outside world, as I alluded to above, was missing in his teaching, at least in the classes I observed. What I am trying to illustrate here is that not only was the perception of mathematics from the local community a hindrance in integrating mathematics in the local classroom but so was the teacher's perspective. Both viewed mathematics as numerical - with arithmetic operations as a key component of this view. This view, though capable of incorporating local context and culture, excluded such things as reasoning, explaining, and playing.

To expound on the importance of perception for a little while longer I want to focus on the changing view of mathematics as I had discussions with Lakota teachers. At first when I asked Lakota teachers about mathematics they would describe it similarly to most of the participants I had talked to earlier. That is, mathematics is "just the numbers, adding, subtracting, that kind of stuff..." Yet as we progressed further into the interviews and I continued to try to see if they had a deeper view of mathematics, whereby I'd mention things like estimating time when traveling at a certain rate or in the measuring of ingredients for cooking their descriptions of mathematics changed. I asked a teacher to look again to see where math

might be present in her daily life. "Math in general…yeah, I see it all the time... Ahmm…well like even in the kitchen. You go how many you get, how many do you take away…or when I am ordering supplies…everything that you do has something to do with math." If you recall the administrator I interviewed spoke also of the uses of mathematics within the daily lives of students - practical uses. "When you take it back and relate it to life and talk about those things from a life perspective, they use math every day." She finished this by stating something I think is crucial to integrating culture in the classroom - "So I think we need to change how we teach math so they see it from that perspective." In order to include Lakota culture in the classroom, so that the mathematics can be related to a life perspective, a cultural perspective, the approach to teaching it has to change. If students are going to see it as something useful in their lives, the angle in which it is presented has to change.

If Lakota culture is to be included the presentation of mathematics has to make explicit these connections to daily life. Some of this can come from the framework we built whereby mathematics was shown in Lakota cultural activities and language. We saw in designing and locating from a Lakota perspective some very rich symbols and some deep connections to the spiritual realm. For example we saw a predominance of symmetry in Lakota beadwork and in Lakota designs in general. We also saw in locating the Lakota cosmological phrase, "What is above is below." Can it be that extensive use of symmetry in bead and quillwork has its roots in this Lakota cosmological understanding? If so, how much richer can a discussion be in the push for the understanding of how symmetry has been used in mathematics? Again, in locating we saw attention paid to both the stars above, to ceremony and also to economy and life, especially in following of the buffalo herds. Can we not begin to ask some interesting mathematical questions concerning the relationship between the buffalo and the Lakota? Can we not also

come to appreciate mathematically the vastness of the Lakota territory, the distances they traveled and the impact of the horse as a radical new variable in the life-ways of the Lakota?

In another context one can ask the question, "How do the Lakota count?" In explaining how the Lakota count other questions arise. For instance, "How is place value noted in the way the Lakota count?" or "What numbers can be expressed in the Lakota language and what can't?" These discussions might help students come to understand that the jump between counting numbers/rational numbers and irrational numbers is actually not an easy one to make, culturally speaking. We can show historically that other cultures have struggled with notions of irrational numbers (the Pythagoreans had issues with the square root of two, did they not?). The discussion on numbers might then lead to cultural contexts for the development of important mathematical ideas such as the use of the number line as ways to represent sets of numbers. This in turn can bring to light the usefulness of mathematical tools used to help represent relationships seen in nature - which in turn can help students see mathematics in phenomena all around them.

Throughout this study I was able to see that mathematics was given space within the Lakota classroom especially in regards to counting in the Lakota language. (It was and is a part of the curriculum and as you may recall, counting was included in the Lakota Studies Standards.) It is worth noting that I saw them as mathematical in nature whereas the Lakota teachers didn't necessarily see them as such at first. As our discussions progressed their views on what they already did in the classroom shifted. They eventually came to realize that they were teaching and doing many mathematical activities in their own classrooms, they just hadn't seen these activities as such.

One Lakota instructor, who had described mathematics prior as "numbers" had already seen the value of trying to teaching Lakota numbers and arithmetic in her classroom, albeit in an

unexpected way. She thought that teaching Lakota numbers was an excellent context for illustrating to students the important process involved in going from English to Lakota and vice-versa - the switching in the mind that is involved in going from one language to another, from going backwards to forwards, and backwards again:

> I think it kind of opened up a little bit the way their thinking is…I need more…and then I put in Lakota like takeaway and add. I tried to get them into that, and then the numbers, you know you have, you are counting clear up to like a hundred, and that's all Lakota, it all has to be…and it was really hard for them at first. They would say "This is really hard" lču or yuȟeyab, it was hard for them to get the idea of it but when you would say in English, this is just this and this, "Oh" you know…(laughs). Yeah, I try to explain it to them…but I try to do everything in Lakota so their brain is like switching to that more often because they get all the English they want out there. The more I can get in their head here and they're thinking can say oh okay, so this is what this means, and it helps them I think a little bit...

It wasn't just numbers and counting that she used in doing this. She brought in quite naturally arithmetic - adding and subtracting. During our discussion about mathematics and Lakota culture she began to see connections between the two in other projects she did, especially in the construction of miniature tipis,

> Yeah you can, because you have to have a circle, that's the bottom of the tipi, or circumference, you have to center it, you've got to measure your tipi poles, you got to measure the fabric, and then you know…the design itself probably doesn't have to much to do with it, but it's just the construction itself, even the real-life tipi you have like 18 foot/16 foot poles…it has a lot to do with you know, how to construct it.

Other Lakota teachers - at the elementary level also saw some interplay with mathematics and what they taught in their classes, though they did not look at these activities as containing mathematics at first:

> I'd like to know more about that from whatever you can—because we never did implement ___. We do the numbers….Symbols and designs and patterns, they all have math in it, but it was never—We do it, but we don't think of it as math. Like

> a star quilt design, that's math right there. The shapes, that's geometry. I was talkin' to _____, he said a long time ago the men going to the creek area to cut wood, they cut posts, they call it wiyawa in second—first grade. But I don't go into details like that.

Toward the end of the conversation with these two Lakota teachers they made the following comments which leads me to believe that the integration of mathematics - made explicit - with the teaching of Lakota that is already occurring in the Lakota classroom might be fruitful for the teaching of mathematics in the math classroom:

> (I have also some manipulatives for fractions. Its in a circle. Its got halves, its got thirds, fourths. Its got all of those things...)
> 1. This is interesting. 2. I find it very interesting.
> 2. You really opened my eyes to a lot of ways to teach....You don't know it, but I'm receiving quite a bit. I'm also gonna take some lessons on that math you was talking about, ___.
> *2.* Unkuŋpikte (we can use that!)

In my discussions with Lakota teachers, when we looked at mathematics, and, in the process, (to borrow a phrase from D'Ambrosio) "demystified" it a new perspective emerged, one in which mathematics was no longer left to the mathematics instructor to teach, but one in which fluency in both the Lakota language and the mathematical language could emerge. Mathematics became usable, a tool, a language and a process. If mathematics can be shown to relate to life and is discussed from a life/cultural perspective, then it has meaning and purpose - it becomes dynamic and something we all do.

Part of the issue in integrating Lakota culture and mathematics is not only making explicit the mathematics found in cultural activities but also making known to the teachers of mathematics that there are available cultural activities available in which they can situate the mathematics in their own classroom. A line of communication between the Lakota Studies Department and the mathematics teachers has to open whereby the mathematics teacher

communicates with the Lakota instructor(s) and is part of the discussion in which he/she can be shown these contexts. In turn he/she can highlight the mathematics in the activities the Lakota instructors are doing in their own classroom. In essence they teach each other about mathematics and Lakota culture.

I had made some comments in my journal concerning the teaching of mathematics in the Lakota classroom and the absence of Lakota culture and language in the mathematics classroom. These thoughts reflect some of the things I have mentioned above:

> _____is a strong Lakota teacher with fluency in the language. She is incorporating mathematics into the classroom, and...is really using some of the six mathematical activities in the classroom...adding and subtracting in Lakota. She will be doing Hand Games and has present in her classroom the cardinal directions. There is no communication between what she is doing with what _____is doing (the math teacher). This might be fine since _____is non-Indian and a first year teacher at that. Asking him to integrate the Lakota culture into his classroom may not be a good idea.

The most important comment I made during my observations that dealt with the perception of mathematics was the following where I was comparing how mathematics was taught to how the Lakota language was taught, "Another thing to think about is how mathematics is presented in the math class. It is not presented as a cultural phenomenon whereas Lakota is." Again, what this means, is a lack of connection to life and the world and really the development of mathematical thought. Looking at it from this perspective would allow students to see that mathematics developed in cultures across the world and over time.

NCLB/AYP

The next factor that impacts the teaching of mathematics and the integration of Lakota culture is the heavy influence of No Child Left Behind (NCLB) and the need to meet Academic Yearly Progress (AYP). I have noted already the reasons for using *Saxon* curriculum materials

and also the need to be "faithful to the curriculum" as a way of appeasing the powers that be during the reconstruction phase that came as a result of not meeting AYP.

What I saw in the mathematics classroom was an approach to mathematics that was driven by the mandated "fidelity to the curriculum" mantra. What this meant was some curricular hoop dancing in order to satisfy the federal government due to an inability of *Isna-Wica Owayawa* to meet Academic Yearly Progress in both mathematics and reading. The reason to stay in line with the methods and curriculum of *Saxon* texts was the assumption that the materials and pedagogy developed by *Saxon* lead to higher test scores. And since they supposedly readily aligned to state standards were an easy adaption for use within the math classroom. What was not expressed was whether this was true over the course of the past ten years, hence justified as the best approach to meeting state standards. Also, what can't be answered but is a question that should be asked is whether or not it is a correct assumption to rely on any mathematics curriculum to raise test scores. A third question arises as to whether or not it should be test scores that drive the direction of the classroom content and discussions in the first place.

I have already discussed at length what restructuring and fidelity to the curriculum meant when I looked for reasons for the choice of *Saxon* curriculum. However, it bears repeating that this mandate was both acknowledged by administration and math teachers alike and as such was a heavy burden, especially when it came time to supplementing materials and adding activities to help aid students in learning concepts. It is clear that this mandate meant any deviation from texts would not be looked upon favorably. As a consequence excluding cultural contexts in the classroom was an implied part of this mandate. From the perspective of the first year teacher it was clear he knew what he could and couldn't do as a math teacher:

AYP/NCLB and Self-determination

What does restructuring and AYP/NCLB have to do with a push for self-determination in the mathematics classroom? Really the question pertains not only to the mathematics classroom but the direction of the whole school and really the issue of local control at the community level. Who decides the educational outcomes of *Isna-Wica Owayawa*? At this point, even though there is local control with a local school board and an inclusion of language and culture in various manifestations at the school one has to wonder, when looking at the issue of self-determination outside the context of the Lakota Studies Department whether or not the issue has been thought through. In the age of self-determination there is again more irony. If one is entirely a proponent of self-determination, with all the goals implied (self-sufficiency, fluency in language, masters of a bi-cultural education, producing students built for employment and also able to understand their own culture) one has to wonder why there is still the need to, if I may, dance to the beat of a different drummer? I understand the funding issues that come with strings attached. I also understand that the school operates within a system still regulated by the BIE despite the rhetoric to get the BIA out of the funding years ago. The gist of it is that the goal of self-determination, at least seen systematically in this local context, is not self-determination in the sense that one gets to chose an outcome individually nor does this happen collectively as a community nor as a tribe.

Self-determination as a guiding principal built in political rhetoric seems to be a call to stay in the gray area that is described by the language developed by Chief Justice Marshall some two hundred years ago. In that language are two phrases that have been the cornerstone in how the federal government interacts with Indian tribes, "quasi-sovereign" and "domestic dependent nations." These two phrases suggest rather plainly that full sovereignty is not possible - that it is

always regulated. It is "given" to the tribes, which means it is not sincere nor by definition not self-determination. It is a concept bounded by the federal government. Given these bounds and the political whims that hit them periodically one has to be cynical in the local push for Indian educational self-determination. In its ideal state it is a push for local control hence something which is developed by the local community and is not interfered with in anyway from the outside. The local community decides the purpose of educating its children and the process by which it happens - as we have seen for Indian communities this meant an inclusion of language and culture in the classrooms.

It may not be difficult then to come to understand, at least in the results that have occurred in the educational realm, that self-determination does not mean self-sufficiency. If the tribe or the community is truly rooted in a push for self-determination doesn't it necessarily mean a total divorce from the purse-strings in which it is attached and therefore controlled? Don't curricular mandates and school structuring from the outside inherently impede the wishes of the community? Don't standardized testing and "standards" necessarily imply something other than local control? Perhaps the adaption of a self-determination rooted in quasi-sovereignty and domestic dependence can help explain in some way, the lack of cultural and linguistic fluency among students who leave *Isna-Wica Owayawa* after the eighth grade. Perhaps it explains, in part, an inability to meet AYP.

Conclusion

Despite the number of ways in which Lakota culture and language could be used in the teaching of mathematics there is not present within the mathematics classroom at *Isna-Wica Owayawa* either. There are three main reasons for this lack of inclusion, the first centered on the mathematics teacher, the second was a lack of communication between the mathematics teacher

and the Lakota Studies department. This in turn was impacted by a limited view of mathematics - a perception which emphasized arithmetic operations and number sense. Also included in this lack of discussion was direction from the administration- can mathematics really be a context for the teaching of Lakota culture and language? Should it be? Finally, the last reason for the lack of inclusion of Lakota language and culture in the math classroom seems to be the overbearing weight of satisfying Academic Yearly Progress, whose main purpose is getting a certain number of students proficient in mathematics.

There is much potential for the inclusion of Lakota culture and language in the mathematics classroom. In order for it to occur it has to be given not just verbal expression but has to become part of the vision involved in fluency of the language and also included as a context for coming to understand Lakota culture. Once these things occur then finding Lakota contexts for the math classroom must come to light. The six universal mathematical activities can become a springboard as possible contexts. Lakota Studies staff must begin to teach not only to the students at *Isna-Wica Owayawa* (since they are doing some of these activities already anyway) but also non-Native staff who teaches mathematics courses. In turn the mathematics teacher can use his/her expertise to tease out the mathematics in the cultural activities. In short, dialogue and cooperation needs to happen for the development of curriculum designed for both the Lakota language courses and the mathematics courses.

The point of including language and culture in the mathematics classroom is to meet the stated goals in gaining local control in the first place. That is, to push for fluency in the Lakota language; to come to understand Lakota culture and to get students to appreciate their own culture. The ideal of self-determination, both at the individual level and at the collective/tribal level is the embodiment of self-sufficiency. Though this ideal has not been realized yet after

thirty-five years of implementing notions of self-determination in the classroom, it is still one worth pursuing for, in the end, it is really the individual child who will have to feed himself as an adult.

In my role as a researcher and an Oglala community member from afar there are many things that I still hold dear to me from my home. I love the culture, I love the fact that I was raised on land my ancestors fought and died for us to have. I have a great sense of pride in knowing that I come from the Oglala Sioux Tribe. That said, I have relatives (nieces and nephews and grandchildren) who attend *Isna-Wica Owayawa* and I wonder about their future and indeed the future of my tribe. I also wonder about Lakota culture and language and what will befall the community once the generation of elders, who are bilingual and the best vehicles by which the culture is lived, hence taught, come to the end of their life journey. As one of my elderly aunts asked when I was discussing with her the state of the young children at a funeral of one of our relatives in Oglala, "Who will take care of these kids once I am gone?" Indeed who will? And the larger question rooted in self-determination is "Will they be able to take care of themselves?"

Chapter 12: Conclusion - A Look Back, A Look Ahead

In the early years the push for Indian educational self-determination generally meant that schools would fall under local control and local influence. The community would shape the direction and function of the schools and the curriculum. They would be Indian-run, with local school boards providing the direction, they would employ locally. They would determine curriculum. Invariably this meant the inclusion of the local Native culture and language integrated into the formal schooling of the children. Early on there was much excitement for what this entailed. It was also empowering and held much promise. This initial foray into local control was followed by some innovative experimentation with the structures of the school and classroom content.

In 1975 the Indian Educational Self-Determination Act was passed by the Nixon administration whereby tribes could now become the source impacting the direction of their educational systems. The main result of this act was that now schools could contract with the BIA rather than be dictated by the BIA in how they function. Contract Schools in Indian communities came into operation. "Contract schools were independent Indian school boards contracting with BIA funds to operate their own school. The money was federal, but the policy and the administration were local" (Sharpes, 1979, p. 21). The responsibility for educating the Indian child now rested within the Indian community.

It was decided very early on in the push for local control that the focus of education of Indian children should be bi-cultural. In the decades of the sixties and seventies this bi-cultural characteristic of self-determination/local control began to show influence on curriculum development. In various ways local context, values, outlook, history and language were integrated into culture classes as well as some content areas. This local control was reflected in

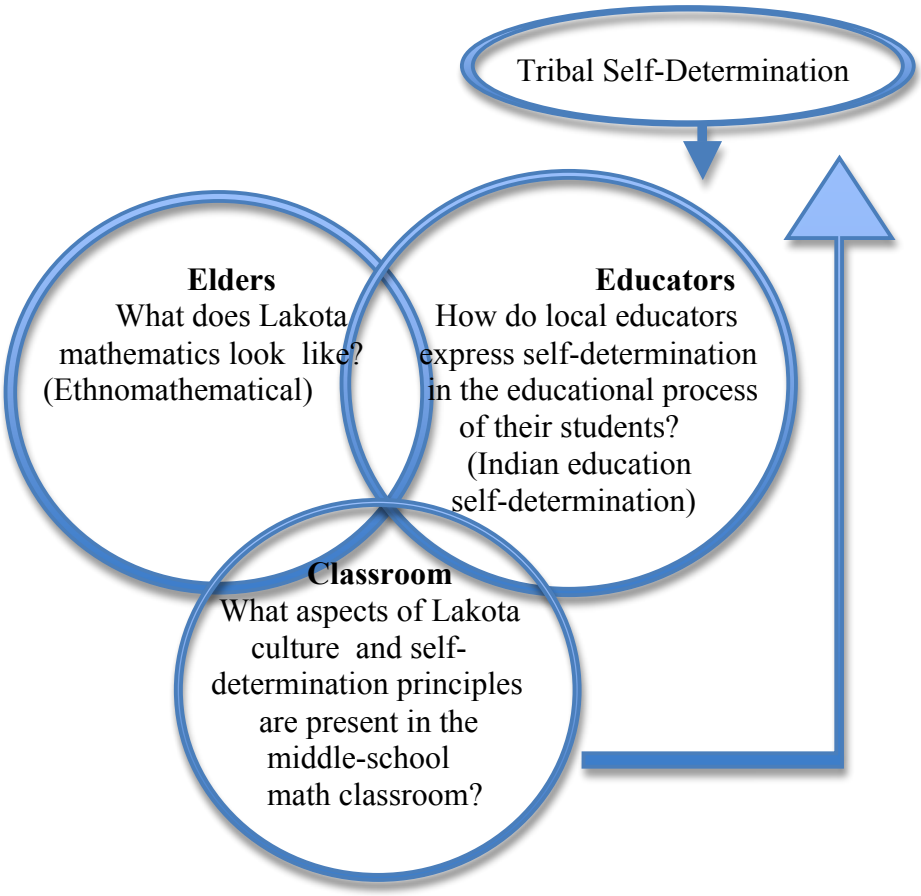
the purpose of the education of Indian children. This meant that students should be taught White culture while at the same time learning and about their own tribal-specific culture. Bi-lingual programs were incorporated whereby two languages were taught, English and the respective local Native language. Similarly academic content reflected this dual nature whereby in some locations local Indian culture was incorporated within different content areas. We saw that such content areas included social studies, history, government, science, astronomy and music. These classes were taught alongside and within what was then viewed as regular academic courses. The purpose of this bi-cultural educational approach was to get students to come to appreciate their own tribal heritage and to see that their people's life-ways, tribal values and viewpoints had merit and were just as valid as those found in Western culture. This in turn was supposed to help the student develop a better self-image, thus raising his self-esteem. This assumption rested heavily in the belief that successfully educating the child in this fashion would help end the cycle of poverty - education would be the means by which social ills would be cured. It could do this by also educating the child for future employment. Thus, the ideal end of this educational system was a student who was versed in his culture and language, appreciative of his heritage and prideful of who he was as an Indian person. In addition to these traits he was also wholly employable and thus could live in both the white man's world and the Indian world.

As time progressed bi-lingual programs within the sphere of this bi-cultural education changed direction - reflecting the changing characteristics of the younger generations of children coming into the schools. A decline in fluency in native languages among the younger generations prompted a change in the teaching of two-languages. In the original rhetoric, teaching native speakers English was viewed in light of helping them become employable in the future. Now that most students were coming into schools as English speakers teaching the

Native language in this changing cultural dynamic meant teaching for language maintenance and revitalization and also cultural survival.

The description of self-determination gathered in the literature, especially at the curriculum and classroom level gave rise to a framework that I developed to help look at the teaching of mathematics at the cultural level. The initial point in all of this was to find evidence of self-determination principles in the local Oglala mathematics classroom to help answer the following two questions: (1) Was Lakota culture used as a context for the teaching of mathematics? and (2) Was the Lakota language used to help express any mathematical terms or concepts? The original conceptual framework which arose from the literature and was employed in this study is shown below.

Figure 12-1. Original Conceptual Framework



In my original conception of Indian educational self-determination there was an assumption made that there would be influences evident which would impact what was occurring in the math classroom; in the math classroom the content would be a function of how elders, community members and local educators put into practice ideas of self-determination. That is, Lakota language and culture would be present in the mathematics classroom. This idea is reflected above in the Venn diagram where the circle representing "Elders" intersects with the circle representing "Classroom." I had also thought that the best way to look for evidence of Lakota culture and language in the math classroom was to see how Lakota speakers verbalized mathematical concepts by way of Bishop's SUMA. Since nothing existed in the literature that dealt with the intersection of Lakota culture and mathematics at the time this study began I felt I had to construct this. The only way I thought this was possible was to speak with Lakota elders. Educators in the community, I thought, had dealt intimately with notions of self-determination so it seemed reasonable that I could approach them for conceptions of self-determination. They too, with their influence and their ideas of self-determination would also play a part in the teaching of mathematics. Thus with the aid of both a Lakota mathematics (by way of elders in the community) and notions of self-determination (by way of local educators) I set out in this study equipped to look for evidence of culture and language in the mathematics classroom.

In the end this model was incomplete (as I will describe below). What was found at *Isna-Wica Owayawa* was the inclusion of culture and language in the structure of the school in various forms. The school exuded notions of self-determination, which was manifested in large part by the inclusion of cultural materials in the school - murals, phrases, images, etc. In addition to this was the attention given in the informal curriculum found in field trips, drum groups, morning Lakota prayers, smudging, sweats and very visual Lakota cultural symbols

everywhere. In the very structure of the school a Lakota Studies Department was housed. This department was instrumental in guiding both the Lakota language classes and was also influential in producing an informal curriculum. Thus there were two vehicles by which Lakota culture was taught to students, a formal curriculum found in the Lakota language classes and expressed in the Lakota Studies Standards, and informally by way of fieldtrips, drum groups, songs, dance, images, etc.

In looking at self-determination at *Isna-Wica Owayawa* I also was able to come across some of its historical developments. It is interesting to note that its development in the Oglala community mirrored what I had seen in the literature. Local Oglala residents were inspired by what was occurring in the Rough Rock Demonstration School in Arizona in the late 1960s. They pushed for local control of Loneman Day School in the early 70s and by the mid-1970's the Oglala community had gained local control. They changed the school's name to reflect its new identity; it became Loneman School Corporation, a contract school. With local control came the inclusion of Lakota language and culture as part of the curriculum at Loneman. Currently the school is still heavily influenced by the local community as seen with the continual integration of Lakota culture and language mentioned above.

Eventually I was able to focus on the teaching of mathematics (while building a Lakota mathematics framework). What I found was that elders, local community members and Lakota educators had no influence on the teaching of mathematics at *Isna-Wica Owayawa.* There was no evidence of self-determination principles - language and Lakota culture were not present in the mathematics classroom. The mathematics classroom was left to itself and therefore resembled mathematics classrooms across America, including a main-line, traditional text source book series. It was driven heavily by federal mandates and the need to have a certain number of

students score in the proficient range on standardized test scores. This finding can be viewed in at least two different ways. First, the influence on the direction of the math content was not from the local community since there was no room for its inclusion as a result of restructuring and thus an imposition of the federal government, in the guise of standards, on local control. Second, the notion that since math was not viewed as a Lakota cultural entity meant that its direction and content could best be informed from the outside.

The second point to make about my initial conceptual framework and the impact this research has had on it occurred in the formulation of a "Lakota mathematics." In devising this model, with the use of Bishop (1991) and guidance from Barta & Shockey (2001) and Barta et. al (2006), I had assumed that elders in the community and speakers of the Lakota language would have a firm understanding of cultural knowledge as it pertains to Bishop's six universal mathematical activities. What was most surprising is that most had not given much of these topics any thought. Most had no knowledge of the vast amounts of information concerning such things as Lakota games, except perhaps Hand Games (most adult Lakota games have since disappeared a long time ago whereas most of the male children's games are still in existence -at least they were played by my generation). Most speakers had not attempted to approach mathematics - leaving the verbalization of many types of numbers unstated - thus there were no words for such things as negative numbers, and most rational numbers, etc. All could verbalize big numbers with some effort. Also of note was the need to lean on published materials for such things as the names of months and star knowledge. All of this being said, speakers in the community were able to provide direction that in turn helped me find sources to "fill in the missing pieces." Lingering for the moment on the topic of games for instance, I was able to find that Lakota games were well-documented throughout the past hundred ten years but I did not

know the names of some of these games prior to finding those historical sources. The elders and educators provided the names of some of these games. These sources, in turn, allowed me to compare what once was an integral part of Lakota life to what is now missing. Thus for each mathematical activity I investigated I was pointed in a general direction from elders and speakers in the community and in trying to make sense of what was shared, found many historical sources as helpful supplemental material.

In trying to develop a description of mathematics in Lakota cultural activities and in the verbalization of some mathematical concepts I found that some of the best resources were Lakota teachers. This should have been obvious going into the study, because they are the ones who would have had to deal with issues found in trying to teach to Lakota students content material. Especially true of this are those who taught a generation ago. In those times a large portion of students coming into the schools spoke only the Lakota language - these Lakota teachers would have taught in the late 1960s and earlier. The issue with this is that not many of these teachers are still alive. One of the things that is missing in the literature is how these native speakers approached their content material - how did they get across to their students an understanding of fractions, or areas, volume, etc.? It would have been an amazing find if I could have come across some historical documents of teachers who taught mathematics to Lakota students in the language. What were their methods and how did they approach mathematics? Again, the greatest resource for this study was Lakota teachers (current and former) and not the average Lakota speaker or elder.

The Lakota language teachers at *Isna-Wica Owayawa* provided another unanticipated finding as well. As far as espousing principles of self-determination they were the penultimate. They had been and are continually trying to figure out how best to incorporate Lakota culture

into the formal education at *Isna-Wica Owayawa.* As a result, they were the most innovative. In my conversations with these teachers I was able to hear about their efforts to teach the language thematically. Thus I heard about thoughts concerning teaching the language through the use of seasons, gardening, through cultural values, the creation of tipi's, through song and dance, etc. Sometimes I wondered if they were not charged with too much for they not only taught the language but also values, history, star knowledge, religion, etc. They did this all the while trying to figure out ways to integrate these topics with the teaching of the language. They, as a result of this, quite naturally brought in many of the six universal mathematical activities into their classroom. I saw Hand Games, place names, numbers, shapes, designs already interwoven into what they taught.

The next important finding to mention as a result of this study is the fact that if it is a goal to continue to have the Lakota language and culture at the school how much are they to be included in the teaching of not just mathematics but also the other content areas like science? If fluency in the Lakota language and an understanding of Lakota culture are viewed as important should not the local culture and language be included in the teaching of courses whose roots are not seen as embedded in Lakota culture? If this is something to be pursued, and I think it should be, then the Lakota Studies Department would have to be involved in a major way. In the context of mathematics, as the administrator stated, "When you take it back and relate it to life and talk about those things from a life perspective, they use math every day. So I think we need to change how we teach math so they see it from that perspective." Mathematics can't continue to be looked at as strictly a push only for fluency in numbers and deftness in arithmetic operations rather it has to be broadened. Teachers have to come to realize that mathematics is a cultural creation, one that has impacted cultures the world over and throughout the history of

humanity. The goal here is still bi-cultural in a sense, but it is more than that; presenting mathematics as cultural, dynamic, living and changing, may help students come to understand its usefulness, hence inherent power.

I mention this new direction in the teaching of mathematics, using the language as the vehicle by which it happens in part because these materials do not exist - and they should. Throughout the duration of this study I found myself wondering why it is that the Lakota language is taught only for oral proficiency and not written as well. My thinking on the matter comes with the conviction that in order to be fluent in a language speaking it, writing it and reading it all play major roles. I have learned about various topics in the English language and continually do so because I have access to written material. Also, thinking about mathematical concepts and related ideas needs to occur in the Lakota language - it is the thinking -in-the-language aspect that is important, especially about concepts that are abstract and academic in nature.

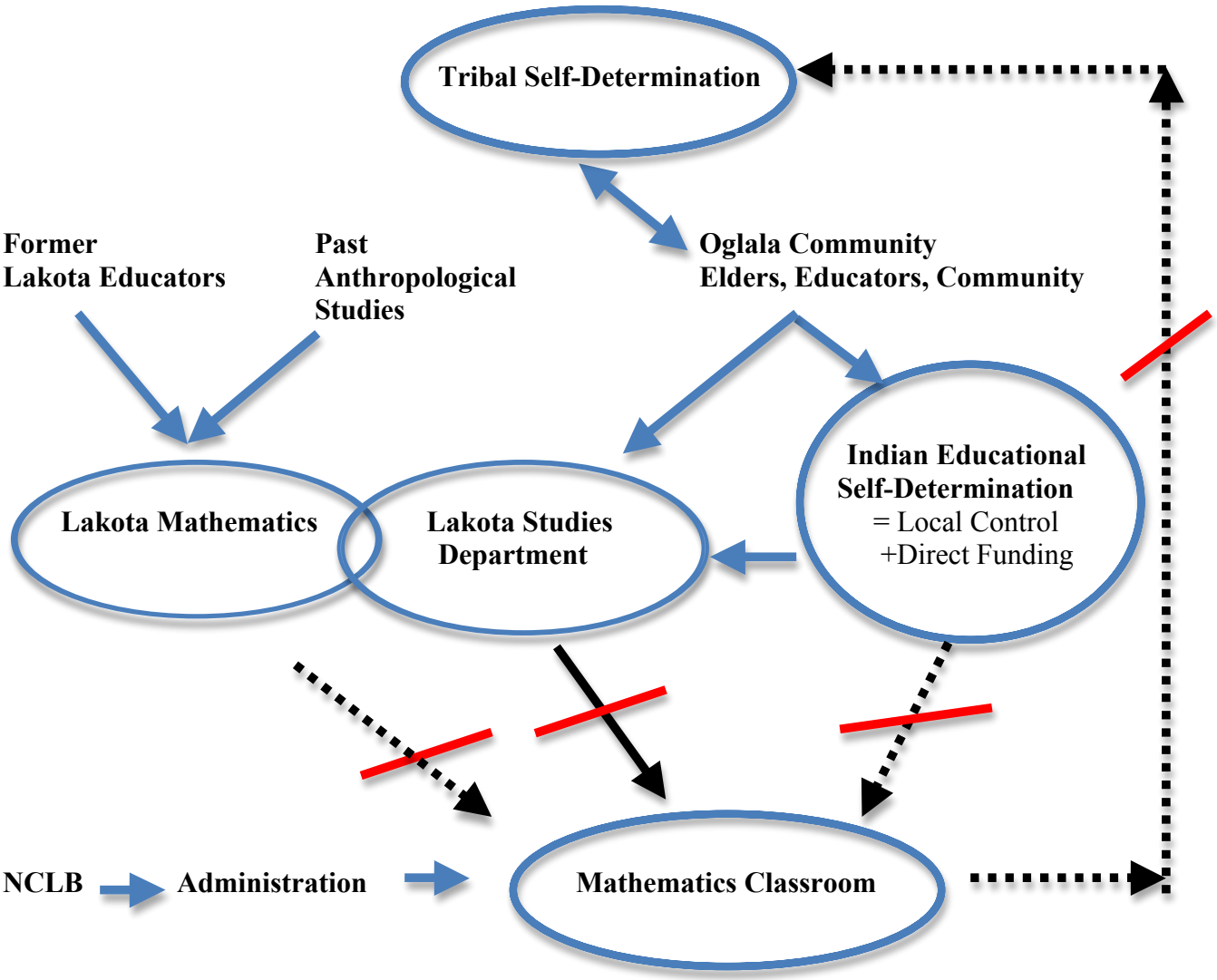
As it now stands I cannot access Lakota thought about science and mathematics - it doesn't exist in written form. Nothing exists in the literature that allows me to approach mathematics from the Lakota culture, as written in the Lakota language. I cannot answer the question "How does Lakota thought perceive a trigonometric function?" Or how is an integral or derivative explained with the Lakota language?" What is Lakota literature? Where is it? How can I access it? Nothing contemporary is written in the Lakota language. We have to go to anthropological studies, essentially back in time to someone like Ella Deloria to find that these stories exist in writing. Hence, I cannot access mathematics except through the English language. The same is true of science. There are no Lakota Chemistry textbooks. Why not? If fluency in the language is to occur at a profound depth, not just in the naming of shapes, numbers

etc. or geared to conversational setting, but is to get students, our children, to think with the Lakota language as a medium, should not the Lakota language be used to teach mathematical concepts? Shouldn't a Lakota Algebra text exist?

The last piece of information to come from this study was an understanding that there is really no tribal governmental influence on the direction of *Isna-Wica Owayawa*. There is also no mention or existence of ways in which the school can be of assistance to the tribe. Thus, when talking about tribal self-determination it is not typical to include Indian educational self-determination in the conversation other than acknowledging that at the federal level Indian educational self-determination may not have happened. From my understanding, the only part the tribe plays in the functioning of *Isna-Wica Owayawa* is the effort to sign-off on its contract on an annual basis. There is not present any rhetoric in any materials produced by *Isna-Wica Owayawa* nor rhetoric spoken by employees at *Isna-Wica Owayawa* regarding how the education of students can impact the tribe on a social/cultural or political level. Nor is there any effort made to show how mathematics can come into play regarding tribal self-determination and sovereignty. Thus there is no tribal oversight in the running of *Isna-Wica Owayawa* (that I could see). In return nothing was offered back to the tribe from *Isna-Wica Owayawa*. The large question remains. What is the overriding purpose of educating students at *Isna-Wica Owayawa?* If it is exclusively to produce individual purveyors of a bi-cultural education what is the long-term effect on the tribe and its autonomy?

With a clearer view of the conception of Indian educational self-determination in the Oglala community, its impact on the structure and direction of *Isna-Wica Owayawa* and its non-influence on the teaching of mathematics coupled with the knowledge gained from the process of creating a Lakota mathematics I offer the following revised conceptual framework.

Figure 12-2. Revised Conceptual Framework



In the revised conceptual framework above the arrows in the figure represent influences. For example, both "Former Lakota Educators" and "Past Anthropological Studies" are influences in the development of "Lakota Mathematics." The dashed arrows with a line through them show what I had thought would be influences on a certain concept but in reality did not exist. So both "Lakota Mathematics" and "Indian Educational Self-Determination" were theorized to be

influences on the teaching of mathematics at *Isna-Wica Owayawa*. In reality they had no influence on what was occurring in the math classroom. The "Lakota Studies Department" is included in this revised framework because it was found to already have included, as part of its curriculum some Lakota mathematical activities (hence its overlapping intersection with the oval representing Lakota Mathematics). It is included also due to the potential it holds in influencing the content and curriculum of the mathematics classroom should Lakota language and culture be included in the classroom. Hence the non-dashed arrow points towards the "Mathematics Classroom." The line through this arrow signifies that currently it is not influencing the mathematics classroom. The only entities influencing the teaching of mathematics at *Isna-Wica Owayawa* are the policies implemented at the federal level known as No Child Left Behind. Since *Isna-Wica Owayawa* was in a "restructuring" phase, what was taught in the mathematics classroom (curriculum) and pedagogy were determined directly by the administration, which in turn was influenced by NCLB. Finally, as I mentioned earlier, there is no self-determination purpose given in the teaching of mathematics pertaining to the tribe. Thus the teaching of mathematics at *Isna-Wica Owayawa* has no civic or long-term cultural impact/responsibility regarding the way its students could/should impact the Oglala Sioux Tribe in the future.

Conclusion - A look ahead

What lies ahead is really determined by what has been laid behind. How it has been laid is irrelevant - Was it laid to waste? Was it set as a cornerstone? Was it set in place haphazardly? It doesn't matter. It is already done. This is true in the way the federal government classified the process by which it would deal with Indian tribes. Indian tribes would forever be political entities by which a certain form of subservience was asked and in return would be given a sense of political autonomy - a space carved out that is really a small morsel; a small token of what once

was or what could be. It didn't seem to matter that what was outside that geographical morsel we call reservation lands was something that was necessary for the completion of a people to make sense of the world all around. In a very real sense for the Lakota, the efforts of the sons of *Tate* has to be reworked, direction has to be re-established in this new context, for the foundation they laid has been laid to waste. What now?

This shaky foundation, set a long time ago, is also found in the way the federal government classified the process by which it would deal with the education of the Indian child. Again the groundwork was laid haphazardly when it was decided that the education of the Indian had to occur in the same cookie-cutter industrialized assembly line process that was democratic enough to shape all kids. The language, the culture, the Indian worldview, the sense by which the world was known, was not included in the way the Indian child would be educated. They would become civilized.

In modern times Indian tribes are dealing with these pieces, these fragments, these morsels. Indian culture and language have resurfaced in the education of Indian students through the efforts of Indian leaders. The new educational direction is bi-lingual and bi-cultural and is set in the context of tribal self-determination. Is this enough? Has it worked? What now?

In looking ahead I have looked back. I have seen embedded in the Lakota culture, from a mathematical/academic viewpoint, activities in which something academic can be built. I have seen that the Lakota language is still a viable vehicle from which the future can be articulated. From a participant/researcher perspective I went out on an exploratory journey wondering what there is to learn about the role of mathematics in Indian self-determination. I wanted to describe it. I wanted to become informed. I came back from the land of my youth, having seen the elderly faces that I had known so long ago when there were no lines or gray areas. I have seen the eldest

of my own generation - some toiling in noble efforts. I looked to the younger generation, to those for whom the walls of Loneman Day School, then Loneman School Corporation, now *Isna-Wica Owayawa,* were built. All I can think of over and over, is the question my aunt asked me while we were having a conversation at a funeral. "Who will take care of these kids when I am gone?"

Who will take care of these kids when I am gone?

In all of the rubble, the small successes, the glimmers of hope, the encouragement, and the enthusiasm found, there is present a quaint allusion for meaningful push that lies in real autonomy. It is not enough, I think, to continue as is. In this form of autonomy which was not really ever truly attained, is direction provided by local control. But even more, it also contains an approach to education which has as its goal to produce not just bi-lingual students but students capable of the full range of human intellect - students who are philosophers, who speak and write the Lakota language, who dance and sing "Indian", who can write a mathematical equation in three languages (Lakota, English and mathematics). I say this realizing I have no answers, only suggestions. There is no guarantee to be found in anything I paint with words on paper. That said, I believe the Lakota are almost there. But to get there requires a prolonged, re-doubled effort. It entails, if we are talking about formal education, an understanding of another kind of subservience (for don't all forms of education aim to mold and shape?) - one that continues to pay heed to the past, to the elders, to the stories, but also one that approaches other boundaries and in a sense makes them its own. It is a content-specific future, not necessarily disjoint since it relies on the language to bring it together. It is a vision - one that is spoken in Lakota and incorporates various things not typically associated with Lakota culture.

In looking ahead I seem to always look back. I always point to the horse and to the gun and how they first were spoken of and then adapted into the Lakota culture. These two things were *wakan.* Yet they were not just approached, for our ancestors understood their usefulness; they were adapted then incorporated into the culture. These two pieces of technology changed the Lakota people forever in ways that perhaps those living at the time couldn't imagine. Adapting these two things into Lakota culture changed the way the Lakota lived, and in doing so changed the way they thought. Even though they changed they were still known as the Lakota, now dwellers on the plains. In a very real sense, because of a willingness to adapt the gun and the horse into the Lakota culture, time expanded for the Lakota and a whole new universe spread out before them whereby the two-legged on the four-legged, together, came together in a seeming race-dance around the Black Hills.

I think the same is true here as we take a look at mathematics and what it can offer. It is indeed a language used to explain and model various things in nature, yet it is something more. It is also a tool. It is also a thought process. Learning it expands time and the universe. Things become knowable with mathematics, and because they are knowable become malleable. In looking at the mathematical activities in Lakota culture, as well as the yet living Lakota language to express mathematical content, I am thrilled to think that the journey ahead is just a small step and as such can start soon. I think it starts with the inclusion of mathematics to the Lakota language. We must build pre-K and kindergarten math texts books in the Lakota language. Then, we wait and see what happens. Include in this texts books the already known shapes, numbers, patterns, categorizations and games. Continue to build this curriculum into the 1st, 2nd and 3rd grades. Include fractions, big numbers, place values, zero and the infinite. Add more shapes, the number line, money, and games and translations. Work not just to the left of zero,

but also to the right on the number line. Work also towards the middle school, take the three languages along the way and show that the Lakota were mathematical in nature, show where these lie in the culture - all cultures - and continue to integrate the languages together.

It is a start, it has no guarantee - but neither did the plains on the other side of the big river. I think it is what lies ahead, and it is, I think, what is necessary.

"Lie awake, this is not yet the end of the tale."

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