



Middle school science classroom practices in Crow and Northern Cheyenne schools
by Walter Harold Woolbaugh

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Education
Montana State University

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Abstract:

This study first identifies the teaching and learning practices that have shown to be effective in producing achievement gains with K-12 Native American students. In order to identify effective practices, policy guidelines and research studies focusing on achievement gains among Native American students were reviewed. This information was then mapped to the National Science Education Standards and aligned with a widely used mathematics and science observation instrument. The instrument was used by the author to gather data from 13 teachers by observing 68 lessons in 11 middle schools on the Crow and Northern Cheyenne Reservations in Southeast Montana. Interviewing and surveying the observed teachers generated further data. To complete the study, administrators and community members, including tribal elders, were interviewed.

The literature reveals that Native American students achieve more when student centered teaching methods are used. These methods include the use of visual teaching aids, cooperative learning, and practical applications all interwoven in culturally relevant lessons. The literature supports building community support, including involvement from tribal elders.

Data gathered by the researcher revealed that the teachers on and near the two reservations have more teaching experience, more science credits, and attain higher ratings for observed lessons than a national sample of teachers. A factor analysis indicated that Crow and Northern Cheyenne region teachers scored especially high in student / teacher relationships, classroom management, and content knowledge. Even though 43 percent of class time was spent in hands-on paired activities, teachers scored lower on indicators pertaining to creating classroom environments that engaged students in rigorous, meaningful learning experiences. Teachers reported on not feeling prepared to include cultural applications and meanings during instruction. Teachers attaining lower scores during classroom observations tended to cite low student motivation as their major barrier, while teachers receiving higher ratings cited external factors like the size of their classroom. The teachers described colleagues and professional development opportunities as particularly beneficial.

Recommendations for further studies include additional research on effective classroom practices that produce achievement gains with Native American students, and stronger professional development focused on specific advanced teaching skills, including methods of embedding culture and community in the science curriculum.

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NORTHERN CHEYENNE SCHOOLS

by

Walter Harold Woolbaugh

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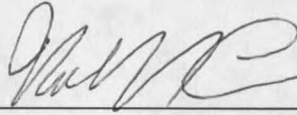
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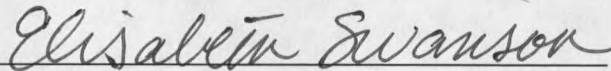
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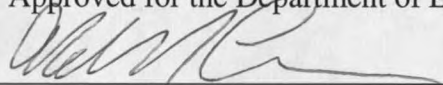


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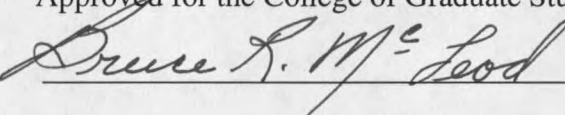


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ABSTRACT

This study first identifies the teaching and learning practices that have shown to be effective in producing achievement gains with K-12 Native American students. In order to identify effective practices, policy guidelines and research studies focusing on achievement gains among Native American students were reviewed. This information was then mapped to the National Science Education Standards and aligned with a widely used mathematics and science observation instrument. The instrument was used by the author to gather data from 13 teachers by observing 68 lessons in 11 middle schools on the Crow and Northern Cheyenne Reservations in Southeast Montana. Interviewing and surveying the observed teachers generated further data. To complete the study, administrators and community members, including tribal elders, were interviewed.

The literature reveals that Native American students achieve more when student centered teaching methods are used. These methods include the use of visual teaching aids, cooperative learning, and practical applications all interwoven in culturally relevant lessons. The literature supports building community support, including involvement from tribal elders.

Data gathered by the researcher revealed that the teachers on and near the two reservations have more teaching experience, more science credits, and attain higher ratings for observed lessons than a national sample of teachers. A factor analysis indicated that Crow and Northern Cheyenne region teachers scored especially high in student / teacher relationships, classroom management, and content knowledge. Even though 43 percent of class time was spent in hands-on paired activities, teachers scored lower on indicators pertaining to creating classroom environments that engaged students in rigorous, meaningful learning experiences. Teachers reported on not feeling prepared to include cultural applications and meanings during instruction. Teachers attaining lower scores during classroom observations tended to cite low student motivation as their major barrier, while teachers receiving higher ratings cited external factors like the size of their classroom. The teachers described colleagues and professional development opportunities as particularly beneficial.

Recommendations for further studies include additional research on effective classroom practices that produce achievement gains with Native American students, and stronger professional development focused on specific advanced teaching skills, including methods of embedding culture and community in the science curriculum.

INTRODUCTION

Improving the quality of education in the Native American classroom remains a challenge for educators, researchers, parents, students, tribal and political leaders. With schools serving high percentages of Native American students lagging behind other schools in standardized test scores, combined with the relatively low numbers of Native American students who complete high school nationwide and in Montana, this becomes a concern for all of society (Montana Office of Public Instruction, 2001). It is a problem that involves classrooms, schools, families, and communities, and that requires appropriate interventions at all of these levels over sustained periods of time. Bringing about change at just one level, for example implementing more effective classroom practices, will not alone improve education for Native American students. Thoughtful and open communication needs to occur that is focused upon understanding, valuing, and committing to the school's improvement at many levels (Spraker, 2002). Like all large and complex problems, this one is composed of many smaller problems, some of which may not yet be realized. This study begins to research one of these components.

The Problem

The problem is that there is a gap between Native American and non-Native American student learning as indicated in standardized test scores in science at all grade levels for which data is available (<http://www.opi.state.mt.us/Assessment/index.html>.; <http://nces.ed.gov/nationsreportcard/reading/results2003/raceethnicity.asp>). This is a

difficult issue to address in that teaching and learning practices in classrooms serving significant numbers of Native American students have not been adequately documented in the research. It is not known what teaching and learning practices are occurring in these classrooms, or how these practices align with educational guidelines and standards for science education and specifically for Native American education. It is also not known how these practices align with practices recommended in current research on teaching and learning in Native American classrooms.

The purpose of this descriptive study is to document teaching and learning practices in middle school science classrooms on the Crow and Northern Cheyenne Reservations in Montana and to compare these to practices recommended in policy guidelines for science education and Native American education and in current research on Native American education.

Specifically, the study addresses the following questions.

1. To what degree does consistency exist among the research on effective teaching and learning practices for Native American students, policy guidelines in this area, and the National Science Education Standards?

Prior to any observational data being collected, it needs to be determined how well the National Science Education Standards align with current research and guidelines on effective teaching and learning practices for Native American students. This study identified a number of practices which were recommended by multiple sources and others which were recommended by a smaller number of sources. These sources included Native American classroom research studies, Native American educational policy guidelines, and the National Science Education Standards. Practices that were

recommended across multiple sources were considered key indicators of effective practice and thus were targeted for observation in classrooms on the two reservations.

2. To what degree does consistency exist between the research on effective teaching and learning practices for Native American students policy guidelines and standards identified in question 1 and actual teaching and learning practices as observed in middle school science classrooms on the Crow and Northern Cheyenne Reservations?

Once the key indicators of effective teaching and learning were identified, it became possible to use this list to observe the degree to which these indicators were present in the middle school science classrooms.

3. What classroom, school, and community conditions support implementation of the practices recommended in:
 - 3a. Existing research and policy guidelines for promoting Native American students' learning?
 - 3b. The teaching and learning practices recommended in the National Science Education Standards?
4. What classroom, school, and community barriers prevent the implementation of the teaching and learning practices recommended in:
 - 4a. Existing research and policy guidelines for promoting Native American students' learning?
 - 4b. The National Science Education Standards?

As important as the positive resources that help teachers, schools, and communities develop effective programs are the barriers or constraints that make such programs difficult to implement. This study identified certain conditions supporting effective middle school science programs for Native American students and barriers. This information was obtained from interviews with teachers, school administrators, selected community members, and classroom observations conducted by the researcher.

Definitions and Clarification of Terms

A number of terms and phrases which require description and definition are used throughout this paper. Some of these terms include the *achievement gap*, *effective teaching and learning practices*, and *research results* compared to *policy guidelines* pertaining to Native American education. A description of the National Science Education Standards as these standards relate to this paper will be provided in the next chapter.

Johnston and Viadero (2000) define the *achievement gap* as the disparity in academic performance between different ethnic groups. According to Pleog, the senior researcher for the North Central Regional Educational Laboratory, the gap is not restricted to ethnic groups (Taylor, 2001).

In many instances, gaps exist among diverse groups of students in their achievement in various content areas, in their curricular experiences, and in their access to resources (p 2).

A major contributor to this gap is poverty and in schools with poverty rates of 25 percent or higher, all students record lower academic performance and differences (Johnston and Viadero, 2000). These differences show up in grades, test scores, course selection, and high school completion. They occur in cities, suburbs, and in rural school districts. Although disparities in achievement based upon factors like ethnicity, culture, language, and income exist between schools and districts, disaggregated data may reveal significant achievement gaps within a single school's population too.

On the National Assessment of Educational Progress science assessment, Native American 4th graders in Montana scored a 145 while the average for white students was 164. This means that 37 percent of the Native American students were below basic while only 14 percent of the white students were below basic. In 8th grade science, Native American students scored a 132 compared to a student group average of 164. This means that 51 percent were below basic while only 16 percent of the white students were below basic (<http://www.nces.ed.gov/>). Such differences are one indication of the *achievement gap* between Native American and non-Native American student populations. Not only are there often differences in standardized test scores, but also differences in educational levels obtained. For example, national census figures reveal that lower numbers of Native Americans graduate from high school and college compared to non-Native Americans (U.S. Department of Commerce, 2000). Data from Montana's Office of Public Instruction (2002) show that 58 percent of the students on the Crow Reservation and 63 percent on the Northern Cheyenne graduate from high school compared with a state average of 84 percent. The concept of achievement gaps will be explored in greater depth in the next chapter.

Effective teaching and learning practices are those strategies that improve student learning in a particular context. For example, the ten steps outlined in Table 1, developed by the Center for Learning and Teaching in the West (CLT West), include a wide range of strategies to improve student learning in particular schools served by the Center (CLT West proposal, 2001). It is presumed that educators who utilize *effective teaching and learning practices* in their classrooms will be helping their learners gain in achievement.

Table 1. Learning and Teaching Strategies (CLT West proposal, 2001)

“the ultimate goal.... Must be the development of professionals who can help complex learning happen for students” (Feiman-Nemser et al, 1999).

CLT West instructors will improve k-20 mathematics and science learning by:

1. Providing up-to-date and relevant course content that is challenging, yet accessible, with resources to facilitate student success.
 2. Providing well-designed opportunities for students to learn about and engage in inquiry and to recognize the power and limitations of science.
 3. Promoting full participation and success for students from underrepresented groups.
 4. Engaging students interactively in small group learning environments, especially in large enrollment courses.
 5. Encouraging conceptual development by engaging student learning styles using a variety of methods.
 6. Using technology for data collection (in lab or field settings or on the Web), and for interpreting, modeling, and sharing results.
 7. Using interdisciplinary approaches that illustrate the connections between science or mathematics and other human endeavors in the arts, humanities, or social science.
 8. Conducting ongoing student assessment and program evaluation using multiple credible techniques, and using the results as a starting point for redesign of instruction.
 9. Reflecting on practice individually and as an active member of a wider community of educators, and sharing results through appropriate dissemination.
 10. Involving parents and community members as true partners in planning and supporting students' learning.
-

Effective teaching and learning practices in this study are those practices identified by research studies and policy guidelines as promoting Native American students'

achievement. Many, but not all, of these practices also appear in the National Science Education Standards because they are believed to promote all students' achievement.

The research into effective practices in Native American classrooms covers a wide range of topics (Kleinfied, 1975; Sawyer, 1991; Brendtro & Brokenleg, 1993). Such studies document the impact of community and school relationships, specific teaching and learning strategies, teacher characteristics, and classroom conditions on achievement gains. At times, multiple study results all supported the conclusion that a particular practice was effective. The following criteria were considered when selecting studies for this research.

- The studies selected take place in 4-12 grade classrooms serving predominately Native American student populations. The studies involve many different Native American and Native Alaskan groups.
- The studies chosen all examine the impact of particular practices on student achievement. Some studies showed significant achievement gains in relationship to the treatment of the study, and others did not.
- Although the curricula in the studies were mainly from mathematics and science, studies involving other subject areas were also included.
- The research designs of the studies varied, with descriptive and comparative approaches being the most common. Traditional experimental research designs were used in some of the studies.

The criteria used in selecting research studies will be explored more completely in Chapter Two. Findings from these research studies and other sources were synthesized to identify the indicators of effective practice to be observed during the study.

To identify appropriate indicators of effective practice, this study also examined *policy guidelines* on Native American education developed by various regional and national organizations. In each instance, a task force formulated these policy guidelines with opportunities for input from the organization's broader membership. In some cases, educational researchers were among those contributing to the guidelines but practitioners' views were well represented too. The policy guidelines of concern in this study deal with effective teaching and learning practices in Native American classrooms. Three policy group documents were examined in this study. The National Indian Education Association (NIEA) drafted the "21st Century Blueprint for American Indian and Alaska Native Education" in 1999. This document identified both a series of key questions regarding Native American education and a series of recommendations for national, state, and local agencies. The American Indian Science & Engineering Society (AISES) at the annual conference in 1994 developed a listing of barriers, issues, and concerns affecting Native Americans; they also drafted recommended classroom practices, recommended curricula, and recommended teacher preparation and enhancement. A third policy guideline comes from the Northwest Regional Educational Laboratory (NWREL). Their "Learn-Ed Nations Inventory" (2002) is a tool for improving schools with American Indian and Alaska Native students. The inventory contained items from a variety of sources including NWREL's earlier document, *Effective Practices in Indian Education*

(1985). These three policy groups represent a diverse group of thinkers whose interests are in better educational opportunities for Native Americans.

Significance of the Study

There are three areas in which this study has the potential to provide significant benefits. One is the synthesis from the research and policy literature of effective teaching and learning strategies with respect to Native American students and relating these strategies to those recommended for all students in the National Science Education Standards. A second potential benefit is the collection of observational data from Native American classrooms, and a third is the documentation of the prevalence of teaching strategies supported by the literature as effective in working with Native American students. Each of these benefits will be discussed separately.

The first benefit is the development of a matrix that aligns recommendations from research studies on teaching and learning practices shown to be effective with Native American students with policy guidelines pertaining to Native American education and the National Science Education Standards (NSES, 1996). The National Standards present a framework upon which many states have based their science education programs. This framework is premised on a conviction that all students deserve and must have the opportunity to become scientifically literate (p. ix). The Standards are comprehensive and do not attempt to give priority to any particular item or section. Research studies selected for inclusion in this dissertation look at teaching strategies and teacher characteristics and their relationships to achievement gains among Native American students. Teachers who

work with these populations of students would benefit from knowing the strategies that research indicates are most effective. This cross-referencing between the Standards and practices recommended as effective in Native American classrooms would not only be valuable for helping instructors to examine and enhance their own teaching techniques, but also for designing professional development. Professional development for science teachers of Native American students could focus on strategies that appear to be good indicators of instructional effectiveness for Native American students. These indicators can then be embedded in an observation instrument. This study takes an existing classroom observation instrument (Horizon's 2002 Classroom Observation Protocol), which has been extensively piloted and evaluated in national studies, then (a) identifies indicators already built into the instrument that are linked with achievement gains for Native American students, and (b) adds several other research- and policy-supported indicators of educational effectiveness for Native American students that were not part of the original instrument. The piloting of this procedure could prove useful in other contexts. Researchers, designers of professional development, or teachers seeking to improve their students' learning might examine existing research regarding practices influencing achievement gains with a particular student population, identify indicators of such practices, and use these to design instruments and collect data in classrooms serving this group.

A second benefit of this study is the collection of observational data from Native American classrooms. The strategies and techniques that teachers use in designing and implementing their lessons are documented. The types of instruction, assessment, the

nature of the science content, and classroom activities are described. One example of an organization which could make direct use of such observational data is the Center sponsoring this dissertation study. In October of 2001 the National Science Foundation initiated support for the Center for Learning and Teaching in the West (CLT West). Among the Center's goals is a focus on research on the inservice and preservice preparation of mathematics and science teachers with an emphasis on ethnicity and diversity issues and on improving the education for high need student populations. The Center supports doctoral candidates who help in developing and implementing ongoing professional development for teachers in high need schools. The sites initially selected by CLT West are schools on and near the Crow and Northern Cheyenne Reservations. Currently, observational data from Native American classrooms in these schools are lacking. Without such data, it would be difficult in future years to determine whether or not any professional development and school improvement initiatives supported either by grant projects, like CLT West or the schools themselves, are having a positive impact. This study involves the collection and analysis of such classroom data. Since barriers to student learning perceived by teachers, administrators, and tribal elders will also be a part of the study, the educational community will gain specific ideas regarding where further professional development should be targeted.

Not only is observational data lacking regarding science teachers' everyday practice on and near the Northern Cheyenne and Crow Reservations, but actual classroom observation data from reservation schools nationwide is also lacking (Demmert, 2001). If educators, administrators, and policy makers are not familiar with the strengths and

weaknesses of current classroom practices, they will lack knowledge and direction in terms of improvement. This study helps to provide such field-based data from these Native American classrooms.

In addition, the American Indian and Alaska Native Education Research Agenda (Strang & Glatz, 2001) emphasizes the significance in studies like the proposed one on collection of observational data to establish prevalent practices in the field by stating: "A descriptive survey of a sample of schools with high Native enrollment percentages would be useful to obtain perspectives on what content and performance standards are in place..."(p. 39). It is evident that a study examining Native American classroom practices is an important and relevant study.

This study examines classrooms and practices from schools that show an achievement gap. At this point, many of the learners in these classrooms are testing in the "novice" category. A third benefit to this study is that the information obtained should not only be helpful to Native American parents and educators, but should help parents and educators in other situations involving large numbers of students currently performing at the novice level. If one can show which research- and policy-supported practices occur on a regular basis in science classrooms serving high need students, and which recommended practices are observed less frequently or not at all, then educators will be in a better position to identify "next steps" to improve learning in such classrooms.

Information gathered that helps teachers work with high need student populations who otherwise have a difficult time succeeding in school should prove a worthwhile

benefit of this study. This study can especially help in this regard by indicating the level of use of a cluster of recommended teaching and learning practices in classrooms on the two reservations studied, thus making more apparent what is already being handled very well, and where there is room for growth and change.

In summary this study will add to the knowledge base on educational practices with high need student populations. A study of this nature does have limitations and it is important to recognize what these limitations are.

Limitations of this Study

Classroom observations have a number of limitations that include the time frame available and the frequency of the observations. The specific geographic region of schools being observed combined with a specific set of research questions means that other important classroom activities need to be left out of the study. Each of these limitations will be discussed in this section.

This study represents a snapshot in time of the middle school science classrooms from various schools serving two different Native American tribes. All the observations took place within the period of one semester. Certainly classes, schedules, and even teachers can change from year to year in these reservation schools, and such changes will not be recorded in this study. It would be impossible to describe and document all the information regarding the activities in each classroom each day, so the results of this study will be based on designated observation times. A sampling of class activities, while practical for a study, is not a complete record of what happens in the class. The

study looks at a limited number of schools and a limited number of classrooms in each school. The sample size is small with respect to making larger generalizations.

There are over 300 tribes in the continental United States, with 13 Indian nations being recognized in Montana (Juneau, 2001). The study focuses on only two tribes, the Northern Cheyenne and the Crow, and the results are not meant to imply they affect all populations of Native Americans. The study serves to provide some information from reservation middle school science classrooms.

The logistical nature of the observation also is a limitation. It is not possible to observe classrooms in a random fashion. Observations must be set up ahead of time. This means that observations are based partly on what the teacher wishes the observer to see. A "showcase" lesson could certainly be presented, and the day to day routine of the classroom could be missing from the observations. On the other hand, there is research (Fairhurst & Fairhurst, 1995) indicating that teachers' general characteristics and styles remain constant throughout their lessons. This indicates that we must interpret data based upon the lesson observed, but there is evidence that teacher characteristics observed in the lesson are representative of teachers' other lessons as well.

Another limitation in the study involves culture and culturally appropriate activities and attitudes. A number of scholars have written about cultural differences between home and school, some focusing on language differences, and others on differences such as patterns of participation, assumptions about time, the tendency to think holistically vs. analytically, or differing sources and standards of evidence (Demmert & Towner, 2003; Deloria & Wildcat, 2001; Nelson-Barber & Estrin, 1995;

Au, 1980; Heath, 1983; Labov, 1972). Children from minority and low income families often enter school with different patterns of communication from those prevalent in the school environment. Erickson and Mohatt (1982) found differences between Native American classes taught by Native American teachers compared to classes taught by non-Native American teachers. They felt the participation in a Native American teacher's class more closely resembled the student's home environment, and therefore helped the student in school. American Indian cultures do not accept the separation of science from other parts of people's lives, but rather science is interwoven into daily life (Deloria, 1991). Science is not portrayed as a mechanical process as it often is in Western culture, and the Native American student may have difficulty when presented with a classroom curriculum that separates content into various disciplines (Weeks & Stepanek, 2003). Cultures differ in ways of using language and in ways of communicating (Lancy, 1983). Students raised with one model at home, then exposed to a different model in school, may face difficulties. These cultural differences, and their implications for science curricula and instruction, are very important, but they are not the sole focus of this study. Through teacher interviews and classroom observations attempts were made to identify the frequency and nature of culturally based activities included in the science classrooms observed. The teacher-perceived barriers to and resources for culture in science classrooms were described. However, this study examines the degree to which a wide range of practices recommended for Native American students are being implemented in science classrooms. In one sense, the practices supported by the research and policy literature on Native American education are intended to be congruent with Native

American culture. But these practices vary in the degree to which they explicitly address aspects of traditional or contemporary Native American culture. Although this study included culturally based practices in the data collection and analysis, this study could not provide the intense focus on such issues that is needed in future research.

There are a number of examples in the literature of science lessons and curricula that are culturally-based (Lipka, & Adams, 2002; Brenner, 1998; Bruchac, 1992; Weiss, 1982). Lessons that present stories on the origin of constellations, multiple uses of plants for dyes, rituals, clothing, or a unit that studies the spiritual classification of rocks are all examples of culturally-based approaches. While these approaches are important, teachers' use of similar approaches was seldom observed or referred to during data collection for this study. Thus the intention to observe a wide range of practices recommended in the Native American education literature, along with the lack of instances in which the teachers in this study modeled or referred to practices that are explicitly culturally based prevented this from being a major theme in this study.

Connecting the community to local schools is always important, but community participation may be even more important in reservation settings (Cotton, 1995). Each of the policy guidelines on Native American education (AISES, NIEA, and NWREL) and many research studies (Kleinfeld, 1985; Leveque, 1994; Mason, 1998) recommend a strong school / community partnership with members of the Native American community, especially the elders. In other words, the local community should be part of school lessons, school culture, and school decision-making processes. This component is far too important to leave out of any study involving Native American education. Thus,

even though this study focuses primarily on classroom practices, information will also be gathered on community members' beliefs about science and youth science education.

The impact of observers in Native American classrooms has not been documented in the literature, and that may be a factor affecting research results. The degree to which an observer in the classroom affects the class lessons is not known. Learners and teacher may respond in more positive or negative ways throughout the lessons when an observer is present as compared to normal classroom routines without an observer.

This study investigated classroom practices in middle school science classrooms serving significant numbers of Native American students. These observations were based on effective teaching and learning practices for Native Americans as determined by research studies and policy guidelines that indicate achievement gains. Barriers and constraints to effective science teaching as viewed by teachers and administrators were explored. The study is significant in establishing observational data from these classrooms that may be used to better understand how to improve Native American students' performance and engagement in science, to design and to guide future professional development opportunities for their teachers, and to guide future research studies. To the extent that the existing research and policy recommendations regarding effective teaching and learning strategies in Native American schools are accurate and by mapping current practices in Native American science classrooms on two reservations, this study documents areas of strength and areas where the need for change is apparent. Information from this study can help contribute to present knowledge with regard to more effective teaching strategies, especially for high need student populations.

LITERATURE REVIEW

A number of important issues needed to be considered prior to conducting a study on teaching and learning in Native American science classrooms. This literature review first examines the historical and socio-historical background behind Native American education, along with the implications of the Native American culture for classroom teaching and learning. Another topic of discussion is the achievement gap, including how it is defined by various sources, as well as possible causes and possible solutions. Information from this study provides information that will lead to stronger middle school science instruction to reduce this achievement gap.

Differences and similarities among various Native American policy group guidelines are discussed and these groups' recommendations are identified. Over 50 research studies are discussed that reveal that student achievement gains among Native American students are influenced by school / community relationships, a series of specific teaching strategies, teacher characteristics, and the classroom's physical environment.

This chapter concludes by illustrating the connections and differences between recommendations from the research on effective teaching and learning practices in Native American classrooms, policy guidelines for Native American students and the National Science Education Standards.

Historical Perspectives

Formal educational programs for Native Americans have been in existence since the time treaties were signed. Juneau (2001) writes that the first examples of American education being offered to Indians occurred in 1617 at Moor's Charity School, Hampton Institute and Harvard University. Other colleges followed suit. Off-reservation schools for K-12 Native American students began about 1874 with many Montana Native American students being transported to the East Coast. Carlisle Indian School in Pennsylvania was the first federally funded effort, and one of the school's contributions was in convincing the misinformed public and congress that Native Americans were educable. By the turn of the century twenty-five boarding schools had been opened (Szasz, 1998). In his book, *The Indian Industrial School* (1977), George Horse Capture writes about both the positive and negative experiences of these schools. In one sense, the schools brought honor to Indian students who were chosen to attend them, but the strict discipline, verbal and physical abuse, and assimilation policies had a destructive effect on many students and on Indian culture (Szasz, 1998). These schools represented the beginning of formal education for Native American students. As white people began to lease reservation land, state supported schools were built on and near reservations, and the populations of students in these schools were largely Native American. These schools were popular with policymakers and families for several reasons. One advantage was they were cheaper for governments to fund than boarding schools, and a second advantage was that students remained in a home environment. Shortly after the turn of the century there were four types of schooling for Native Americans: federally run off-

reservation boarding schools, on-reservation boarding schools, state funded public schools and mission sponsored schools. The mission and church sponsored schools were providing a service by alleviating the overcrowded conditions in boarding schools and church personnel felt they were ministering to the spiritual needs of the students (Chapman, 1965). Federally sponsored schools, public schools, and church sponsored schools still operate on the Crow and Northern Cheyenne Reservations.

Curricula in Native American schools experienced a wide range of changes. During the early boarding school years, a strict discipline code was prevalent and schools were similar to military institutions. It was not uncommon for students to drill march to the dining room, drill march to recreation and drill march back to their living quarters. Between 1910 and 1925 policy groups advocated the Uniform Course of Study (Fey, 1970), which included instruction in the English classics, algebra, geometry and ancient history. In 1928 the Meriam Report challenged the Uniform Course of Study and the need for Native American students to learn material that was not applicable to their lives. It was questioned whether students who were used to other lifestyles, for example a nomadic life herding sheep, needed the classics in literature (Szasz, 1998). Political agendas and economic conditions dominated Indian education policies throughout the 1930s, 1940s and 1950s. The use of Native American teachers, teaching of Native American culture, and bilingual instruction were just a few of the topics that confronted Native American education policy throughout this period. In most reservation schools these ideas did not take hold either because of low finances, lack of qualified personnel, or because of leadership viewpoints. The Kennedy Report of 1969 and the Indian Education Act of 1972 began a shift in Indian education control from the government to Indians

themselves. The formation of Indian organizations like the National Indian Education Association (NIEA) helped to define policies and guidelines for Native American education and often these policies and guidelines were developed by Native Americans. The Meriam Report, the Kennedy Report, and the Indian Nations At-Risk report in 1991 all called for more community and local involvement along with increased native control in determining the education services for Native American students.

Indian education in Montana began in 1890 with a boarding school and a day school (Juneau, 2001). Today Montana's Native American students attend schools of many types, including public schools on and off reservations, as well as schools operated by individual tribes, the Bureau of Indian Affairs (BIA), and the Catholic church. Although most students attend day schools, boarding dormitories are still offered at some BIA and Catholic schools.

Socio-historical Perspectives

Some minority groups do quite well in school despite many differences in culture and backgrounds. Ogbu and his colleagues offer a socio-historical explanation for this when they distinguish between voluntary and involuntary minorities (Ogbu, 1987, Solomon, 1992, Fordham, 1993). They identified voluntary minorities as those who more or less willingly move to the United States for better opportunities. They are people whose ancestral or modern day relatives wanted to be here, and they welcome the educational system's efforts to help them assimilate into the dominant culture. These populations generally believe education improves life. Involuntary minorities are people who have been conquered, colonized, or enslaved. They are permanently a part of United

States society against their will. Their ancestors did not choose to either come here or be colonized. African Americans and American Indians are the two most prominent examples. Because white people forced this situation on them, they sometimes resent whites for having more opportunities today. The involuntary population's evaluation of their own schools is influenced by negative comparisons with schools primarily serving white students. In many cases, their long experience with discrimination, racism, and conflict leads them to distrust white-controlled institutions of which the public school system is one. Involuntary minority parents convey to their children mixed messages about the educational system (Ogbu & Simons, 1998). On one hand they tell their children to work hard in school; on the other hand, their own attitudes and comments reflect to their children their mistrust of the system. Ogbu and colleagues believe that involuntary minorities build up resistance strategies to treatment by white people. Therefore, this population may resist teaching strategies used by teachers in reservation schools, which creates a complex problem for all participants. Ogbu accounts for the complicity of minority students in their own failure:

School performance is not due only to what is done to or for the minorities; it is also due to the fact that the nature of the minorities' interpretations and responses makes them more or less accomplices to their own school success or failure (Ogbu, 1993, p. 88).

Individual learner situations can be very complex when resistant strategies exist within communities, parents, the individual learner, or a combination.

The socio-historical context for Native American education must be taken into consideration as attempts are made to improve education in reservation schools, or to understand the achievement gap. This gap will briefly be examined in terms of possible

causes, inaccuracies caused by factors such as test bias that lead to a distorted understanding of the gap, and some possible solutions in reducing the achievement gap for high need populations.

The Achievement Gap

The term *achievement gap* is now receiving attention at the national level due to the 2002 “No Child Left Behind” legislation, which takes on the commitment of educating every child with an equal and quality education, regardless of ethnicity, income, or background. (<http://www.nochildleftbehind.gov>).

The causes of the achievement gap are complex and varied (Haycock, 2001; Viadero, 1999; Jencks & Phillips, 1998). Viadero (1999) performed a review of the research in order to identify potential causes for the achievement gap. Poverty may be the single most important cause, or contributing factor, to gaps in student achievement. Studies look at the achievement gap as related to race, health care issues, the family’s educational history and attainment, and community influence. Academic programs in which minority students are in effect denied access to higher level courses because they have not had the opportunity to take prerequisite courses, creates another category of achievement gap. In some cases different levels of a curriculum are taught differently depending on the affluence of the schools. A 1994 federal study found that “A” students from a high minority, low income school scored on national tests about the same as “C” and “D” students from wealthier schools (Viadero, 1999). Peer pressure in many schools may keep lower achieving underrepresented students from being successful in school because it may not be popular for these students to be in higher level classes. The high

mobility rate within this population indicates that students move from one school to another several times throughout the school year. Schools and neighboring schools that do not share common, coherent curricula run the risk of leaving these learners behind. Students that have not studied a particular mathematics topic in one school may be lost if the transfer school has already covered that topic (Nelson, Simonsen & Swanson, 2002).

The area of teacher quality in lower economic areas is the focus of many research studies. Darling-Hammond (2000) writes that many times the students who need the very best teachers often receive teachers who are not certified or qualified to teach in their subject area. The living conditions and geographical areas that underrepresented groups reside in may not be desirable for highly qualified motivated teachers. On the average, high need schools get a larger share of teachers who come from the least selective colleges (Wayne, 2001). High poverty schools hire more teachers who score poorly on SAT or ACT college entrance exams ("Quality Counts," 2000). High poverty and high need schools have nearly double the proportion of inexperienced teachers, that is, teachers with less than four years of classroom experience (Mayer, Mullens & Moore, 2000). In mathematics and science only about half the teachers in colleges with 90 percent or greater minority enrollments meet even their state's minimum requirements to teach those subjects, a far greater percentage than in non-minority schools (National Commission on Teaching, 1996). Teachers' expectations, perceptions and behaviors can help to sustain and even expand underachieving populations' achievement scores (Jencks & Phillips, 1998). The purpose of this study is to begin identifying and addressing this issue of effective teaching and learning practices in these classrooms.

The gap begins very early in a child's life. A report from The United States Department of Education's National Center for Education Statistics reveals that differences exist in children's knowledge base beginning in kindergarten (<http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2000070>, 2000). This report found that when children entered school, 66 percent could recognize letters of the alphabet, 29 percent knew the beginning sounds of words and 17 percent understood the ending sounds. Although many results were inconclusive, some were conclusive. The kindergartners from two parent families were more likely to score at the highest level. Black and Hispanic kindergartners already trailed their white and Asian-American counterparts on tests of general knowledge, early reading and math skills. Jencks and Phillips (1998) believe at least half the academic gap between minority and non-minority students at the end of 12th grade is attributable to learning differences already present when these students begin their school careers. Minority children have less access to good preschool and daycare programs, and even programs such as Head Start, a federal program for disadvantaged students, fail to reach large numbers of qualified children (Viadero, 1999).

Research indicates that many of the assessments used in identifying achievement gaps may contain cultural bias and test analysis inaccuracies (Boone, Rogg, Kahle & Damnjanovic, 1997). For example, errors can occur in the "norming" of standardized test results if particular subgroups of a population do not complete test items. In that instance, analyzed data may not reflect reality. High need populations tend not to complete some test items, which may result in scores that are not accurate indicators of students' knowledge. Steele (as cited in Jencks & Phillips, 1998) points out that one's skill on

these tests is not a good predictor of one's future. Steele questions the wisdom of using these tests as a measure of the achievement gap. His focus is on addressing the problems that cause achievement gaps and in doing that test scores will improve. Popham (2001) found 45 percent of the science test items on the New York State Science Assessment to be culturally biased. He also found that many of the standardized science tests were focused, for the most part, on low-level outcomes, and a question was raised regarding the validity of basing high-stakes decisions or conclusions on any single measure or test.

The Education Trust was established in 1990 by the American Association for Higher Education as a special project to encourage colleges and universities to support K-12 reform efforts. Currently, the mission is to make schools and colleges work for all young people (<http://www.edtrust.org>, 2002). The group identifies six essential elements needed for systemic K-16 improvement (Ed Trust, 1998). These are:

- clear, coherent and rigorous academic standards for all students at all levels that are understood and embraced by the public;
- curriculum aligned with standards for all students;
- ongoing assessment to monitor the progress of students and of schools and colleges toward meeting the standards;
- extra instructional time for students who need it to meet local, state, and national curricula standards;
- mechanisms to help faculty deepen their knowledge, evaluate the effects of their instruction on student work, and improve practice; and

- accountability systems that demand results for and from all students that assure change in schools and colleges that resist improvement and that report regularly to the public with honest data on the progress of all groups of students.

Standardized test scores from schools with predominately Native American populations continue to lag behind schools with non-minority populations.

The first two bullets in the list above are addressed in the National Science Education Standards and the American Association for the Advancement of Science *Benchmarks for Science Literacy*. Understanding these documents is important because they outline, at least from the perspective of the mainstream science and science education communities, what content and concepts are needed to produce a scientifically literate adult.

National Science Education Standards (NSES)
and Benchmarks for Science Literacy

Two major national standards projects of relevance to this study were Project 2061 and the development of the National Science Education Standards (NSES). Each of these will be discussed in terms of purpose, historical development, content focus, and, in a later section, how each relates to standards, guidelines, and research pertaining to Native American education.

In 1985 Project 2061 began as a long-term effort of scientists and educators on behalf of improvement of science education. The purpose in part was to help transform the nation's schools so that all students become well-educated in science, mathematics, and technology. The Project was funded by the American Association for the Advancement of Science (AAAS), the group comprised of over 140,000 scientists,

engineers, educators, and policymakers. The group's first publication, *Science for all Americans* (AAAS, 1989), addressed the question of what constitutes adult science literacy and recommended guidelines regarding what all students should know in science, mathematics and technology. The measure for achieving these goals came in the form of a document, *Benchmarks for Science Literacy*, published in 1993. This document listed very specific benchmarks that learners and teachers in grades K-2, 3-5, 6-8, and 9-12 should be accountable to. Such curriculum areas as the nature of science, mathematics, and technology, the physical and biological sciences, and historical, psychological, and sociological perspectives were listed along with accompanying benchmarks. The assumption is that if students exit grade 12 having achieved these benchmarks, they will be scientifically, mathematically and technologically literate as described in *Science for All Americans* (SFAA, 1989). The benchmarks contained in the book are very specific. For example, in the Living Environment section for grades 6 through 8 (p. 104) some benchmarks include:

By the end of the 8th grade, students should know that

- One of the most general distinctions among organisms is between plants, which use sunlight to make their own food, and animals, which consume energy-rich foods. Some kinds of organisms, many of them microscopic, cannot be neatly classified as either plants or animals.
- Animals and plants have a great variety of body plans and internal structures that contribute to their being able to make or find food and reproduce.

Each of the benchmarks in each of the sections is equally specific prescribing the place that learners should be by the end of a given grade. Although the benchmarks thoroughly describe what content should be presented, they have limited value in classroom observations because they do not address how the content is taught or learned. A number

of resources are available along with *Benchmarks* (1993) and *SFAA* (1989) which partially address this lack. *Designs for Science Literacy* (2001) describes effective curriculum models in classrooms, *Blueprints for Reform* (2002) provides recommendations for policy makers needed for effective reforms in education, and *Resources for Science Literacy* (2003) provides a continually updated data base of outstanding teaching and learning materials. In addition, *ATLAS of Science Literacy* (2001) graphically depicts both the sequence and grade level learners should be taught science, mathematics and technology concepts.

A new national goal for education reform was developed in 1989 when the National Governors Association called for the development of national standards. The first such standards were developed by the National Council of Teachers of Mathematics (NCTM) in 1989 and later endorsed by the National Research Council (NRC) of the National Academy of Sciences (NAS). A science committee was formed consisting of representatives from various science curriculum groups including the National Science Teacher's Association (NSTA), American Association for the Advancement of Science (AAAS), American Chemical Society (ACS), National Science Resources Center (NSRC) and six other curriculum groups (NRC, 1996). Each of these groups recruited volunteers to form committees and working groups. This group formed a draft version of the National Science Education Standards, and later revised this to form the working version of the NSES (1996). The purpose of the Standards, as with the AAAS benchmarks, was to produce a scientifically literate society. The NSES is a general framework outlining teaching standards, professional development standards, assessment standards, content standards, program standards, and science education system standards.

The general nature of the Standards can be witnessed by reading content standard A for grades 5 – 8.

Content Standard A:

As a result of activities in grades 5 – 8, all students should develop

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

This Standard does not specify or define how the classroom teacher should teach inquiry or the frequency that inquiry should be taught, but rather specifies that activities should be utilized that help students develop inquiry.

Local school districts throughout the country utilize the curriculum they find beneficial to their school and community, and that matches state requirements. The Standards strongly influence many of these state curricula, and thus local curricula. The Standards represent views from a wide variety of scientists, educators, curriculum developers, and policy makers, but they did not solicit input or put emphasis on cultural, gender, social, racial, religious, or linguistic influences that affect our nation's school systems on a daily basis.

Policy Guidelines

A number of documents have presented guidelines for educational practices with Native American students. Three such documents included in this discussion will be the American Indian Science & Engineering Society (AISES, 1995) document "Educating American Indian / Alaska Native Elementary and Secondary Students," The Northwest Regional Educational Laboratory's (NWREL) document "Learn-ed Nations: Planning

School Improvement in Native American Communities” (2002), and the executive summary “Forum on the 21st Century: Indian Education Blueprint” by the National Indian Education Association (NIEA, 1999). The discussion of these policy guidelines revolves around each group’s recommendations for student learning, pedagogical approaches, curriculum content, assessment procedures, and any other area of importance to Native American education.

American Indian Science & Engineering
Society (AISES)

AISES sponsored an NSF-funded conference on Native American/Alaska Native education in May of 1994. The conference included over 30 participants from 16 different tribes from throughout the United States. As a result of this conference meeting a number of recommendations and suggestions regarding Native American education were developed (AISES, 1995). The primary goal of the conference was to develop a set of guidelines ensuring that cultural needs and issues are addressed in Native American education. A number of barriers, issues, and concerns relating to Native American education were discussed. The high dropout rate, inadequate parental involvement, discrimination, and culturally irrelevant classroom activities are a few such constraints. The group’s recommendations for improvement focused around community, school, and classroom strategies.

A number of key suggestions were presented on the effective use of pedagogical techniques. It was recommended that teachers use hands-on, inquiry-based learning approaches. Problem solving lessons should be introduced to students, along with

cooperative group activities. All science, mathematics, and technology education should be relevant to Native Americans and the communities they live in. Teachers should attempt to understand the culture of the particular tribe they are working with. Whenever possible, community members and community resources should be included in teaching the above lessons. Teachers should recognize individual students for their participation and progress in school.

The above pedagogical techniques should be delivered within the context of a strong curriculum. The AISES conference participants recommended that the curriculum be aligned with the assessed cultural needs and concerns of the community. They stated that the curriculum should be holistic and spiritual bringing in local Native Americans as resource people. Appropriate cultural knowledge, methodologies and language utilization should be emphasized. Technology should be integrated throughout the curriculum.

AISES addressed assessment on three levels: assessment of the learner, assessment of the curriculum and needs assessments in the community. Some major recommendations regarding assessment include the use of performance-based assessment with individual learners. Ongoing assessment comparing the curriculum to community goals helps to insure alignment between the school and the community. Assessment should be used to continually compare the implementation, impact and outcomes of the curriculum. Community-wide needs assessments should be used in designing the science, mathematics, and technology curriculum. These needs assessments include community elders, role models, and potential mentors.

Learn-ed Nations: Planning School Improvement
in Native American Communities (NWREL)

A Department of Energy funded project beginning in 1985 produced a number of monographs relating to research on classroom practices that were effective with Indian students. These monographs were widely used in the Pacific Northwest as a guide in educating Native American students. Since the original monographs did not contain information regarding standards and assessment that is important to teachers of Native American students today, a panel of Native master teachers was assembled several years ago to provide suggestions regarding such practices. This group decided that a tool was needed to inventory Native American schools and communities for the purpose of gathering baseline data which could be used locally to chart a course for the future. Out of this work, a "Learn-Ed Nations" inventory tool was developed (NWREL, 2002). This tool can be used to survey areas such as school improvement, administrative leadership, community characteristics and needs, instructional practices, assessment, and professional development.

Regarding pedagogical techniques, the "Learn-Ed Nations" document states that instruction should be based on quality research, and should develop students' higher-order thinking skills. Local ways of knowing and teaching should be included in instruction. Technology should be utilized to provide access to additional instructional and learning resources, and instruction should be aligned to students' varied learning styles. Real world, inquiry-based cooperative learning opportunities should be provided,

and all instruction should be aligned with the curriculum, and with state, and national standards. There should be an emphasis on self-directed learning.

“Learned-Ed Nations” is also concerned with curriculum considerations. The document states that the curriculum must set high expectations for all learners. The curriculum should be culturally inclusive with high regard for diversity. Assessments should be aligned with the curriculum, instruction, and state and national standards. Assessment instruments should be reviewed for cultural bias, and assessments should be used as formative learning tools, given frequently with adjustments and interventions allowed. Students should be taught criteria used to assess their work so that they can begin to develop self-assessment skills.

The NWREL document also recognizes the importance of additional factors. For example, the report states that students having a voice in developing behavioral policies is important as well as parents and community members having a voice in the school setting. The report also recommends outreach activities that involve the students in learning experiences in the community.

According to “Learned-Ed Nations,” administrative leadership teams need to be collaborative, empowered, and should exist at all levels (district, school, and community). Long range vision and improvement plans should be in place, should be developed and understood by all stakeholders, and should be culturally inclusive. Facilities need to be accessible and inviting for all, and the community needs to take an active role in keeping these facilities clean and in good repair. The school should be decorated with student art or projects that show students’ accomplishments, and the school should serve as a central gathering place for community events.

National Indian Education Association (NIEA)

As a part of the National Indian Education Association 1999 convention, a forum was conducted to initiate public discussion about the needs of Indian education.

Approximately 60 people attended the session, and while the recommendations are not nearly as extensive as those from the other two groups, there is merit in listing some of the issues raised (<http://www.niea.org/blueprint1a.htm>).

Standards or expectations for Native American students are not clearly established. Many in society have come to accept poor academic performance by Native American students as normal, and a better image of these students must be nurtured. A difficulty arises in schools with large Native American populations in hiring Indian teachers. Native American teachers are difficult to find and hire, yet they are important as role models for Native American learners. New teachers, in addition to existing instructors, need to be supported by fellow teachers, administrators, and communities. Another discussion at the convention centered on whether schools should develop local curricula with limited resources or use existing national curricula. Assessing learners and checking the cultural validity of existing norm-referenced tests are important points. If current norm-referenced tests are not culturally valid, then the public may be given information that is not accurate for this population of people. Developing local leadership to initiate and guide systemic change in education may be part of the solution.

Another source of information came from West Virginia University which developed a series of modules about access and equity in education which is available on the web (<http://www.as.wvu.edu/~equity/native.html>, 2002). One of these modules

focuses on students underrepresented in science fields and outlines strategies for teaching Native American students. The strategies were taken from a variety of sources, books, journal articles, the 1994 AISES conference, and the university's own faculty. The module addresses general instructional strategies, discussion strategies, extracurricular activities, experiential activities, and institutional activities. It contains a section on materials / methods / curriculum that provides numerous curricular suggestions to all science disciplines for engaging Native American students.

Research Studies

In addition to policy guidelines from AISES, NWREL and NIEA, research studies on effective teaching and learning practices in Native American classrooms were examined. The research studies selected pertain to Native American classrooms or Native American students. A number of criteria established what studies were included in the review:

- The research questions addressed teaching and learning of Native American students in 4th through 12th grade.
- Journal articles were published in national journals requiring peer-review.
- Books needed validity and acceptance in the field of Native American education. These books and their authors were cited frequently throughout the literature on Native American education.
- An effort was made to include studies addressing groups of students in a typical classroom setting rather than studies that focus on just one individual student.
- Acceptable designs include experimental, comparative, and descriptive studies.

- The content of the research study was mainly from science, mathematics, and language arts.

Language arts is included because of the importance of reading and grammatical skills in other curricular subjects. Correlation between standardized test scores of mathematics, science and reading will be explained in the next chapter.

The 58 research studies presented in Table 2 met the above requirements. Written presentations and dissertations involving research in Native American classrooms are included as well. Three policy groups already mentioned (AISES, NWREL, NIEA), the West Virginia web site, and the 58 articles are used as sources of expert recommendations regarding Native American education.

Recommendations in the research studies and policy guidelines fell into four categories (See Table 2). These categories include school and community factors that affect Native American learning, general concepts and practices that all teachers of Native American students should incorporate into their lessons, teaching strategies used in Native American classrooms, characteristics of teachers, and the physical environment of the classroom. The recommendations in these categories in Table 2 are arranged with the relevant studies listed beneath them.

General Approaches to Content, Instruction, and Assessment of Specific Teaching Strategies

The research shows gains in Native American students' school performance when certain teaching strategies are present. Teachers who prioritize supporting students first seem to enable Native American students to be most successful (Reyes, Scriber &

Paredes, 1999; Little Soldier, 1988). In these classrooms the teacher serves as a facilitator or delegator working with students in a cooperative approach often involving group problem solving strategies (Gilliland, 1988). Science lessons resulting in significant gains in achievement often occur in an outdoor setting (Zwick & Miller, 1996) or are framed around culturally related activities (Haukoos & LeBeau, 1992). In science, the opportunity to present such culturally related activities within the historical context of the lesson is readily present.

While cooperative learning is a valuable teaching strategy for all students (Slavin, 1983), research shows that the use of this technique with Native American populations is especially important. For example, a quasi-experimental design study investigating the achievement gains of Indian middle school mathematics students found significant gains when cooperative teaching strategies were used (Brancov, 1994). The sample included 129 students on one Indian Reservation in South Dakota, where two groups were taught a unit on problem solving. Analysis of data with a pre- and post-tests indicated significant achievement gains in the cooperative learning taught group. Six other studies found significant gains in Native American student achievement when some form of cooperative learning was used, and several policy guidelines recommend this teaching strategy. In addition to significant achievement gains when cooperative learning strategies were used, more student on-task behaviors were recorded (Cajete, 1999). Another study demonstrating effective classroom language learning found higher gains when the students were taught using a cooperative approach (Bennett, 1987). Some research indicates that in many Native American cultures it is not appropriate to show oneself to be superior to others (Dumont, 1972, Wax, Wax & Dumont, 1964). This may

be one of the contributing factors explaining why cooperative group work is more effective compared to competitive activities in Native American classrooms.

Teachers who provide a variety of teaching strategies (Larimore, 2000; Banks, 1994; Swisher, 1990) in high activity classrooms (Cleary & Peacock, 1998) are teachers who experience success with their Native American learners. While studies show that these strategies involve many different approaches, the use of inquiry-based strategies is particularly successful (Cleary & Peacock, 1998). These approaches lend themselves well to cooperative learning in a student-centered classroom.

When Native American students are instructed using visual learning techniques, both achievement and interest increase. Nineteen studies present converging evidence that Indian students are image driven (Plank, 1994; Swisher & Deyhle, 1992; Gilliland, 1992). Teachers of Native Americans who use visual learning aids such as outlines, pictures, maps and demonstrations are implementing visual learning strategies. A descriptive study involving 112 Native students and 88 non-Native students revealed students' preferences for classroom learning (Wauters, Bruce, Black & Hocker, 1989). A multivariate analysis of variance (MANOVA) was used to find that Native students were significantly more peer-oriented than non-Natives, preferred kinesthetic, visual and tactile learning when compared to non-Native students.

Holistic approaches that organize the student's life around culture, relevancy, learning styles, spirituality, and the community will help support Native American learning. Frequently, mathematics, science, and technology courses may support a hierarchical style that makes it difficult for the Native American learner to assimilate his or her world experiences (Haukoos & LeBeau, 1992). A technique for helping students

in this area might be the inclusion of practical, real world examples in lessons (Walker, Dodd & Bigelow, 1989).

Individual studies support the use of specific strategies with Native students. Research indicates that Native American students need to feel competent prior to engaging in a learning discussion (Appleton, 1983; Longstreet, 1978; Brewer, 1977). The "wait time" for Native Americans can be longer (Winterton, 1976). Native American students may be more field dependent learners than students from other cultural or ethnic groups (Swisher & Page, 1990; Ramirez & Castanda, 1974). Children raised in formally organized families that promote strong individual identity tend to be more field independent (Cohen, 1969), while children raised in families where group identity is promoted tend to be more field dependent (Dershowitz, 1971). Many Native American families promote an extended family approach that often extends through several generations. A study by Dinges & Hollenbeck (1978) supports this idea in that 40 Navajo children from extended families scored significantly higher than non-Native children when tested on a field dependence-independence test. If a learner is field dependent he or she is unable to perceive elements separate from his or her environment. It becomes very difficult for the field dependent student to discern important details from a confusing background. A biology teacher who attempts to teach the concept of cell structure by including all the other areas with which a cell interacts would be presenting a difficult lesson for field dependent learners. The field dependent learner would need the cell structure taught by only including information about the cell without the addition of other concepts or information. The field dependency of learners can be important as teachers plan and teach lessons. Native American students may be more silent when

involved in cooperative discussion (Guilmet, 1978). Traditionally most Indians prefer to listen as opposed to speaking. Idle conversation would generally not happen except among close friends (Cajete, 1999). Achievement gains for Native American students are higher when teachers use higher order thinking skills in their lessons and include the use of open-ended questions (McCarthy, Wallace, Lynch & Benally, 1991). One study indicated that grade point averages are statistically higher when Native students are taught by teachers using informal teaching techniques as compared with teachers using formal teaching techniques (Klitza, 1972).

Native American learning seems to be associated with observation and modeling, and teachers who favor this style may be the most successful with this population (Sunia & Smolkin, 1994; Bennett deMarrais, Nelson & Baker, 1992). Fifteen research studies support the idea of the teacher utilizing modeling as a teaching style technique.

These teaching strategies are not new and have been shown to be effective with many types of learners. However, with Native American learners, it may be especially important to include these teaching strategies. Additional research is needed to determine the level of importance of these strategies.

Teacher Characteristics

Different teachers bring different personalities and characteristics to their classrooms, which is another area of research in Native American education. Even though research on teachers' personality traits and behaviors does or does not produce a large number of consistent findings (Schalock, 1979; Druva & Anderson, 1983), studies

suggest that effective teachers adjust their teaching to fit the needs of different populations of students (Doyle, 1985).

A warm personal teaching style along with someone who is friendly, uses humor, and is encouraging may be the ideal teacher for Native American students (Pepper, 1985). A research study by Kleinfeld (1973) with 15 Athabascan Indian students revealed significant achievement gains when a warm nonverbal approach was used when administering the Wechsler Intelligence Scale Test as opposed to a cold nonverbal approach. Humor can be a useful teaching strategy when working with Native American students. Humor can be important in bringing Indian students together and reaffirming bonds of kinship (Herring, 1999). Care should be taken to use humor discreetly being sure not to offend any part of the group. Classroom management plans are best developed by communities, tribal councils, administrators, teachers and students (NWREL, 2002), and teachers who utilize a well defined, consistent approach towards classroom management will have the most success with their Native American students (Pepper, 1985).

Classroom Physical Environment

Researchers recommend that teachers create an informal classroom structure (Brancov; 1994, Gilliland, 1992), and this informal structure allows a flexible arrangement of furniture meaning that teaching and learning situations can be set up that are conducive to cooperative learning strategies.

The Community and the School

Many studies on Native American education examine the relationships between the school and the community (Kleinfeld, 1985; Leveque, 1994; Mason, 1998; Dupuis & Walker, 1988). Within these studies three themes emerge that pertain to classroom instruction. The first theme is community involvement in developing the school curriculum. Many of the articles pertaining to this theme are case studies that research successful school / community partnerships focusing on curriculum development. One such example is the Santa Fe Indian School where community members, school personnel, and students work together to improve the school (Dozier, 1999). Prior to implementing any changes to the curriculum or other aspects of the school program, the above stakeholders met to share individual visions on what successful Pueblo education might be like. Out of this emerged the Community-Based Education Model (CBEM) which addressed philosophies, community needs, student and assessment needs, and research and evaluation requirements. The school developed themes around community needs and also developed strategies to integrate community leaders, business people, and tribal elders into the workings of the school. This qualitative study revealed positive reactions on behalf of students to the integration of Pueblo community culture, traditions, and needs into the school curriculum. Cutting edge technology was available for student and community use. Student motivation to learn environmental science increased, and networks were developed between the business community and the school. Similar results were obtained in another case study from the Kickapoo Nation School located in Powhattan, Kansas (Dupuis & Walker, 1988). In 1985 a new school administrator used

community input to develop an open education concept and a "Circle of Learning" approach which addressed the Indian child's values in a school setting. Some examples of specific learning activities students encountered in regular classes as a result of this program including giving oral presentations concerning their own culture, reading contemporary Indian literature, studying the structure of tribal government, and learning about contributions of Indian community projects. Student performance turned around at Kickapoo. Prior to intervention, achievement records indicated that severe deficiencies existed in language arts, mathematics, and science. After two years of the program, these deficiencies were reversed. The key to this success was the continued cooperative efforts of community, staff, and students.

A second theme in the literature is the relationship between parental involvement in the school and student success. One study showed the strongest link to student achievement was parental involvement and participation in school activities (Leveque, 1994). In another study students who had previously experienced difficulty in a school setting by frequently being absent, tardy, or suspended were helped when parental input was solicited and programs were put into place that valued parental input (Mason, 1998).

A third theme of the community based literature is the role of family in the students' lives. In tribes in which family traditions include doing well in the context of the broader society, the students demonstrated solid achievement in school (McInerney, McInerney, Ardington & DeRachewiltz, 1997). In tribes in which families generally valued achievement, students had higher grade point averages, attended class more regularly, and spent more time doing homework (Lin, 1990).

According to this segment of the literature, a strong relationship with the community the school serves is an important contributor to the success of a school. This community / school partnership should be developed and maintained for the maximum gain of Native American learners.

Gaps in the Literature

Despite the large number of studies on Native American populations in a classroom setting, there is still a great deal that is not known.

- Many of the teaching strategies available to science teachers are not included in the existing studies.
- The long-term impact on student learning of the strategies implemented has not been researched. Oftentimes the measurements were collected shortly after the treatment was administered, and long term gains were not monitored.
- The impact of various curricula on Native American education is an area absent from research studies. Many of the policy guidelines recommend holistic, culturally relevant curricula, but significant numbers of research studies or even examples of such curricula are not present in the literature.
- The impact on student learning of Native American teachers compared to non-Native American teachers has not been researched.
- One strategy commonly used in Native American classrooms is involving students in science fair projects (AISES, 1995). More research is needed to monitor any achievement gains resulting from student participation in science fairs and other project-based activities.

- The importance of community involvement in Native American schools is well documented in the research literature. However, the impact of community participation on student learning in individual Native American classrooms has not been studied extensively. Research is needed to find the gains obtained from such strategies as regularly bringing tribal elders into the classroom setting as guest presenters.
- AISES recommends curricula that foster the spiritual relationship between Native Americans and their environment. Such curricula need to be developed, followed by research studies to determine the benefits.

Table Two

For the purpose of developing observation rubrics, Table 2 was developed to show the relationships between research studies, policy guidelines, and the National Science Education Standards (NSES). From the literature, research studies and policy guidelines involving achievement gains with Native American students were identified. Analysis revealed that these studies could be classified into four general categories: community and school, teaching strategies, factors teachers should include in their lessons, and teacher characteristics in the physical environment of the classroom. Each of these categories is listed along with the research study or policy guidelines that supports that theme. The policy guidelines are in italics, the book references in bold and the research studies in normal font style.

The NSES is a very general framework. In the matrix, a letter identifies the various Standards and beneath these lettered Standards are bulleted items. Each of the

bulleted items was given a number rating for the matrix. For example, Teaching Standard A2 would state:

- Teachers of science plan an inquiry-based science program for their students. In doing this, teachers
- Select science content and adapt and design curricula to meet the interests, knowledge, understanding, abilities, and experiences of students (NSES, 1996, p. 30).

Using this number scheme, a reader can progress down through the various teaching, professional development, assessment, content, program and system standards, identifying the ones that correspond to the Native American research or policy guidelines. A complete list of the identified NSES standards along with a table showing the frequency they occur is listed in appendix A.

Table 2. Relationships between Recommendations from Native American Education Research Studies, Policy Guidelines, and the National Science Education Standards

Theme for Recommendation	Source of Recommendation Research Study, Policy Guidelines and Books	Corresponding NSES Standard letter, ref. number
Communities and School Community involvement in curriculum development	NWREL, 2002; NIEA, 1999; Dozier, 1999; Reyes, 1999; Mason, 1998; AISES, 1995,; Sears & Medearis, 1992; Dupuis & Walker, 1988; Kleinfeld, 1985; Jannusch & Big John, 1976.	Teaching Standard D5, Program Standards B2, E1, System Standard A1, B1, E1.
Parental involvement in school-related activities.	AISES, 1995; Leveque, 1994; Butterfield & Pepper, 1991; Cummins, 1986; Rohner, 1965.	Teaching Standard C5.
Broader family influences outside of school	WVU site, 2002; Willetto, 1999; McInerney, McInerney, Ardington & DeRachewiltz, 1997; Coggins, Williams & Radin, 1996; Lin, 1990.	Content Standard F6, Program Standard D5.
General Approaches to Content, Instruction, and Assessment		

Theme for Recommendation	Source of Recommendation Research Study, Policy Guidelines and Books	Corresponding NSES Standard letter, ref. number
Use of formative assessments	NWREL, 2002; Reyes, 1999; Bordeaux, 1995; AISES, 1995.	Teaching Standards A3, C1, C3; Assessment Standards B3, C4, D1, D2, D3, D4.
Student-centered classrooms	Reyes, 1999; Little Soldier, 1988; Kleinfeld, 1972; Klitza, 1972.	Teaching Standards A2, D2, D6, E3.
Inclusion of culturally related activities	WVU site, 2002; NWREL, 2002; AISES, 1995; Brancov, 1994; Haukoos, G, 1992.	Teaching Standards A2, B4, E1. Professional Development Standard D5.
Use of strategies to address limited English skills	WVU site, 2002.	Assessment Standard D3.
Inclusion of a variety of teaching strategies	Larimore, 2000; AISES, 1995; Banks, 1994; Swisher, 1990; Shade, 1989; Walker, 1989; Delpit, 1988; Ramiriz & Castaneda, 1974;	Teaching Standard A2, C1.
Presenting curriculum in a holistic fashion	Cajete, 1999; AISES, 1995; Rhodes, 1988; Mokakit Paper presentation, 1984.	Teaching Standards A2; Professional Development Standard B1; Content Standards F5, G1; Program Standards B1, B2, B4.
Students' need to feel competent prior to engaging. Activity-rich motivating classrooms	Appleton, 1983; Longstreet, 1978; Brewer, 1977; Werner & Begishe, 1968; Wax, 1964. Cleary & Peacock, 1998.	Teaching Standard A2.
Specific Teaching Strategies Learning through observation and modeling	Suina & Smolkin, 1994; Bennet deMarrais, 1992; Swisher & Deyhle, 1989; Pepper, 1985; Wolcott, 1984, Appleton, 1983; Guilmet, 1979; Downey, 1977; John-Steiner & Osterreich, 1975; John, 1972; Phillips, 1972; Cazden & John, 1971; Briggs, 1970; Phillion & Galloway, 1969; Rohner, 1965.	Teaching Standard B5, Professional Development Standard B2.
Group problem solving	WVU web site; 2002, AISES, 1995; Gilliland, 1992.	Teaching Standard A2.
Use of Nature activities and outside activities	Zwick & Miller, 1996; Haukoos., G., 1992; Gilliland, 1992.	Teaching Standards A2, D5.
Cooperative group work	NWREL, 2002; Cajete, 1999; Brancov, 1994; Plank, 1994; Stah and VanSickle, 1992; Little Soldier, 1988; Cleary & Peacock, 1998; Bennett, 1987; Cohen, 1986; Johnson, 1984; Slavin, 1983; Phillips, 1972.	Teaching Standards A2, B2, E4.

Theme for Recommendation	Source of Recommendation Research Study, Policy Guidelines and Books	Corresponding NSES Standard letter, ref. number
Use of technology to Provide additional instructional and learning resources.	NWREL, 2002; AISES 1995.	Professional Development Standard A3; Content Standards E1, E2.
Use of inductive reasoning - inquiry	NWREL, 2002; Cleary & Peacock, 1998; McCarthy, 1991.	Teaching Standards A2, B1, D2; Professional Development Standard B4; Program Standard B3.
Use of visual learning approaches	Larimore, 2000; Cajete, 1999; AISES, 1995; Plank, 1994; Swisher & Deyhle, 1992; Gilliland, 1992; Kaulback, 1984; Appleton, 1983; Brewer, 1977; Wolcott, 1976; Berry, 1976; John-Steiner & Osterreich, 1975; Kleinfeld, 1973; John, 1972; Philips, 1972; Cazden & John, 1971; Lombardi, 1970; Philion & Galloway, 1969; Collier, 1967; Rohner, 1965; Wax, 1964.	Teaching Standards A2, C1.
Extended "Wait Time" Respond to students' field dependence / field independence	Winterton, 1976. Pewewardy, 2002; Cajete, 1999; Swisher & Page, 1990; Dinges & Hollenbeck, 1978; Ramirez & Castanda, 1974.	Teaching Standard A2. Teaching Standard A2.
Making practical applications	NWREL 2002; AISES, 1995; Walker, Dodd & Bigelow, 1989.	Teaching Standard A2; Professional Development Standards A2, B2.
Use of approaches that understand and respect silence in Native American students	Guilmet, 1978.	Teaching Standard A2.
Use of open ended questions	McCarthy, 1991.	Teaching Standard A2.
Teacher characteristics Warm personal teaching style, teacher is friendly, uses humor and is encouraging; behavior management is calm and "matter of fact."	WVU site, 2002; AISES, 1995; Wauters, 1989; Pepper, 1985; Kleinfeld, 1973.	
Classroom physical environment Classroom decorated with student art or other projects.	NWREL, 2002.	
Informal classroom structure	WVU site, 2002; Brancov, 1994; Gilliland, 1992; Whyte, 1986; Pepper, 1985	Teaching Standard D6.

Including NSES in Table 2 helps to demonstrate the considerable overlap between practices recommended in the research and policy guidelines on Native American education and recommendations in NSES. Both the AISES and NWREL documents indicate that requirements and Standards for Native American students should be upheld, and, as shown in the matrix above, there are many areas of overlap between the recommendations of the NSES and the findings research studies on Native American education.

This Table provides another benefit. By plotting the frequency that various recommendations from the research or policy documents connect with a standard in NSES, one can help teachers, parents, administrators, planners of professional development, and policy makers to identify key areas of overlap or difference regarding recommendations for Native American teaching and learning and the NSES. For example, a reader reviewing Table 2 might note that NSES Teaching Standard A2, which states that

Teachers of science plan an inquiry-based science program and select science content and adapt and design curricula to meet the interests, knowledge, understanding, abilities, and experiences of students (p 30).

This is reinforced by the findings of 15 research studies and policy documents on Native American education. This standard, important to all teachers, is especially important according to research to those working with Native American students.

Another example can be found in Teaching Standard B where one finds several connections to the Native American research studies. This includes:

Teaching Standard B

Teachers of science guide and facilitate learning. In doing this, teachers

- Focus and support inquiries while interacting with students
- Orchestrate discourse among students about scientific ideas.
- Recognize and respond to student diversity and encourage all students to participate fully in science learning.
- Encourage and model skills of scientific inquiry, as well as the curiosity, openness to new ideas and data, and skepticism that characterize science (NSES, 1996, p. 32).

Teachers of Native American students should find success by focusing on the above Standard, as this is important for the population of students they are teaching.

Someone working in the area of professional development with Native American teachers might focus on the Professional Development Standards. The recommendations in the Professional Development Standard B2 is supported by 16 research studies and two policy guidelines.

Professional Development Standard B

- Professional development for teachers of science requires integrating knowledge of science, learning, pedagogy, and students; it also requires applying that knowledge to science teaching. Learning experiences for teachers of science must
 1. Occur in a variety of places where effective science teaching can be illustrated and modeled, permitting teachers to struggle with real situations and expand their knowledge and skills in appropriate contexts (NSES, 1996, p. 62).

The above model can be extended into the Assessment Standards, the Content Standards, the Program Standards, or the Systems Standards. For example, educational communities interested in developing strong science programming for Native American schools would look at the matrix and first begin efforts on Program Standard B and

Program Standard F. For Program Standard B, communities and schools would work together to make sure the program of study includes all the content standards, and this content should be embedded within a variety of curriculum patterns that are interesting to students. The research indicates (Dozier, 1999; Leveque, 1994; Sears & Medearis, 1992; Dupuis & Walker, 1988) that when Native American communities and schools work together, the results are high achieving Native American schools. A planning team of school educators, representative community members including tribal elders and school age students would be involved in reviewing and adapting curricula, school management plans and programs of study. These programs of studies should be connected to other school subjects and to the students' life experiences (NSES, 1996, p. 212).

What is Missing in the NSES

The NSES was developed and written with the goal of producing a scientific literate citizen. There was not any consideration given for culture, race or ethnicity. This leaves gaps when attempting to align the NSES with the research studies and policy guidelines found to produce achievement gains with Native American students. Some gaps include:

- A lack of emphasis on community in regards to the teaching of science. Strong family units within the Native American community are essential to consider when teaching Native American students. In Native American families this may include relatives and tribal elders living outside the home. Inclusion of tribal elders, cultural and cultural traditions help students understand the importance of science.

- A lack of emphasis on the culture of Native Americans, a culture rich in history and tradition. Effective science instruction will highlight and emphasize these areas. For some tribes, items like feathers, dissection of animals, various types of plants, roles of men and women, etc., have special significance and require sensitive treatment that science teachers teaching on a reservation need to understand.
- Spirituality is an important component in Native American culture. For many tribes all states of matter are spiritual and Native American students will benefit from effective introductions and explanations into how this spirituality relates to modern science.
- Native American “ways of knowing” are often different from traditional Western approaches to science. Traditionally, Native Americans have shared knowledge of the natural world through stories and other approaches that connect knowledge rather than dissecting it. This is best understood in a statement by Deloria (2001).

Indian accumulation of information is directly opposed to the Western scientific method of investigation because it is primarily observation. Indians look for messages in nature, but they do not force nature to perform functions that it does not naturally do (p. 27).

To the Native American, the world of nature is in constant flux; therefore, Native science does not try to categorize or analyze the same way as Western science. Native thinking does not isolate an object or phenomenon in order to understand it, but rather thinks of nature in terms of an interwoven relationship (Cajete, 1999). The NSES does not address these differences.

Conclusion

Native American students have traditionally had difficulty in performing well on standard measures of academic achievement (See Table 3 in Chapter 3). The research indicates that indirect instructional styles are more effective for Native American students than traditional, direct instructional styles. The reasons may be related to cultural upbringing, socioeconomic conditions or a variety of other factors.

The research on teacher characteristics indicates that the most effective personality for Native American students is one that is warm, friendly, and uses humor, in other words, an encouraging teacher who displays interest in students. Research on the physical environment of the classroom indicates that Native American student learning will improve in a room different from a traditional classroom, one that is informal, learner-centered, and in which student work is displayed. The degree to which all of this actually occurs in Native American classrooms remains to be found.

One question of this study was to determine the degree to which middle school science lessons on the Crow and Northern Cheyenne reservations align with what research and policy guidelines pertaining to Native American education, as well as the National Science Education Standards indicate are effective lessons. This chapter addressed the degree of consistency between effective teaching and learning practices for Native American students, policy guidelines and the NSES. A relatively extensive search of the literature revealed teaching, curriculum and assessment strategies, teacher characteristics, and features of the physical environment that help produce achievement gains in Native American students. The next step was to take this information and

incorporate it in an observation instrument to be used in observing Native American classrooms. The classroom observations reveals the degree to which these recommended teaching and learning principles are evident in middle school science classrooms on two reservations.

METHODS AND INSTRUMENTATION

This study documents teaching and learning practices from middle school science classrooms on the Crow and Northern Cheyenne reservations in Montana and compares these results to the practices that research and policy guidelines for Native American education or science education indicate are effective teaching and learning practices.

In order to accomplish this, it was necessary to address some specific questions. It was first determined which teaching and learning practices, as identified from research studies and policy guidelines, are associated with achievement gains by Native American students. The practices identified were described in Chapter 2. These practices were then compared to those measured in a widely used classroom observation instrument (Horizon Research, 2001) designed to monitor standards-based instruction in math and science classrooms. The instrument was modified to include practices that are recommended for Native American students, but are not present or emphasized in the science standards. Data were then collected from middle school science classrooms in Crow and Northern Cheyenne reservation schools using this instrument and other data collection techniques. The collected data was analyzed considering classroom, school, and community conditions reported to support Native American students' learning. Also barriers and constraints which prevent the implementation of such practices were identified.

This chapter outlines the design for the study. A description of the Crow and Northern Cheyenne population is presented along with sampling methods, data collection approaches including instrumentation and data analysis techniques.

The primary data collection techniques included surveys, interviews and observations. Barriers and constraints to teaching and learning as indicated by teachers, administrators, and community tribal elders in reservation schools were identified through teacher interviews, teacher surveys, community member / elder interviews, administrator interviews and researcher observations. Teacher interviews and teacher surveys indicated the teachers' perceptions of the classroom lesson, and the observations helped to assess what was actually happening in the classroom.

The final section of this chapter will examine a similar study conducted in schools throughout the United States. Horizon Research, which developed the classroom observation protocol adapted for use in this dissertation, took the original instrument into classrooms throughout the country (Weiss, 2003). That study provides valuable baseline data to compare with this study of middle school science in 11 schools on two reservations.

Schools in the Study

The schools in the study are on or near the Crow and Northern Cheyenne Indian Reservations in southeastern Montana. The total number of schools in the study is 11 with a total of 13 middle school science teachers. With the exception of St. Charles school in Pryor, these schools represent all of the private and public middle schools on or near the Crow and Northern Cheyenne Reservations having a science curriculum during the 2002-2003 school year.

Each teacher was observed from two to ten times with a total of 68 different lessons being observed. The observations occurred within one semester. Individual

lesson observations were scheduled approximately every ten days with the goal of observing each teacher four times. Due to school schedules and personal teaching situations like sick days and unexpected schedule changes, the number of lessons observed varied with each teacher. Teachers were surveyed and interviewed regarding their teaching strategies so a thorough description was developed of the teachers' classroom practices. Sixteen community members and all the administrators were interviewed in both the reservations along with five tribal elders from the two tribes. All of the middle school principals were interviewed so a sampling procedure was not required. Both curriculum directors from two of the larger schools were interviewed along with one attendance officer.

The sampling procedure for community members involved the use of snowball or chain sampling (Patton, 1990). The process began by asking professionals in the school setting names of community members who might be familiar with the educational setting in their school. After locating and conducting interviews with these community members, they were asked the same question of who else in the area might provide additional information. Using this technique a number of community members who could represent local views on the schools were identified. Twenty-one community members included parents, health care professionals, business owners, and tribal elders.

The Community and the School

The schools listed are very different in size, economics, demographic characteristics, and funding sources. There are several private Catholic schools in the list that are not required to follow Montana Office of Public Instruction regulations including

the use of certified teachers (all of the observed middle school teachers were certified). The 2000 Census data reveal interesting differences among the Rosebud County population (mainly Northern Cheyenne schools), the Big Horn County population (mainly Crow schools) and the rest of Montana. A higher percentage of Native Americans comprise the population of Big Horn (60 percent) compared to Rosebud County (32 percent). In both counties the percentage of the population living below poverty level is almost twice (24 percent) the average in Montana (14 percent). The retail sales per capita of these two areas is roughly half (\$4,400) of that in other areas in Montana. (\$9,000). The per capita / wage earner income on the Northern Cheyenne Reservation is approximately \$11,000 and for the Crow Reservation is \$15,000. The average for Montana is \$17,151. These reservation areas are less populated (2.5 people per square mile) compared to other areas in Montana (6.2 people per square mile). In approximately 15 percent of the households on the Crow and Northern Cheyenne Reservations a grandparent is the primary caregiver of the family, which compares to a state average of 3 percent.

Since the achievement gap is defined in part as differences in standardized test performance, it is important to look at these performances and the students in the schools for which scores are reported. Science scores are presented from Crow and Northern Cheyenne schools followed by a comparison of Native American students' scores to those of non-Native students, and finally a comparison between students on free and reduced lunch and other students. This section concludes with a comparison of student performance in three subject areas, reading, mathematics, and science followed by the correlations among student performance levels in these subjects. The ITBS scores allow

a comparison; plus they help to bring the achievement gap ideas presented in Chapter Two into the study setting -- the Northern Cheyenne and Crow Reservations. The approach includes Table 3, looking only at science scores; Table 4, making a comparison between Native and non-Native students and free and reduced lunch students; Table 5, providing a comparison of reading, math & science scores -- the general trend is that when one score increases, so do the other scores. Table 6 becomes a quantitative look at these three subjects.

Table 3. Middle Schools on the Northern Cheyenne and Crow Reservations

	Approx. Number of Middle School Students	Number of Middle School Science Teachers	2000/2001 8 th grade ITBS Science Data -- NPR (N= # of students)	2001/2002 8 th grade ITBS Science Data -- NPR (N= # of students)	2002/2003 8 th grade ITBS Science Data -- NPR (N= # of students)
Northern Cheyenne Schools					
Ashland	17	1	49 (N= 11)	60 (N=9)	(N<10)
Colstrip	80	3	54 (N=70)	61 (N = 68)	58 (N = 39)
Lame	46	1	28 (N= 39)	25 (N= 37)	41 (N= 34)
Deer					
St. Labre	80	2			
Tribal	25	1	16 (N= 24)		
School					
Crow Schools					
Crow	40	1			
Agency					
Hardin	130	3	48 (N= 123)	49 (N= 130)	51 (N=123)
Lodge	54	2	33 (N= 50)	25 (N= 41)	27 (N= 49)
Grass					
Pretty	28	1			
Eagle					
Pryor	20	1	<6	33 (N=8)	<10
Wyola	10	1	<6	<6	<10

Table 3 presents Iowa Test of Basic Skills (ITBS) scores for 8th grade science. This was the standardized test used in Montana during the period of this study, and all schools were required to administer this test in 4th, 8th, and 11th grade.

Fairly large differences in standardized test performance exist between schools just off the reservation like Hardin and Colstrip which achieved National Percentile Rank (NPR) scores of 49-61, and reservations schools like Lame Deer and Lodge Grass with NPR scores of 25-41. It appears that an achievement gap exists between reservation schools and nearby non-reservation schools. Ashland, a very small reservation school, whose students achieved an average NPR of 49-61, is an exception. The average NPR for all Montana 8th grade science students for 2001, 2002, and 2003 was 64. The average NPR for Native American 8th grade science students was 42 (N=1344) in 2001, 41 (N=1301) in 2002, and 43 (N=1387) in 2003.

Disaggregating the data based on ethnicity and free / reduced lunch for Hardin and Colstrip is helpful in order to compare the test scores for Native and non-Native students. These two schools have large enough populations of Native American students and non-Native American students to allow meaningful comparisons of standardized test performance. It is helpful to show ITBS scores for two other curriculum areas, reading and mathematics. The achievement gap in test scores is present in science, and also evident in other subjects like reading and mathematics. The scores shown below are for 2001-2002 since this is the most recent year for which disaggregated data were available.

Table 4. 2001 – 2002 Disaggregated ITBS National Percentile Rank (NPR) Scores for 8th Graders in Colstrip, MT; Hardin, MT; and MT; State Average Scores

	Reading (N= # of students)	Mathematics (N= # of students)	Science (N=# of students)
Colstrip			
Native American	47 (N=25)	31 (N=25)	51 (N=25)
White, Non-Hispanic	59 (N=39)	52 (N=39)	65 (N=39)

	Reading (N= # of students)	Mathematics (N= # of students)	Science (N=# of students)
Not free/reduced lunch	60 (N=48)	50 (N=48)	65 (N=48)
Free/reduced lunch	41 (N=20)	34 (N=20)	49 (N=20)
Hardin			
Native American	28 (N= 69)	30 (N=66)	36 (N= 66)
White, Non-Hispanic	61 (N=51)	55 (N=51)	66 (N=51)
Not free/reduced lunch	54 (N=57)	54 (N=57)	57 (N=38)
Free/reduced lunch.	38 (N=76)	29 (N=73)	26 (N=73)
State of Montana Averages			
Native American	35 (N= 1295)	32 (N = 1279)	41 (N=1301)
White, Non-Hispanic	64 (N=9748)	62 (N=9683)	68 (N=9759)
Not free/reduced lunch	66 (N=8464)	63 (N=8414)	69 (N=8476)
Free/reduced lunch.	47 (N=3403))	45 (N=3372)	53 (N=3410)

When 8th graders' average science scores in Colstrip and Hardin are disaggregated based upon ethnicity it is found that in science the NPR for Native American students is 51 (N=25) and for other students it is 65 (N=39). For Hardin Middle School, the results are similar with the Native American students achieving an NPR of 36 (N= 66), compared to 66 (N= 51) for other students. The results indicate an achievement gap associated with ethnicity for these two schools located near the Crow and Northern Cheyenne Reservations.

The scores also indicate an achievement gap linked to income level. Students in Colstrip who participate in free / reduced lunch programs achieved an average NPR of 49 (N=20) in science, while those who did not participate in free / reduced lunch programs reached an average NPR of 65(N=66). The results follow a similar pattern in Hardin and in the state of Montana as a whole. The average ITBS performance of all students in Montana is higher than for non-Native students, and performance is higher for students who are not on a free and reduced lunch plan. These results align with the information presented in the literature review in the previous chapter regarding the relationships between ethnicity, income level, and standardized test performance.

A comparison can be made of average scores on the 8th grade ITBS in three different subject areas.

Table 5. 8th Grade 2001-2002 ITBS Scores for Reading, Mathematics, and Science

Schools	Reading (N= # of students)	Mathematics (N= # of students)	Science (N=# of students)
Ashland	60 (N=9)	73 (N=8)	60 (N=9)
Colstrip	52 (N=68)	47 (N=68)	56 (N=68)
Lame Deer	19 (N=34)	17 (N=36)	25 (N=36)
Hardin	40 (N=133)	40 (N=130)	49 (N=130)
Lodge Grass	16 (N= 41)	19 (N=41)	25 (N=41)
Pryor	29 (N=8)	19 (N=8)	33 (N=8)

ITBS scores were not available for five other schools in the study. Two of the schools are private and are not required to submit scores, two of the schools were reorganizing their educational programs and either did not take the test or did not submit scores for the 8th grade year, and the remaining school is a K-6 school.

The school with the highest NPR (60) in science also has the highest NPR (73) in mathematics and in reading (60). Likewise the two schools that have the lowest NPR

(25) in science also have the lowest NPRs (17 and 19) in mathematics and in reading (19 and 16). This information helps to show that when the student population in a school performs well or poorly in one area of the ITBS, they usually do the same in other areas. It is important to show relationships between standardized test scores in reading, mathematics, and science for two reasons. First, a portion of the achievement gap is linked to reading skills (Goodwin, 2000; Haycock, 1998). Secondly, teachers in this study are middle school science teachers and the findings reported throughout this study pertain primarily to science. Correlations between reading, mathematics and science standardize test scores help to illustrate possible relationships between what students learn in science classrooms and what they learn in other settings.

Table 6. Correlation of 2001-2002 ITBS Reading, Mathematics and Science Scores for Students in Crow and Northern Cheyenne Schools

		ITBS 8 th grade math	ITBS 8 th grade reading
ITBS 8 th grade science	Pearson		
	Correlation	.932*	.987*
	Sig. (2-tailed)	.007	.000
	N	291	293
ITBS 8 th grade math	Pearson		
	Correlation		.946*
	Sig. (2-tailed)		.004
	N		292

*Correlation is significant at the 0.01 level (2-tailed).

A Pearson Correlation comparing student performance in mathematics, reading, and science for the 2001 / 2002 ITBS tests range from .932 to .987. A p-value of less than 0.01 was required for significance. The results presented in Table 6 indicate that all correlations are significant. A student who scores well on the reading test will also score well on the mathematics and science tests. A contributing factor to this relationship between the various subjects may be the reading requirements of standardized tests.

Students who demonstrate strong reading comprehension on the reading test, should be able to use this ability on the science and mathematics test as well. The high correlations among the three disciplines represented in the ITBS data were very consistent for all subjects regardless of which year was selected.

These scores indicate several achievement gaps for 8th grade students in schools on and near the Crow and Northern Cheyenne Reservations. The gaps are visible in two schools with sizable Native American and non-Native populations when the data is disaggregated by ethnicity or income level. The gaps are evident not only in science, but also in reading and mathematics. When performance in these two subjects is compared to that in science, there is strong correlation among student scores.

Data Collection Methods

Each of the research questions in the study was addressed by different sections of the classroom observation protocol adapted for this study from the Horizon COP plus CETP instrument and the Community Member/ Elder / Interview or Administrator Interview. Administrators were asked a different set of questions than community members or teachers. Table 7 identifies the instruments that address the various research questions.

The instrument selected for several components of the data collection in this study is the Horizon Research Classroom Observational Protocol (COP) plus CETP. This instrument was developed as part of the National Science Foundation funded Local System Change (LSC) initiatives and is used in the evaluation of reform work done by

Table 7. Research Questions Addressed by Study Instruments

Research Question	Literature Review	Horizon COP plus CERP				
		Pre Observ. Interview	Classroom Observation	Post Observ Interview	Teacher Questionnaire	Communit /Elders/ Administ. Interview
#1 – The degree that research / policy guidelines align with NSES						
#2 – The degrees that question # 1 aligns with classroom practices.						
#3 (a) (b)-Support for question # 2						
#4 (a) (b) – Barriers and constraints for question # 2						

educational initiatives throughout the nation. The LSC program created a series of reform projects whose goal is to improve science and mathematics through the utilization of professional development opportunities for teachers. It is the same instrument used in Horizon's *Looking Inside the Classroom: A Study of K-12 Mathematics and Science Education in the United States* (Weiss, 2003).

According to Horizon Research, Inc. (2001), the COP plus CERP was developed to measure the quality of an observed science or mathematics classroom lesson. The protocol and the items it contains are based on standards of quality mathematics and science instruction as outlined in the *National Science Education Standards* (National Research Council, 1996), the *Curriculum and Evaluation Standards for School Mathematics* (National Council of Teachers of Mathematics [NCTM], 1989),

Professional Teaching Standards for School Mathematics (NCTM, 1991), and *Assessment Standards for School Mathematics* (NCTM, 1995).

The Horizon COP plus CETP (2001) consists of four instruments: a *pre-observation interview*, the *classroom observation form*, a *post-observation interview* and a *teacher questionnaire*. Copies of each of these instruments are in appendix B.

The *pre-observation interview* is completed several days prior to the classroom observation. The main purpose of this interview is to learn about the context of the lesson to be observed. It reveals both the teacher's lesson plans, and the teacher's perceptions of the class.

The *classroom observation form* is divided into two parts. Part one of the classroom observation form targets background and contextual information regarding the class subject, number of students observed, teacher and student demographics, grade level, and teacher aides. The observer completes a rating of the physical environment, classroom space, and room arrangement. The first part also contains a general teacher checklist of 33 questions divided into four categories. Like many items on the observation form, the questions from the four categories can be completed after the observation. The four categories include Design of the lesson, Implementation of the lesson, Science Content of the lesson and the Classroom Culture within the lesson. Under each of these categories, six to ten questions are listed. Each of these questions becomes a key indicator for a specific aspect of the lesson. An observer rates each key indicator by circling a number from 1 (not at all) to 5 (to a great extent). The observer may also circle numbers 6 (doesn't know) or 7 (not applicable).

For example, under the category of Design, defined as the structure of the observed lesson (Horizon, 2001), structure refers to the sequence of the lesson, how much time was allowed for each of the activities, the instructional strategies, the assigned roles, and the resources of the lesson. Ten key indicators are included in this Design category. The observer circling the appropriate number would rate indicator #8 as listed below.

8. Adequate time and structure were provided for wrap-up.

The numerical rating would indicate the degree to which the observer found the defined time and structure criteria present in the lesson.

Implementation refers to how the teacher carries out the basic structure of the lesson. Questions such as, *"How effectively does the teacher implement the design?"* and *"Is the implementation of the lesson likely to move the students in the observed class forward in their understanding?"* are sample items in this category. Question number one in the Implementation part of the instrument is not applicable to this study as it contains information that was designated for use by the Local Systemic Change (LSC) for which the instrument was initially developed. Teachers in reservation schools would not have completed this treatment, so they would not have access to these LSC materials. A modification of this question will be provided in a later section of this paper.

The Science Content category includes both science concepts and process skills; the nine key indicators reflect that there are many teaching strategies. The Classroom Culture category is important in this study as it measures the extent and nature of the engagement of students in the class. It also provides an opportunity for the observer to document issues of equity and diversity as well as how these issues may impact the observed class lesson.

After completing each of the above four categories, the observer writes a narrative description on his or her overall impressions on that section. A quantitative score is recorded in a "capsule rating" measuring the overall quality of the observed lesson. Responses to the capsule rating are provided on a seven-point scale from "exemplary instruction" to "ineffective instruction."

Part two of the classroom observation form is a modification by the original LSC instrument of another NSF initiative, the Collaboratives for Excellence in Teacher Preparation (CETP) Program. In this second part, the types of classroom instruction and student / teacher interactions are recorded in five-minute intervals. A tally of this information reveals the amount of time spent on instructional strategies such as lecture or hands-on activities; plus student / teacher interactions are recorded in areas such as the numbers of student generated questions.

The *post-observation interview* is conducted with the teacher as soon after the classroom observation as possible. Two purposes of this interview is to determine if the lesson went the way the teacher had planned and to identify barriers and constraints to supporting the learning of Native American students. This interview contains questions regarding the teacher's perceptions of effective teaching and learning practices for Native American learners.

The *teacher questionnaire* is completed after the classroom observation, and this is done at the earliest convenience of the teacher. The questionnaire collects demographic information, including race; it also surveys work related experience. Another part of the questionnaire records the number of semesters of coursework the teacher completed in various science disciplines. Questions also survey teachers regarding the frequency they

use various science instructional techniques in their classrooms. Regarding teacher preparation, teachers are asked to rate the degree to which they feel they are prepared in utilizing various teaching strategies within the classroom. Many of these strategies match up directly with the teaching and learning practices recommended for Native American students. A final series of questions on the questionnaire collects data regarding the teacher's perception on the degree students engage in various classroom activities. Once again, many of these questions correspond to teaching and learning practices recommended as effective with Native American students. Therefore, the original teacher questionnaire developed by Horizon was not modified for this study.

The Pre-Observation Interview, Classroom Observation, Post Observation and Teacher Survey forms are all part of the Horizon COP plus CETP instrument collection. In order to gain additional insights into the community and tribal elder perspectives of questions three and four, an interview was used. The purposes of this *community / tribal elder interview* is to survey community members and tribal elders about their views on current and future school and community relationships. Questions were asked pertaining to community member / tribal elder backgrounds and involvement in the school; plus ideas were obtained regarding how the school might serve the community in a stronger fashion. Other information was collected regarding community member perspectives of science education and their views of science relating to Native American lives and culture.

An *administrator interview* was conducted to discover additional support, as well as constraints and barriers facing schools in reservation communities. Data were

collected regarding issues such as student mobility between schools, student attendance, teacher qualifications, and the teacher availability.

Relationships of the Classroom Observational
Protocol to Effective Teaching and Learning
Practices for Native American Students

The Horizon COP plus CETP instrument and protocol was developed within the framework of the NSES (2001). High scores on the various items in the Horizon COP- CETP indicate the classroom is aligned with the NSES guidelines. In view of the literature on effective teaching and learning practices with Native American learners, some questions in the COP instrument become more important when observations are being conducted in Native American classrooms. Table 8 shows links between key indicator questions from the COP instrument and the research or policy recommended practices to which they correspond. The column titled "Horizon COP plus CETP" contains each key indicator question coded according to which of the four categories (Design, Implementation, Content, Classroom Culture) it corresponds to. For example, a D9 means that item is from the Design category and it is the ninth key indicator question in that category. An I1 is the first key indicator question from the Implementation category. An "L" is from the Content category and a "C" is from the Classroom Culture category. TI refers to the teacher interview, TQ refers to the teacher questionnaire, and CI indicates the community interview.

Table 8. Relationships between Recommended Practices for Native American Education and Horizon COP plus CETP Instrument

Recommended Practices for Native American Teaching and Learning	Corresponding Horizon COP plus CETP Question
School and Community	
Community involvement in curriculum development	CI, TI
Parental involvement in school-related activities.	CI, TI
Broader family influences outside school	CI
General Approaches to Content, Instruction and Assessment	
Use of formative performance assessments	D9, I1, I8 TI, TQ
Student-centered classrooms	D3, D5, D6, D7, D10, I1, I5, I6, I8, L2, L9, C1, C2, C3, C4, C5, TI, TQ
Inclusion of a variety of teaching strategies	D1, I1, I2, I5, I6, I8, L6, L8, C6, TI, TQ
Inclusion of culturally related activities	D3, D5, I1, C1, C2, TI, TQ
Presenting curriculum in a holistic fashion	D1, D7, I1, L8, TI, TQ
Use of strategies to support students' need to feel competent prior to engaging	D3, D5, D7, D8, D10, I1, I5, I6, I8, L2, C2, C4, C5, TI, TQ
Activity-rich, motivating classrooms	D3, D5, I1, I4, I5, C1, TI, TQ
Student learning through observation and modeling	D1, D3, D5, I1, I2, L9, TI, TQ
Use of strategies to address limited English skills	D5, I1, I5, I6, C1, C2, C5, TI, TQ

Recommended Practices for Native American
Teaching and Learning

Horizon COP plus CETP Question

Specific Teaching Strategies

Group problem solving	D1, I1, I2, I7, L6, C5, C6 TI, TQ
Use of nature activities and outside activities	D1, D5, I1, L8, TI, TQ
Cooperative group work	D5, D6, I1, C3, C4, TI, TQ
Inclusion of a variety of teaching strategies	D1, I1, I2, I5, I6, I8, L6, L8, C6, TI, TQ
Use of inductive reasoning and inquiry	D1, D7, I1, I2, I7, L6, L7, C5, C6, TI, TQ
Use of visual learning approaches	D3, I1, I6, TI, TQ
Extended "Wait Time"	I7
Responsiveness to students' field dependence / field independence	D3, D5, I1, L9
Need for practical applications	I1, L8, TI, TQ
Use of approaches that show understanding and respect for silence in Native American students	D3, D5, I1, I7
Use of open-ended questions	D3, D5, I1, I2, TQ

Teacher Characteristics

Warm personal teaching style	I1, I6, I8, L9, C1, C2, C3, C5, TI
Teacher is friendly, uses humor, and is encouraging; behavior management is calm and "matter of fact"	D3, D5, I1, I4, I6, C1, C2, C3, C5, TI

Classroom Physical Environment

Informal classroom structure	D5, D6, D7, D8, D10, I1, I5, I6, I8, L2, L9, C1, C2, C3, C4, C5, TI, TQ
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Note: D = Design Category, I = Implementation Category, L= Content Category, C= Classroom Culture Category, CI = Community/administrator Interview, TI = Teacher Interview, TQ = Teacher Questionnaire

Table 8 is used to produce Table 9, which provides insights into data analysis.

Data were gathered pertaining to all themes in the COP plus CETP. During analysis and

in the subsequent written discussion special attention was paid to indicators that reflect recommended practices for Native American classrooms.

Table 9. Horizon Questions in Relation to the Frequency of Their Appearance in Native American Research Studies and Policy Guidelines

Horizon Question	Frequency of item	Horizon Question	Frequency of item	Horizon Question	Frequency of item	Horizon Question	Frequency of item
Design 1 (D1)	4	Implem. 1 (I1)	14	Content 2 (L2)	2	Culture 1 (C1)	4
D3	8	I2	4	L6	2	C2	4
D5	8	I4	2	L7	1	C3	3
D6	1	I5	4	L8	3	C4	2
D7	5	I6	6	L9	4	C5	5
D8	2	I7	2			C6	2
D10	2	I8	4				

All ten key indicators in the Design category are important in terms of effective science education. Some of the questions, such as D3 and D5 (appearing 8 times) are stronger indicator questions in Native American classrooms as determined by Native American research studies and policy guidelines. For example, the third key indicator in the Design (D3) category asks the observer to rate from 1 to 5 the following statement:

D3. The instructional strategies and activities used in this lesson reflected attention to students' experience, preparedness, and/or learning styles.

This question combines several specific areas into one general question because data are gathered for the question based upon observation in one class period. During analysis and discussion, attempts were made to addressing specific areas of the question. The major focus of the question was rating the extent to which teachers present their lessons for a diverse group of learners.

Eight research studies and/or policy guidelines found that using a variety of instructional strategies with Native American students helps to increase student

achievement (Table 2 –matrix on Research studies). A classroom with a high rating in D3 may indicate teaching strategies that are congruent with high achievement among Native American populations. Another example is key indicator D5. This would be the fifth question in the Design category.

D5. The instructional strategies and activities reflected attention to issues of access, equity and diversity for students (e.g. cooperative learning, language-appropriate strategies/materials).

As in the last example, eight different research studies and/or policy guidelines found that when strategies and activities reflecting attention to access, equity, and diversity issues were utilized, increased achievement occurred among Native American students. Use of cooperative learning and language-appropriate strategies or materials are listed as examples of observable evidence of an instructor's attention to the equity and diversity issues. Other types of evidence might include the use of field dependency when teaching a lesson and evidence of group problem solving work. Interestingly, there are other cooperative learning items in addition to D5 in the Horizon COP plus CETP. For example, item I6 asks the observer to determine the degree to which, "*The design of the lesson encouraged a collaborative approach to learning.*" Collaborative learning is supported by six of the research studies or policy documents reported in Chapter Two. Books and policy guidelines might be represented in more than one category, but research studies tend to focus on one area.

In the category of Implementation (I1) wording was changed from the original Horizon instrument to the instrument used in this study. The original question referred to instructional materials designated for use by the LSC, and since the schools involved in this study are not LSC initiatives, the new question read as follows:

11. The instruction was consistent with the underlying approach of effective teaching and learning practices in Native American classrooms as determined by research studies and policy guidelines.

A second part to this question is: *The instruction was consistent with the underlying approach of effective teaching and learning practices as determined by the National Science Education Standards.* Both of these questions represent broad capsule rating questions, and they were scored at the conclusion of each lesson. Due to the nature of these questions, they represent a large number of research studies for one question (14), a consideration when analyzing this data. Both of these questions are global in nature and they require the observer to synthesize major parts of the observed lesson into a quantitative rating.

Table 9 is valuable in selecting Horizon observation items that are good indicators of effective teaching and learning practices with Native American students. In the category of Classroom Culture the number of studies ranged from two (C6) to five (C5) with an average of three research studies supporting the practices described in each item.

Validity and Reliability

The validity of the Horizon COP plus CETP instrument has been addressed by multiple reviews of the protocol by approximately 60 science and mathematics educators, who served as principal investigators for the Local Systemic Change projects. Questions identified by these individuals as not appropriately measuring the intended objective were revised and returned for further review. This process was repeated several times during the development of the instrument in order to assure broad agreement with the content of

individual questions and the integrity and completeness of the overall instrument (Horizon, 2001).

The validity of the researcher-designed interviews and modified instrument questions was checked by review from a group of Native American educators. This group included a Native American middle school science teacher, a Native American administrator, and a group of doctoral students. The doctoral students were not Native American; however, they were in programs of education and had teaching experience in the public school. In addition, the instruments were sent to a Rural Systemic Initiative meeting where a group of five Native American members from the Flathead Reservation provided input.

Reliability of raters using this protocol was a fundamental concern. A major challenge facing different observers judging a lesson is to assess the effect of various teaching strategies within the placement of the lesson. What one observer assesses as exemplary because the teacher uses a student's question-response as a springboard for discussion the next day, another observer might consider a waste of time, or even as leading to misconceptions by the student. To help minimize observer effects, Horizon Research, Inc., has developed a ten-hour video training session, during which observers rate eight lessons and make comparisons to norm referenced answers. At the conclusion of each section, rationale is provided so future trainers develop consistency in scoring. When this video series was viewed and scored using the classroom observation form, a 92 percent average consistency rating was recorded.

The internal consistency analysis of the five categories is presented in Table 10. By using the overall synthesis rating in each of the categories, the Cronbach's rating was

improved. Horizon Research provided this data for 625 raters during the LSC Core Evaluation in 1997 and 1998.

Table 10. Internal Consistency for Classroom Observation Protocol Item Sets with and without Synthesis Ratings (N=625)

Item Set	Number of items	Cronbach's - without synthesis rating	Cronbach's - with synthesis rating
Lesson design	10	0.96	0.97
Lesson implementation	8	0.94	0.95
Science content	9	0.93	0.94
Classroom culture	8	0.93	0.94
Likely impact on students' understanding	6	0.94	—

Horizon's COP is a strong instrument to use for this study for a number of reasons:

- Reliability and Validity are already established. The training book and video also help to make this instrument user friendly to the observer.
- The core component of the instrument has been in use since 1977, though the 2001 COP version is the newest modification.
- Data exists from other regions and schools in the country so comparative information can be made (though the purpose of this study is not to make such comparisons). The "National Survey of Science and Mathematics Education: Trends from 1977 to 2000" (www.2000survey.horizon-research.com) was just released and contains information that can be related to the COP instrument. "Looking Inside the Classroom: A Study of K-12 Mathematics and Science Education in the United States" also utilizes the same instrument for data collection in classrooms throughout the United States (2003).
- The instrument is designed to elicit many of the kinds of information needed to answer the research questions listed in this study.

The Pre-Observation Interview, Classroom Observation, Post-Observation and Teacher Survey forms are all part of the Horizon COP instrument. In order to gain some additional insights into the community and tribal elder perspectives of research questions 3 and 4, an interview was used. The purpose of these interviews was to survey community members and tribal elders regarding their views on the role of the community in schools and to find out their thoughts regarding science and science understanding.

Data Analysis

Items from the Horizon COP plus CETP instrument relevant to effective teaching and learning practices are explained in the above section. Presumably teachers who utilize such techniques will be ones that are using the most effective practices in teaching Native American students. Each instrument fulfills a requirement in terms of adequately addressing each of the research questions. Table 7 identifies the major questions addressed by each instrument.

Literature Review – In preparation for the study an extensive search of the literature was conducted. Fifty-eight research studies, three policy guidelines, and one web site listing were read, labeled, and divided into four themes. The four themes of school and community, general principles guiding instruction, teaching strategies and teacher characteristics, and the physical environment are used as the guideposts throughout the study. The research studies and policy guidelines are aligned with the appropriate national science standard in Table 3, and this information was used to identify the important observational items from the Horizon instrument.

Pre-Observation Interview – This interview collects data pertaining to the class to be observed. In addition to logistical details of reaffirming the observation date and time, the pre-observation interview identifies teacher perceptions of the upcoming observed lesson. How does the teacher's plan for a lesson match what actually happens, and does the teacher realize any discrepancies (post-interview)? Questions two and three from this interview allow analysis of the degree to which teachers plan sequence into individual lessons or lesson series. Do teachers have a plan regarding the future direction of their lessons? The pre-observation interview helps to answer these questions.

Classroom Observation Form - The information gained from this instrument has many analysis opportunities. The key indicator ratings were placed into an SPSS file. This allowed for quantitative analysis on many levels. The key indicators of practices identified as important in effective Native American teaching and learning were of special interest. In principle, classrooms that earn high scores for these indicators are places where high achievement by Native American students is possible. For example, classrooms whose scores are high in the third, fifth, and seventh items in the Design category are classrooms whose teachers utilize effective teaching and learning practices as identified by research studies and policy guidelines on Native American education. The last section of the classroom observation form indicates the number of times teachers use indirect instructional styles as compared to direct instructional styles. This is particularly relevant to this study because research indicates that teachers of Native American students should shift towards indirect, student-centered instructional techniques. The observer also records what occurs in the class in five-minute intervals. By calculating the frequencies in each of these categories, a "picture" can be developed

of the teaching strategies used in a given classroom. It is beneficial to find the percent of class time that teachers utilize each teaching strategy. A Factor Analysis provides the possibility of reducing the data from the key indicator scores and this may reveal various instructional patterns. The Factor Analysis also helps to group items from the classroom observations into similar categories. This shows the items in the class lesson that exhibit strengths and also items on which teachers need to improve. A one sample t-test determines which of these categories have statistical significance.

Post-Observation Interview – One purpose of this data collection technique is to determine how the teacher's perceptions and goals for the lesson matched what actually happened. The lessons were analyzed from the teacher's beginning ideas (pre-interview) through the actual lesson (Horizon COP plus CETP) and finally to conclusion (post-interview). This was accomplished by comparing the CETP data collected at five-minute intervals with the COP rating scale. The data help to determine teacher awareness and use of recommended teaching and learning principles for Native American classrooms.

Teacher Questionnaire - In May of 2002 Horizon Research (www.2000survey.horizon-research.com) published a National Survey of Science and Mathematics Education: Trends from 1977 to 2000. Because the Teacher Questionnaire was used for this survey, it is possible to compare teachers on the Crow and Northern Cheyenne Reservations with their national data counterparts. Some of the questions which the Teacher Questionnaire helps us to address are:

- How well prepared are science teachers both in content and pedagogy?
- What are teachers trying to accomplish in their science instruction, and what activities do they use to meet these objectives?

- To what extent do teachers support reform notions embodied in the NSES (NRC, 1996)?
- To what degree do teachers understand, feel prepared, and utilize effective teaching strategies with their Native American students?
- What are the barriers to effective and equitable science education?

The survey also collects demographic information, as well as information regarding teacher experience and content preparation.

Tribal Elders/ Community Members and Administrators Interview - As with the other interviews, these were transcribed and coded for patterns or themes. In addition to variations on the questions addressed in the teacher interviews, some questions that were addressed in these interviews include:

- What are the backgrounds or work occupations of tribal leaders/interested community members?
- What are their views regarding the importance of the involvement of tribal leaders / interested community members in the school?
- What is their understanding of "ways of knowing," and how do they perceive the relationship between traditional knowledge or "ways of knowing" and those associated with modern science?

Administrators were asked variations of the questions addressed in the teacher interviews.

Additional questions asked of the administrators include:

- What teacher qualifications and characteristics do administrators look for in hiring?
- What is the nature of student mobility among schools, student attendance, and behavior management in school?

In addition to the National Survey of Science and Mathematics Education survey, Horizon Research also completed a follow up study. *Looking Inside the Classroom: A study of K-12 Mathematics and Science Education in the United States* was the research documenting lesson designs, implementation, content and culture in United States K-12 classrooms (Weiss, 2003).

Looking Inside the Classroom: A study
of K-12 Mathematics and Science
Education in the United States

Horizon Research, Inc., with support from the National Science Foundation conducted observations and interviews in 31 middle school classrooms between November 2000 – April 2002 (Weiss, 2003). Systematic sampling with implicit stratification was used to ensure that the 31 schools would be representative of schools throughout the nation. Instrumentation, methodology, the inclusion of middle schools among those visited, and the time frame for the observations were very similar to this study, meaning that valuable comparative data can be obtained. The purpose of the study, *Inside the Classroom*, was to “look” in the nation’s classrooms to find out the extent that mathematics / science is portrayed as inert collections of facts as opposed to dynamic bodies of knowledge. Thirty classroom observers were trained in the use of the Classroom Observation Protocol and data was collected. A limitation of the study is that each of the thirty teachers was only observed for one lesson. It is also interesting to note that of the 86 middle schools contacted, 46 declined to participate. According to the authors, the selection and sampling techniques used preserved the reliability and validity of this study in sampling science education practices in the nations schools (p. 6). *Inside*

the Classroom provides baseline information on middle schools throughout the country that allows comparisons with middle schools on reservations.

This chapter began by looking at a proposed design for the study followed by a description of the schools and populations involved in the study. Sampling methods were discussed in this section. Instrumentation is important in this study, and descriptions were provided of each instrument used, along with explanations regarding modifications, validity, reliability, and a listing of which research questions were addressed by which instrument. This chapter provides a fundamental methodological framework for the study.

DATA ANALYSIS

As stated in Chapter One, this study examined several questions regarding middle school science teaching and learning in schools with Native American populations. It also compared the degree of consistency between research and policy guidelines on effective teaching and learning in Native American classrooms and the National Science Education Standards to the actual teaching and learning practices in middle school science classrooms. This chapter identifies conditions that support and barriers that prevent the implementation of these practices by reporting information gained through interviews with three relevant groups: community members, administrators, and teachers. It also presents results from middle school science classrooms observation of teachers and their lessons.

The conclusion synthesizes the results of the interviews with these diverse groups by examining their differences and commonalties.

Community Members

Because community members play an integral part in the success of schools, they were interviewed for this study. Valuable insights were gained from parents, health professionals, business owners, and tribal elders as a result of investigating the community atmosphere.

The sampling method used in this study produced a cross section of all these stakeholders. This was accomplished by a modified "snowball" technique (Patton, 2002). At the conclusion of one interview, the community participant was asked if there were

other people in the community who might be able to provide some insights into community / school involvement. This technique was appropriate considering the close networking structure and longevity of the people living in Native American communities. Five elders, four health care professionals, three business owners, and nine parents comprised the interview groups. With the exception of three white parents and two white business owners, participants were Native Americans.

The interview questions explored the background of the individual, community and school relationships, ideas on improving community and school situations, and the inclusion of culturally based activities within the school (See appendix B for a copy of the interview protocol and the interview questions). Community members were also interviewed regarding the support systems or barriers they found in their communities with regards to community and school relationships. The groups are discussed based on these categories with dominant patterns and themes highlighted by actual interview quotations.

Some of the children of interviewed parents are still school-age, while others had already graduated or had dropped out. All of these parents and their children have lived in the community all their lives. In many instances they and their children attended the same school. Regardless of the opening interview question, parents began by relating experiences their children had in school.

My son was a poor reader in school. I couldn't get him to read books at home so when he was in the 5th grade we made a deal that he would read 100 books that year (several stories were told of the yearly reading experiences). He spent the year reading and sure enough his school grades improved and he ended up going to college (Native American parent at the beginning of the interview).

A pattern found throughout all parent interviews related to student success in school. If the student was successful, then parents tended to talk of the positive attributes of the school, and if the child was not successful, then parents tended to talk of the failures of the school. The parent in the first quote talked about the importance of parents in the upbringing of the child.

I thought the school did a good job teaching subjects. My son did well in college and I can thank the school for that. As parents we have the major responsibility in raising our children (Native American parent).

Not all of the opening interview comments had such a positive conclusion.

I had two sons who attended (name of local school). They didn't enjoy school. It wasn't for them. They enjoyed doing things with their hands (several stories were related how they repaired automobiles), and school didn't include such skills in the lessons, so both boys lost interest in school. They were always wanting to quit, and I was trying to bribe them to stay in school. Both of them ended up quitting school (Native American parent at the beginning of the interview).

The group was split regarding the cultural connections incorporated into the school experience. Five parents thought the school was not doing an adequate job, and four parents either felt the school was doing an adequate job or else that it was not the school's responsibility to connect the curriculum with Native American culture.

(The local school) is not addressing the needs of our students. There is prejudice over there (school location) and our students are not getting a chance (Native American parent).

Most of the parents felt that school could do more to help Native American students, and they shared many ideas.

Tribal elders need to come to school and speak to the children. They need to tell the stories of long ago and help students understand their culture (Native American parent).

Grandparents are the key to helping students. They are a wonderful source of information and they are willing and available to come to school (Native American parent and grandparent).

Sometimes the suggested improvements were larger in scope.

Our community needs a high school. It's only then that our children will be educated in the ways of the Crow tribe (Native American parent whose child attends high school in another town).

When asked specifically about ways to improve the school science program, only one parent provided a suggestion.

The tribe needs to sponsor a science camp in the summer. Students might live in Tee Pees and they would be taught science programs along with tribal culture. They can learn this by living together for a week (Native American parent).

Because many parents were not very sure of what science was being taught, and they were not very sure what science should be taught, questioning in this area produced few comments.

Parents expressed concern for their children's dropping out of school and their children's use of drugs and alcohol. These categories were brought up in every interview, even though interview questions did not target these areas.

The four health care professionals consisted of nurses or directors of health clinics (Interview questions in appendix B). In each of the cases, administrators or educators identified these people as "people who understood the climate and nature of the community." When considering community conditions that support and prevent the implementation of teaching and learning practices in Native American communities, health care professionals become a significant factor.

Health issues and health care providers are very important in Native American communities. There were three themes identified in the health care providers interviews. One was the difficulty of distributing health care information, a second was the difficulty of teaching health care prevention, and a third was the frustration of dealing with Fetal Alcohol Syndrome (FAS).

Two health care professionals described efforts to inform the community of upcoming health benefits. One nurse's comment describes this frustration.

Last month we offered a free immunization session where children would be immunized. We put up notices around the town, listings in the paper, we sent announcements to the senior citizen center, sent notes home with school children, had a variety of times throughout the day and the week, and still we had less than 20 children brought in. Despite all our attempts, I don't think we got the word out. It's very difficult and very frustrating to have these services available and not be able to get the information to the people (community hospital nurse).

When questioned how the nurse knew the information did not get to the parents, she talked of people she saw around town that informed her that they never knew about the clinic. Closely related to this theme was another theme of health care prevention. All four health care providers expressed frustration that community people would wait until they had a serious problem prior to coming in for treatment.

People don't realize that simple symptoms can be treated quickly and effectively. They wait until they can hardly get in here, and it requires a great deal of time and money to treat them. We need to educate people on health care issues so they know when and where to go for treatment (community health counselor).

Prevention can be linked to health care education and the concern regarding FAS. A health care worker spent 27 years of her life developing a community clinic with a main focus on treating and identifying FAS. The day of the interview she related a story

of a child who was brought in with FAS. A question was asked regarding the age and experience of the mother of the FAS child.

The mother was not a young girl, in fact this was her sixth child, and each of the other five children has some degree of FAS (community health care director).

This health care director expressed frustration about not having enough staff or money to conduct an active prevention program. She realized that the staff at the clinic was addressing the problem after the fact, and if young families were educated on the effects of FAS on their children's lives, they might be able to make some changes. This director came to the community as a nurse, saw a need for FAS treatment, and raised money to build and staff a clinic; her next goal was to develop a prevention program. She identified the top three health care issues facing Native American communities.

The biggest problem is FAS. It causes children to begin life and begin education behind the eight ball. These kids don't have the same starting point as other children and they are never able to make up this difference. The second biggest problem is substance abuse and the third is alcohol abuse. As a society, these health care issues must be addressed prior to school education (community health care director).

Because of the length of time the health care director spent working in one community, she is a valuable source of information regarding the historical problems that might face one school system in a small community.

When I first came here, I worked as the school nurse in (name of local school). At that point the community was very positive and in favor of the school. Then came inclusion. The private school in town didn't accept special needs students, so parents from our school who didn't understand inclusion thought this would mean a "weaker" curriculum. Instead of becoming informed and instead of getting involved with the school, some of these parents began busing their children to (name of school). This began a decline of the local school. If I could tell parents one thing, I'd tell them to get involved and informed with their local school system (community health care director).

The third community group interviewed, the business owners, reflected on the educational system as a whole. The general feeling was that students were not as prepared for the work force as they once were. They did not blame this on the school system, but rather on society. They did question why the school system allowed these students to get through school. A shop owner who managed a small shop for 22 years expressed her concerns by stating:

It seems like students aren't as capable as they once were. They have difficulty reading price tags and they can't work out some of the simple math used to get their change (shop owner).

Another clerk manager elaborated on this math ability by stating:

I recently had to let go of one of my young employees. She didn't have the skills or ability to work out simple percent problems. We would have customers ask about sale prices and discounts and she continually needed to refer to other people for help with this information. I need independent clerks that are able to learn these types of skills (store manager).

Two of the business people talked about the number of students they would see in their store during the school day. One stated:

It seems like kids don't go to school anymore. I'll see students in here shopping all through the school day. These kids should be in school. Doesn't anybody make kids go to school anymore (store clerk)?

Three Northern Cheyenne and Two Crow tribal elders were interviewed as part of the community interviews (see appendix B). These interviews contain thoughts and ideas on Native American education from their perspectives. A transcript of the interviews is included in Appendix C, and some highlights are discussed below. Each of the tribal elders had at least a seventy-year history of living and working on the reservation. Their educational backgrounds ranged from college graduation to one who had left school in

the 4th grade. Three of the elders spent their lives in some form of ranching or farming. Another worked in a federal position and had volunteered with public school children at various times throughout his life. The fifth was a former tribal judge and tribal chairman; he spent his life working in tribal leadership positions. All of them emphasized the importance of education. The main theme in interviews from the Crow tribal elders is the importance of preserving and maintaining the culture of the tribe.

We need to have Crow culture taught in the curriculum. Traditional values should be taught in the classroom, and these classes should be taught in the Native tongue. Our past history and Native ways of doing things all should be included in the school day. If students understand the Crow language and traditions, then they would be successful in their culture so they could have a basis to be successful in another culture (Crow tribal elder).

A former Crow tribal judge and tribal chairman expressed this same concern differently.

The families no longer pass on traditions so if the culture is to survive, then the school and the community must help out (Crow tribal elder).

A question was asked to the tribal elder regarding how the school might help to sustain the Crow culture.

We have a start in that next fall (2003) our local Head Start program will begin including the Crow language in the program. We need to have Crow language taught in the K-12 school. We also need a high school in (name of local community) so that all our students are together (currently the community has a K-6 school. Students attend an off-reservation school throughout high school).

Two parents also expressed the idea of this community having a K-12 school, and the main focus was that students would then share a common culture, common history,

and common traditions. This interest and focus might provide a key for engaging the school and the community in common goals.

When asked what a culturally relevant curriculum might look like, one tribal elder stated:

Native American legends, stories, and history should be handed down through time and teachers should teach these in school. Stories of the moon, stars, spring and summer seasons, new life – mother nature's way of life, we need to celebrate things with this new way of life. All this should be in the school curriculum. Traditional ways of life should be included. We might have extra courses for teachers to help them understand how to teach these traditional ways of life to students. Indians use animals to survive and we need to pass this type of information on to our youth (tribal elder).

Another tribal elder went on to talk about a culturally relevant curriculum in science.

I would like to see a land grant approach to science – what is needed to survive from the land? The science taught would be based on a study of the land. Courses like "horsemanship" would be taught in the schools (tribal elder).

Two of the tribal elders had thoughts on science curriculum that should not be included.

Teachers should be aware that many plants have cultural implications and they (the teachers) should be knowledgeable about this (tribal elder).

Another tribal elder concisely summed this up by stating:

Botany should not be taught (tribal elder).

Tribal elders and community members talked of plant curriculum topics as those topics that teachers in Native American settings should be careful about teaching. Some plants have spiritual implications and teachers need to be knowledgeable about these

plants. Ecology topics were topics that many community members felt should be included in the curriculum.

The three Northern Cheyenne tribal elders were not as adamant about the inclusion of culture in the schools as the Crow tribal elders were. This may be the result of the location of the tribal elders who were interviewed. The three Northern Cheyenne elders spent most of their lives in communities where students attend schools on the reservation. The Crow elders had spent their lives close to an off-reservation school and all their children had attended the off-reservation school beginning in 9th grade.

The major concern of the Northern Cheyenne tribal elders is in the challenges and discipline of the modern youth.

The most important concern I have is to have some type of structure – youth have fast cars, they go everywhere, do everything, and they don't listen to their elders (tribal elder).

This tribal elder goes on to tell a story of riding in a car with his grandson. There were potholes in the road, and even though he told his grandson about the potholes, the grandson continued to drive fast and hit the potholes. He did not feel that youth listened to their elders. Another tribal elder expressed this same frustration by stating:

I think that discipline in the schools is going down – I watch my grandchildren and their friends and they are not disciplined. They seem to get anything they wish, whenever they wish. I think that students have so many options and get so many things that alcohol and drugs become a natural way to go. I'd recommend that parents and schools provide structure and discipline for children (tribal elder).

Four of the five tribal elders mentioned the importance of bringing elders into school to talk with students. This was also a common suggestion in the parent interviews.

Each of the stakeholders in the community--parents, health care workers, business owners, and tribal elders -- expressed slightly different concerns and suggestions, but a common theme running throughout all interviews was that community and school relations are very important. The participants in these interviews felt the school should involve the community by bringing in tribal elders to speak with students, including parents in school policy making decisions, working with health care professionals on health care prevention issues, and keeping the business community informed regarding student progress.

Middle school science teachers on the reservations were surveyed about how well prepared they felt they were to utilize community resources and community members. Three teachers felt they were not adequately prepared, and four teachers felt they were somewhat prepared. Over 50 percent of the observed teachers felt they could use more training in school / community issues. Five teachers felt fairly well prepared and one teacher felt very well prepared. There were not any relationships between years of experience or observed lesson score ratings and the teachers' perceptions of their school / community preparedness.

Community members were not the only people to have strong opinions about the local school and curriculum. The next two sections explore the views of school administrators and teachers.

Administrators

Administrators provided valuable information about their schools, staffs, and students. As educational leaders in the schools, administrators provide a source of

information regarding the support and barriers facing teachers of Native American students. During interviews for this study specific questions regarding attendance, student mobility, community relations, staff hiring, professional development, retention, and standardized testing were asked (see appendix B). The median number of years experience for the seven male and three female middle school administrators on the Crow and Northern Cheyenne was four years.

One challenge or barrier facing many administrators is the daily school attendance. Four administrators with more experience (above 6 years) report that attendance is good with 93 percent of the students being present in school each day. An administrator with two years experience who reported good attendance was from an off-reservation school.

Conversely, six administrators felt that attendance was a problem in their schools. They reported that dealing with poor attendance is one of their greatest frustrations.

Our attendance problem is very difficult. On "count day" in September (the day Montana Office of Public Instruction certifies numbers of students in a school) we had 98 students enrolled. We are currently down to 55 students, and we've only had about 15 transfer request so where are the other students? Today we have 30 students in school (middle school administrator interviewed in March).

Another administrator expressed the attendance problem this way.

It's frustrating to me that parents won't get their kids to school. The parents want their kids to have a good education, but they don't seem to realize the importance of being at school every day. It seems that kids follow Mom and Dad's schedule instead of Mom and Dad following the kid's schedules (middle school administrator).

This lack of parental support is reflected in many administrator statements.

Attendance is a major problem at our school. From parents of absent students, we don't get the support we need. Forty percent of our

parents don't have a telephone, and we lack an effective truancy office in the school district. It seems like this becomes an issue for social services and not the school (middle school administrator).

Parents won't get excused absences for their children. They take their children out of school for no reason. Students might be in kindergarten one day and not here the next day. Following through with truancy violations is a long process with little consequences (middle school administrator). (A story is told of a two-year legal battle to fine a negligent parent who did not end up having enough money to pay the subsequent fine.)

Administrators also stated possible solutions to the attendance problem. Their main ideas centered on the need to establish better communication avenues between parents and schools especially when the children are young. The attendance problem begins developing early in a child's academic life with the parent taking the child out of school for appointments, meetings or family affairs. According to some administrators, by the time the child reaches middle school, negative patterns have been established that are very difficult to change.

Parental communication issues are expressed in a number of different comments.

The key is to keep communication lines going between all parties. If problems develop between school and home, it's important to contact parents and work together on solving the issue. School improvement is tied into this. Make your school important and make your community proud of the school. Have student notebooks, pencils and book covers all with the school logo on it. Students should be proud to display material from our school. (middle school administrator who reported good attendance).

We need to start early and educate parents on the importance of being in school each day. We also need to be problem solvers. Next year I'm hoping to have an after school program so that parents who have appointments during the school day won't need to take their child out of school. When they finish their appointment at 4:30 there will be supervision for their child and they can take them home (middle school administrator who reported poor attendance).

According to the administrators, solutions to the absentee problem vary with each community and school, thus requiring different approaches. Some administrators advocated an active truancy program and other administrators felt this did not help. Other administrators had success with "community feeds" in which parents were invited into the school for a meal and tour of the building. Other administrators reported that these were not successful. Two schools give awards to students who attend school on a regular basis.

Student mobility was a problem reported in some schools. When students and parents become upset with one school, they move to another school down the road. Students frequently transfer to pursue athletic opportunities, or because they move in with extended family members. Since many school curricula are not consistent with one another, mobile students are often lost when they move back and forth between schools. All the private schools and one public school have closed or limited enrollment with specific rules applying to students entering or leaving a school. Some school policies admit students only during certain times of the year, and other schools have policies that once a student leaves a school, they are not allowed to enroll again during that year. Administrators from these schools report that they do not have a problem with student mobility.

The absentee and mobility problem is closely linked with community relations with the school. With the exception of one principal, every administrator who reported poor attendance problems also reported poor community support. Previous conflicts between schools and communities can serve as dividing points for many years.

We have a divided school community. Tension began to develop when a new high school was built in 1994/95. The community was divided on this issue and this is still with us today (middle school administrator).

Five administrators report that school / community relationships are positive with some districts never having lost a school budget levee in over 20 years. A possible solution for high absenteeism rates, excessive student mobility, and poor community relations is expressed in a comment by one middle school administrator.

Let me tell you what doesn't work. Open Houses, PTO meetings, community meetings, "night feeds," or back to school nights. What does work is one on one contact with each individual parent. Search out these parents and ask the question, "This is your child, can you help us?" Many times we ask these parents to do things they can't do, like help their child with their homework. The parent may not be able to do the homework. We can ask parents to get their child to school; listen to their child read and spend time with their child. It is a slow process, but with persistence, it does work. (middle school administrator).

Administrators are split regarding the ability of their school districts to attract, train and retain a professional teaching staff. Five administrators report that although it is getting more difficult to find qualified teacher applicants, they still have strong applicants and their school district is stable in terms of staff retention. One administrator reported that no one had left the district in two years. When asked about reasons for this success, he cited a higher pay scale, good benefits and a strong school/community relationship. Four administrators mentioned a high pay scale as one of the reasons that staff retention was not a problem, and one administrator mentioned low pay as a reason for having difficulty with staff retention. The base pay for that school district was quoted as \$16,800. This salary competes with another near-reservation public school base salary of \$22,400. In addition to pay, two administrators mentioned teachers not having desirable

living conditions as a difficulty in attracting and retaining teachers. When asked about hiring teachers one administrator commented:

It's not difficult to hire warm bodies with a teaching degree. What is difficult is finding top quality teachers who model exemplary teaching, providing their students with outstanding lessons (middle school administrator).

This administrator relates the story of recruiting a top language arts teacher from a nearby tribal college. The administrator set up a lunch appointment with the prospective teacher and convinced him to teach at his school. The administrator's comment about this new teacher best reflects his practice and beliefs:

You must go and observe (teacher's name). He is the best language arts teacher in the state of Montana (middle school administrator).

The two science teachers from his building observed for this study were also very strong teachers (Mean score of observed lessons for these teachers – 3.34 and 3.45 out of 5). Educational leaders who have a strong, proactive, positive goal oriented approach to their schools seem to produce results.

As part of the hiring process, administrators were asked what teacher qualities help produce successful teachers.

For teachers to succeed they should number one – love kids. It's important to be flexible and accepting of people, as they are. Each teacher is different and has the potential to be effective so that becomes important to remember (middle school administrator).

I've found that successful teachers with Native American students are patient, have good outward composure, teachers who don't raise their voices (middle school administrator).

Teachers who are systematic, consistent, empathetic and treat all their students with respect are the ones who seem to achieve the greatest student achievement. They should de-escalate students instead of escalating them. Our teachers need to be very kid oriented as opposed to content oriented (curriculum director).

None of the school administrators reported any type of new teacher mentoring program within their schools, but they all feel that some type of program should be in place. Mentoring is viewed as a "nice, but not necessary" item.

Professional development is extensive in all the schools. One school offers two weeks of extra stipend supported time for professional development. Another school offers complete reimbursement for higher education courses. Reading workshops lead by national speakers, grant opportunities, content specialists who come into the school each week and teacher release time are just a few of the professional development opportunities. Administrators are trying to fit professional development into teachers' busy schedules.

It's getting more and more difficult to fit professional and curriculum development into a very busy schedule. We have ten days of professional development time, and these end up getting used with school district commitments and obligations. We do have stipends available for after school work, but what seems to happen is that we see the same teachers at session after session (curriculum director).

Administrators view culturally based lessons and culturally based school experiences as important. The most commonly cited examples focused around incorporating the community into the school. Successful experiences highlighted included involving tribal elders as speakers and guests of the school and seeking community input on curriculum revisions and school policy decisions. Administrators said that they get involved in community service organizations like the Rotary Clubs and

in city council meetings. One administrator made a practice of attending monthly senior citizens group meetings, and another administrator held an annual Pow Wow at the school. This administrator also encouraged his staff to attend community functions, and his school's "volunteer grandmother" program meant that many respected citizens in the community participated in school experiences. Another administrator who sponsored a culturally focused science fair invited judges from within the community, and this exposure helped to gain community support for the school. He also used community members as judges for an outdoor science scavenger hunt.

Standardized testing is a topic that administrators had few comments about. At the time of the interviews, all the schools used the Iowa Test of Basic Skills (ITBS), a situation that will change shortly when an assessment linked to the state's science standards is in place. Two of the schools use this test in each grade, and the other schools use the test in grades 4, 8, and 11. One administrator felt the test keeps everything out in front of the public for examination. One of the schools that did not teach science was focusing on mathematics and reading instead of science with hopes that the students would improve their ITBS mathematics and reading scores. This school had double mathematics and reading periods in the morning and afternoon.

Table 11 compares the years of administrator experience, attendance, mobility, community relations, and the mean observed scores of teachers in the administrator's building. This score represents the mean of all the observed key indicators on all the lessons observed. When comparing the mean observed teacher school with other factors, two points are noticed.

First, in three of the four schools where science is not being taught, administrators comment on poor community relations and poor school attendance. This may be indicative of a school experiencing difficult times. In two of these schools, the administrator was in his or her first year at the time of this study. This is noteworthy because turn over of administrators, if it happens often at the same school, may be an indication of a school that is unstable or functioning poorly in other respects. One of the first year administrators had been a teacher at the school for nine years. After experiencing four weak administrators, she applied for the administrator position and is currently trying to rebuild the school. The administrator is very concerned about the quality of education at the school, and she made contact with the researcher at the beginning of the summer to indicate that a new science teacher and science curriculum would be taught during the 2003-2004 year.

The State Action for Education Leadership Project (SAELP) surveyed 450 Montana administrators regarding a variety of educational leadership topics (Erickson, 2002). The 125 principals that identified themselves as middle school principals indicated an average of 6.3 years in that position (D. Nielson, personal communication, January 30, 2004). This is slightly ahead of the 4.7 average number of years that administrators on the Crow and Northern Cheyenne Reservation who participated in this study had been in their positions.

A second point that can be gleaned from Table 11 is that there are not strong relationships between the number of years an administrator has been in a building and the mean observed scores of the science teachers. This may seem self evident, yet one could argue that a school administrator who has experience as an instructional leader in a given

school will positively affect teacher performance in that school. Table 11 shows that a second year administrator oversees the school with the highest scoring science teacher (4.49 COP plus CETP score), as well as a teacher with an average classroom performance synthesis score (3.45), and one with a low score (1.85). Similarly, an eleven-year administrator supervises two science teachers with relatively low average scores (2.83, 2.93), on the COP plus CETP protocol, and another whose average score was in the middle range (3.74).

Table 11. Administrator Interviews from the Crow and Northern Cheyenne Middle Schools

Adm. Exp. in School	Location of School /Public or Private	Attendance	Mobility of Students	Community Relations	Mean Observed Teacher Performance (COP / CETP)	Hiring and Retention of Staff
1 year	Res./ BIA	High attendance problem. 50% of students missing daily	Currently a closed enrollment	Very little community support	No science being taught	Difficult to hire and retain qualified people
1 year	Res./ Public	25% missing daily	High mobility, parents often do not see importance of education	Community is positive and wish to rebuild school	No science being taught	School was in trouble, and they are rebuilding
2 years	Off Res./ Public	Good attendance 6% missing daily	Occasional high Mobility because of employer changes	Very positive, never had a levee fail	3 teachers – 1.85, 3.45, 4.49.	Not a problem – high salary helps to produce a stable staff
2 years	Res / Public	Needs to improve	Closed enrollment	Could be stronger	No Science being taught	Specialists are hard to find, other positions have applicants

Adm. Exp. in School	Location of School /Public or Private	Attendance	Mobility of Students	Community Relations	Mean Observed Teacher Performance (COP / CETP)	Hiring and Retention of Staff
3 years	Public	A big problem	In Elem. & Jr High, not much of a problem	A divided community over school issues	One teacher 2.81	We have lots of applications except for Sp.Ed; high turnover of teachers
5 years	Off Res / Public	A big problem	It's improving	Very poor, low interest in school	One teacher 3.79	Difficult to hire and retain experienced teachers
6 years	Res / Public	It fluctuates depending on the day	Not a problem	This seems OK	Two teachers – 2.79, the other not teaching science	Tough to find Sp. Ed. teachers, staff remains fairly stable
7 years	Res / Private	Pretty good 6% missing daily	Closed enrollment	Good relationship, we work to keep communication open	One teacher 4.15	It's OK currently, but it's getting more difficult
9 years	Off Res./Pri	Pretty good 7% missing daily	Closed enrollment	Needs to work on this.	Two teachers – 3.19, 3.34	Finding teachers isn't hard; it's hard finding good teachers
11 years	Off Res / Public	Good – 10% missing	Would like to improve	Only lost one levee in 27 years.	Three teachers – 2.83, 2.93, 3.74	Not as many applicants, but staff is very stable

To cross check perceptions of individuals at the same school, the same questions were asked regarding attendance, mobility, and standardized testing during both teacher and administrator interviews. On the attendance questions, all but one administrator agreed with the teachers interviewed from his or her school. The administrator who was

the exception stated that attendance was all right at his school, yet both the teacher and the observer noted frequent absenteeism among students.

Interview questions regarding the use of standardized tests revealed that in general teachers had more comments and were more concerned about such tests than administrators. Teachers talked of the need to increase student reading ability and reading comprehension for higher performance levels on ITBS tests in all subject areas while administrators talked of procedural aspects of the ITBS.

Community members and middle school administrators play a vital role in the success of schools, along with the third group this study addresses, the teachers. Teachers were interviewed, surveyed, and observed teaching numerous lessons over a sixteen-week period of time. The findings from this data are described below.

Teachers

Teachers have the responsibility of designing, implementing, and assessing quality lessons that allow optimum learning opportunities for students. Strong content and pedagogical training combined with ongoing professional development and continual self-reflection enhance teaching strategies. Teachers in this study were surveyed regarding their demographic information, their educational, professional backgrounds, training and their perceptions of classroom activities. Lessons were observed and quantitatively rated in these key indicator categories: lesson design, implementation, science content and classroom culture. In this analysis, key indicator scores in each category were averaged for an overall teacher lesson score. The report "Inside the Classroom" (Horizon, 2003) provided national comparison data from middle school

teachers with respect to each of these categories. As with the community members and administrators, teachers were interviewed regarding challenges and barriers within their school setting. In addition, teachers were interviewed regarding some of their strongest positive resources that helped them deliver their lessons. This section reports on these findings.

Table 12. Middle Schools in Crow and Northern Cheyenne Reservation Areas

	Number of Schools	Private or Public Schools
With a Science Curriculum	8	2 private 6 public
Without a Science Curriculum	3	1 private 2 public

Of the 11 middle schools on the Crow and Northern Cheyenne Reservations, eight of the schools were not teaching a science curriculum during the 2002-2003 school year. The eight grades include four 6th grade classes, two 7th grade classes, and two 8th grade classes. Interviews were held with each of the teachers of these grades to obtain insights. In two of the 6th grade classes, the teachers thought they were teaching a science curriculum. However, the approach to their science curriculum was a project approach whereby students would complete science projects such as health fair posters or continental drift maps. Students did not actively study a science curriculum on a regular basis. In both of these cases, however, the middle school administrators thought a science curriculum was being taught. The other 6th, 7th, and 8th grades were from two schools. Both of the schools had experienced difficult situations that almost caused the schools to close, and the educational staff was attempting to build up the core curriculum. For one of the schools, a science teacher and science curriculum were added during the

2003 – 2004 school year. Because there was no science curriculum to observe in three schools in 2002-2003, this study focused on the 13 teachers in the remaining 8 schools. Characteristics of the middle school science teachers in the Crow and Northern Cheyenne schools were compared to those of teachers in the “Inside the Classroom” study.

The number of male and female teachers are fairly even with males slightly better represented in the reservation schools (54 percent) than in the national sample (38 percent). White teachers make up the majority of the national middle school science sample (87 percent) just as they do in the reservation sample (92 percent).

Table 13. Characteristics of Crow and Northern Cheyenne Middle School Science Teachers as Compared to the “Inside the Classroom” (Horizon, 2003) Teachers

	Percent of Teachers in National Sample	Percent of Crow and N. Cheyenne Teachers
Gender		
Male	38% (12 teachers)	54% (7 teachers)
Female	62% (19 teachers)	46% (6 teachers)
Race		
White	87% (27 teachers)	92% (12 teachers)
Native American	0%	8% (1 teacher)
Black or African-American	9% (3 teachers)	0%
Other	4% (1 teacher)	0%
Experience		
0-2 years	24% (8 teachers)	15% (2 teachers)
3-5 years	13% (4 teachers)	15% (2 teachers)
6-10 years	16% (5 teachers)	15% (2 teachers)
11-20 years	22% (6 teachers)	23% (3 teachers)
>21 years	24% (8 teachers)	32% (4 teachers)
Semesters of College Coursework in Science		
Fewer than 6 Semesters	45% (14 teachers)	23% (3 teachers)
6-10 Semesters	35% (11 teachers)	15% (2 teachers)
11-14 Semesters	10% (3 teachers)	15% (2 teachers)
15-20 Semesters	10% (3 teachers)	23% (3 teachers)
More than 20 Semesters		24% (3 teachers)

In comparing the experience level and semesters of college coursework, findings indicate a reservation teaching staff that is highly experienced with 55 percent of the teachers (7 teachers of 13) having more than 11 years of teaching experience. This compares to national sample data of 46 percent of the teachers (14 teachers of 31) having more than 11 years teaching experience. The same modest advantage for reservation teachers holds regarding the semesters of college coursework in science. Fifteen percent of the teachers in the national sample have more than 15 semester science credits while 47 percent of the reservation teachers have more than 15 semester credits. The reservation teachers included five teachers certified in secondary science education (38 percent) and 8 teachers certified in elementary education (62 percent). Interestingly, the reservation teacher with the most semester credits of science (58 semester credits) is certified in elementary education. Data was not available for the national sample regarding certification levels. An overview of the above data indicates that reservation teachers are more experienced and have more semester credits of college coursework in science than the national sample of middle school science teachers surveyed by Horizon.

Before discussing the data from the classroom observations, and what this reveals about the practices of the reservation teachers compared to the national sample in the Horizon study, it is important to discuss how the data analysis for these comparisons was handled. Since reservation teachers were observed on multiple occasions (ranging from two to nine lesson observations), reservation teachers were all observed more than once, each teacher's ratings in a given area were averaged across multiple lessons to acquire the individual mean. These means were then averaged again across teachers to obtain a "grand mean" for reservation teachers. This prevents the performance of the reservation

teachers who were observed most frequently from skewing the results for their cohort. Since Horizon teachers were each observed just once, their ratings came from a single lesson observation. The Horizon teachers' ratings for a specific indicator or other category were then averaged to obtain a simple mean representing their practice in a given area.

Observations in the classrooms reveal some similarities and striking differences between reservation teachers' practices and the Horizon teachers' practices. Regarding the class times spent on instructional and non-instructional activities, the national teacher sample and reservation teachers displayed similar practices. Ninety-three percent of the classroom time observed in classrooms of the Horizon teachers focused on instructional objectives and seven percent was spent on non-instructional tasks such as attending to administrative details. This compares to an average of 92 percent of class time spent on instructional activities in the reservation teachers' classrooms. As indicated in Table 14, the subject area focus of the lessons varied.

Table 14. Content Focus of Observed Lessons in Middle School Science
(National – N=31 teachers observed for one lesson; Reservation – N = 13 teachers observed two - nine lessons each)

	National	Reservation area schools
Lessons with a single content focus	84%	70%
Lessons with more than one focus.	16%	30%
Lessons including a focus		
Life Science	37%	28%
Physical Science	37%	20%
Earth and Space Science	27%	40%
Science as Inquiry	9%	12%
Science in Personal and Social Perspectives	8%	0%

Although the majority of lessons taught by both groups of science teachers had a single content focus, reservation teachers used a more integrated approach to science as 30 percent of their lessons had more than one focus compared to 16 percent for the national sample.

The content area observed most frequently in the lessons of the reservation teachers was earth and space science, while the life sciences and physical sciences received the most emphasis in the lessons of the national sample. Interestingly, none of the lessons observed for either group presented science from a social perspective.

Data was collected regarding the amount of class time each teacher was observed using whole class, pair and individual work. These categories were charted at five-minute intervals during each lesson observation. Teachers in the national sample were observed to involve students in listening to whole class presentations conducted by a teacher in the front of a room during 64% of instructional time. In reservations schools, the highest percentage of instructional time was spent with the students working in pairs. Forty-three percent of classroom activities led by reservation teachers involved students in pair activities, often involving a hands-on task. Like their counterparts in the national sample, the reservation teachers spent a significant portion of their instructional time -- 40 percent in all -- on whole class instruction.

Research studies and policy guidelines indicate that a cooperative approach to learning is effective for Native American students. In this study, hands-on laboratory experiences were the most frequently observed cooperative learning approach.

Table 15. Percentage of Instructional Time Devoted to Whole Class, Pair and Individual Instruction

(National – N=31 teachers each observed once; Reservation – N = 13 teachers each observed from two to nine times)

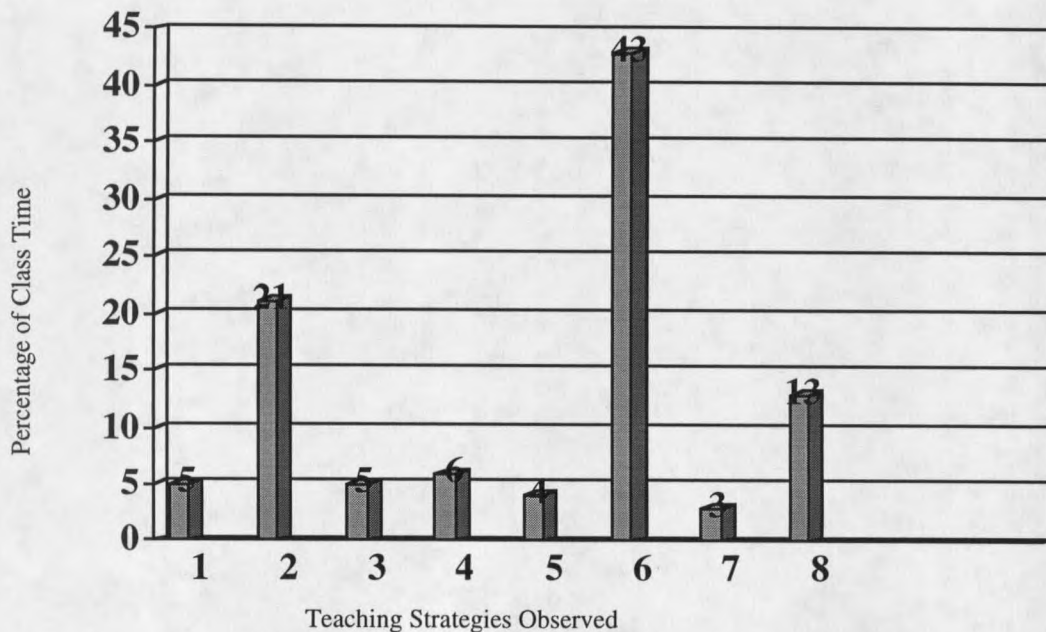
	Students Involved in Whole Class Instruction		Students working in Pairs		Students working Individually	
	National	Res	National	Res	National	Res
Grades 6 - 8	64%	40%	18%	46%	18%	14%

Only three percent of the lesson time observed was spent in cooperative learning activities other than hands-on tasks, and this three percent was all associated with one instructor. This teacher included cooperative learning in many of the students' daily tasks. Potential cooperative learning situations were observed in many classes during different lessons. This teaching strategy, in which students work together to clarify their understanding of key concepts, could be better utilized in the schools observed in this study. Research studies document the value of cooperative learning in enhancing student learning (Brancov, 1994; Plank, 1994; Stah and VanSickle, 1992). This teaching strategy was rarely seen in the lessons observed.

Because policy guidelines and research on effective teaching strategies for Native Americans indicate the importance of hands-on activities in producing achievement gains, it is important that teachers on both reservations were observed to spend a significant portion of class time (43 percent) using such strategies. The second and third most commonly observed teaching strategies are not mentioned in research studies as being particularly effective with Native American students. Nonetheless, they were observed frequently. On the average, teachers used a lecture-with-questions-and-discussion approach during 21 percent of the class time. Students were involved in

written work during 13 percent of class time. Although students were often assigned to work in Pairs, cooperative learning and small group work, either as "stand alone" strategies or embedded within other strategies, were not observed often. The quality of the teaching strategies will be discussed in the next section of this chapter.

Figure 1. Percentage of Class Time Individual Middle School Science Teachers on the Crow and Northern Cheyenne Reservations Devoted to Various Teaching Strategies. (N=13 teachers each observed 2-9 times for a total of 68 lessons)



Key

- | | |
|--|------------------------|
| 1. Administrative tasks | 5. Miscellaneous |
| 2. Lecture with questions / discussion | 6. Hands-on activities |
| 3. Lecture | 7. Reading |
| 4. Reading with written work | 8. Written work |

An observer using the Horizon Observation Protocol assigns lesson ratings in four categories including lesson design, implementation, content and classroom culture. Each of these categories has from six to ten key indicators that help to provide a synthesis rating for the category. Each reservation teacher was observed more than once, and his or her synthesis ratings in a particular category were averaged across all the lessons observed. These individual teacher ratings were then averaged together, resulting in a "grand mean" in each of the four categories for all the reservation teachers. Since each teacher in the Horizon group was observed once, the means reported for this national sample are simple means, including just one synthesis rating per teacher per category.

Table 16. Performance in Four Broad Categories of Reservation Teachers Compared to a National Sample

National sample - N = 31 teachers each observed once

Reservation sample - N=13 teachers each observed 2-9 times for a total of 68 lessons

School / Key Indicator category	Mean	Std. Deviation
National / Design	2.55	.27
Res. / Design	2.91	.27
National / Implem.	2.51	.29
Res. / Implem.	3.25	.34
National / Content	2.67	.54
Res. / Content	3.22	.54
National / Culture	2.75	.43
Res. / Culture	3.17	.62

The average performance within each of the four categories shown in Table 16 was higher for teachers from reservation schools than for teachers in the national sample. The largest difference occurred in the category of lesson implementation with a difference of .74 between the Horizon teachers' average (2.51) and the reservation teachers' average (3.25). This may be the result of smaller class sizes in the reservation schools. The average class size for middle school science teachers in the national sample was 23.6 students (Horizon, 2002), and the average class size in the reservation schools was 12.5 students, ranging from a low of four students to a high of 21 students. The implementation category included key indicator ratings like management style, pace of the lesson, ability to "read" students' level of understanding, and questioning strategies. These teaching skills may be easier to utilize and implement with smaller class sizes.

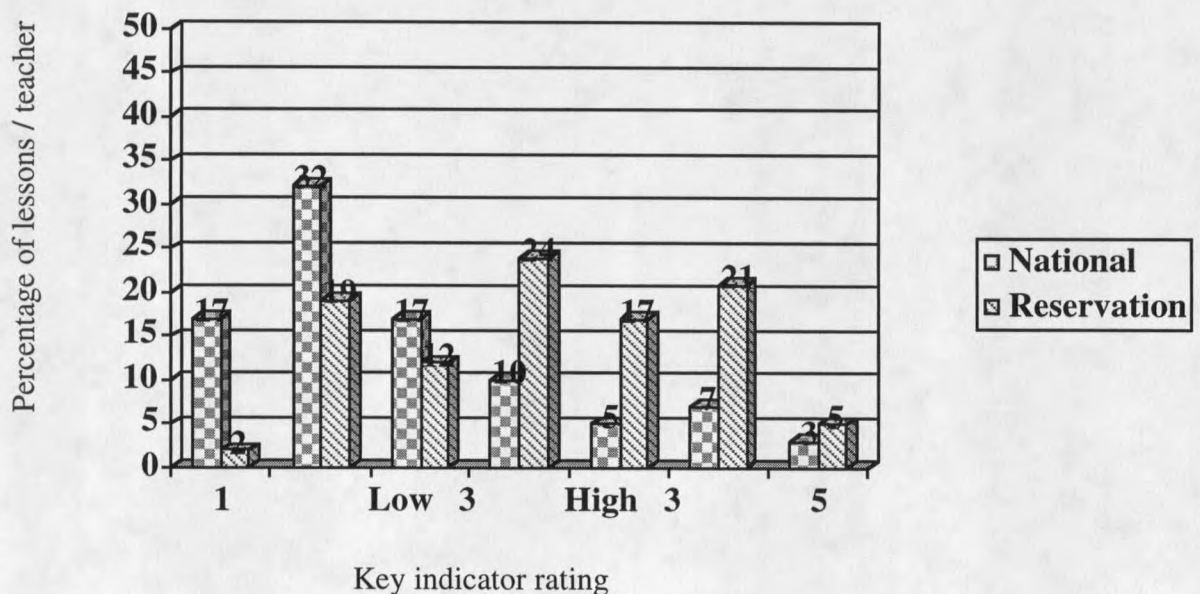
The second highest difference between reservation teachers' performance and the performance of teachers in the national sample was in the content category (.55). Because the reservation teachers in this study had taken more semester credits in science than their national counterparts, they may be able to include more science content, as well as more accurate information in their lessons.

The standard deviation of .62 for the reservation teachers' performance in the culture category is larger than in other categories. A possible explanation might be that key indicator items in this category reflected the overall performance level of the teacher. The key indicator items in this category separated a higher scoring teacher (4.49) from a lower scoring teacher (1.85). Key indicator items like, "climate encourages students to generate ideas and questions," and "intellectual rigor, constructive criticism, and challenging of ideas are evident," tended to have a greater discrepancy of scores between

teachers. Exemplary teachers were able to create classroom atmospheres that encourage ideas, questions and intellectual growth. A detailed comparison of the performance of the reservation teachers with their national counterparts is provided in Appendix D. In this Appendix, the teachers' performances are compared for each indicator within the four performance categories.

In order to create a comparison between the quality of teaching observed in reservation schools and in other schools in the nation, each score in the four categories was averaged to obtain a capsule rating for each lesson. The capsule ratings for all of the lessons taught by a given teacher were then averaged to obtain an overall performance rating for that teacher.

Figure 2. Capsule Ratings for Reservation Teachers Compared to a National Sample. (National - N = 31 teachers each observed once, Reservation - N = 13 teachers each observed from 2 - 9 times for a total of 68 lessons)



The capsule ratings reveal that 76 percent of the middle school science teachers observed in the Horizon study were rated at the beginning stages of effective instruction or below. The majority of teachers observed in this national study (32 percent) received a rating of level 2 indicating that some elements of effective instruction were present in the lessons. Seventy-nine percent of the reservation teachers observed received an overall rating at the beginning stages of effective instruction or above. The majority of the lessons observed (24 percent) had a rating of level 3 indicating the beginning stages of effective instruction. Twenty-six percent of the reservation teachers were rated as accomplished, effective instruction (level 4) or above, compared to 10 percent of the teachers in the national sample. The general trend that is indicated by Figure 2 is that lessons observed in reservation schools contain more elements of effective instruction than lessons observed in the national sample. One possible contributing factor to this gain is the experience level and training of the teachers. As shown earlier in this chapter, the reservation teachers have more years of classroom experience, and have taken more semester credits of science coursework. It is possible that this experience and training help these teachers present science lessons with higher key indicator rating scores.

The next section examines patterns and differences in the classroom practices of the teachers on and near the Crow and Northern Cheyenne Reservations. The mean score of all key indicators was calculated for all lessons observed for a given teacher. This helps to provide insights into the overall quality of each teacher's instruction (Table 17). The average key indicator scores obtained for the reservation teachers ranged from 1.85 to 4.49.

Table 17. Observed Lesson Scores for Middle School Science Teachers On or Near the Crow and Northern Cheyenne Reservations in Montana

Teacher	Number of Observed Lessons	Number of Key Indicator Items	Mean Score of all Key Indicators for all Lessons	Standard Deviation
1	3	88	1.85	1.34
2	4	128	2.15	1.24
3	9	283	2.79	1.04
4	8	214	2.81	.82
5	6	198	2.83	.94
6	6	177	2.93	1.01
7	6	192	3.19	.96
8	4	124	3.34	1.24
9	6	176	3.45	.85
10	4	128	3.74	.72
11	2	62	3.97	.75
12	6	187	4.15	.67
13	4	124	4.49	.50
Total	68	2081	3.22	

Using the scale established by Horizon Research for the COP plus CETP instrument (as described in Chapter III of this dissertation), the teacher obtaining a score of 1.85 would be evaluated between level 1, demonstrating ineffective instruction, and level 2, demonstrating elements of effective instruction. The teacher with a lesson rating of 4.49 performed, on the average, between level 4, accomplished, effective instruction, and level 5, exemplary instruction. The average key indicator rating for all middle school science teachers on both reservations was 3.22. This rating is between a level 3, beginning stages of effective instruction, and level 4, accomplished, effective instruction. The standard deviation indicates the variance between individual key indicator ratings. Teachers who score high in some key indicator items and low in other key indicator ratings would have a higher standard deviation than teachers who are more consistent across their individual key indicator scores. For example, a teacher whose average key

indicator score is a 1.85 with a high standard deviation of 1.34 displayed less consistency in the classroom practices represented by the key indicator items. Such a teacher might be observed to be strong in classroom management and student involvement skills, but weak in either content knowledge or the ability to present lessons that are rigorous and challenging.

Observation data from key indicator ratings were analyzed in each of the four categories of the Horizon instrument. This was done for each of the 13 teachers using data from all 68 lessons observed. In the Design category, key indicator items like “the design of the lesson reflected careful planning and organization” and “the resources available in the lesson contributed to accomplishing the purposes of the lesson” earned high scores by all teachers. Items like “the design incorporated tasks, roles, and interactions consistent with investigative science” and “instructional strategies and activities reflected attention to issues, equity, and diversity for students” earned low scores by all teachers. There were items from other categories that showed variance. In the Implementation category, key indicator ratings on classroom management were very high, and key indicator items on utilizing standards based investigative science lessons with high levels of formative assessment and high levels of questioning strategies were very low. The teachers' science content information tended to be accurate and appropriate (high scores); however, students were not intellectually engaged, science was not portrayed as a dynamic body of knowledge, and few examples linked content information with real world contexts (low scores). In the Classroom Culture category, a high key indicator rating was awarded for a climate of respect for students' ideas, questions, and contributions, and a low rating was scored for the teacher's ability to

utilize collaborative strategies between students and between the teacher and student.

The average ratings earned by the teachers across 68 lessons observations indicated that, in general, the instructors failed to encourage students to generate ideas or questions. The lessons observed also lacked intellectual rigor and active participation by all students.

The three lowest scoring teachers in this study were observed to have average key indicator scores of 1.85, 2.15, and 2.79. These teachers ratings across all indicators were also not consistent, as evidenced by high standard deviations of 1.34, 1.24, and 1.04 respectively. Teachers with relatively low variation in key indicator ratings, and thus low standard deviations (.50 and .67) were also the higher scoring teachers (4.49 and 4.15).

The Classroom Observation Protocol includes 33 items. Twenty-four of these items are supported by research studies and policy guidelines regarding strong teaching practices for Native American students. In an effort to scale the 24 items from the Classroom Observation Protocol, the key indicator items were analyzed using maximum likelihood factor analysis. The number of factors to be rotated was determined by the scree plot of the eigenvalues. Five scales were created using the five factor solution. These five scales were retained as these factors all revealed a sharp descent in the plot prior to the eigenvalues leveling off. Consequently, five factors were rotated using a Varimax rotation procedure.

Each of the items in the five scales was checked for good internal consistency with a Cronbach alpha coefficient. All of the scale ratings were above the accepted value of .7. The strongest alpha coefficients were from scale one, items dealing with "minds-on" science with a .938 rating and factor five, containing items dealing with cooperative learning with a .928 rating. The two lowest alpha coefficients were from factor three,

“lesson implementation” with a .774 rating and factor four, “student / teacher relationships” with a .753 rating.

The results of the rotated solution are shown in Appendix E. The five factors, along with each of the key indicator items in the factor, are listed below.

Factor one – “Minds-on Science” $M = 2.85$; $S.D. = 1.19$

*C6. Intellectual rigor, constructive criticism, and challenging of ideas was evident.

I1. The instruction was consistent with underlying approach of the instructional materials as outlined in the Standards.

I2. The instructional strategies were consistent with investigative science.

L6. Science is portrayed as a dynamic body of knowledge enriched by investigative analysis.

L8. Appropriate connections were made to other areas of science and to real world contexts.

L9. The degree of “sense-making” of science content was appropriate for the developmental needs of learners.

Factor two – “Lesson Design” $M = 3.38$; $S.D. = 1.01$

D1. The design of the lesson incorporated tasks, roles and interactions consistent with investigative science.

D3. The instructional strategies and activities used reflected attention to students’ preparation.

D10. Design for future instruction takes into account what transpired in the lesson.

Factor three – “Lesson Implementation” $M = 3.01$; $S.D. = 1.08$

*C5. The climate of the lesson encouraged students to generate ideas, questions and/or propositions.

**I4. The teacher’s management style enhanced the lesson.

I6. The teacher was able to “read” the students’ level of understanding.

I7. The questioning strategies were likely to enhance the development of student understanding.

I8. The lesson was modified as needed based on teacher questioning.

*D8. Adequate time and structure were provided for wrap-up.

*D7. Adequate time and structure were provided for “sense-making.”

Factor four - "Student / Teacher relationships" $M = 3.62$; $S.D. = 1.04$

C1. Active participation of all was encouraged and valued.

**C2. There was a climate of respect for students' ideas, questions, and contributions.

C4. Interactions reflected collaborative working relationships between teacher and students.

Factor five - "Cooperative Learning" $M = 2.98$; $S.D. = 1.32$

C3. Interactions reflected collegial working relationships among students.

D5. The instructional strategies and activities reflected attention to issues, equity, and diversity for students.

*D6. The design of the lesson encouraged a collaborative approach to learning.

* Indicates items that were significantly lower based on a one sample t-test. ($t=3.22$, $p = .05$)

** Indicates items that were significantly higher based on a one sample t-test. ($t= 3.22$, $p = .05$)

A one-sample t-test was conducted on each of the above key indicators in order to evaluate whether the mean was significantly different from 3.22, the overall mean on key indicator ratings in Crow and Northern Cheyenne middle school science classrooms. The results of this test are displayed in Appendix F, and the items that are statistically significant are noted in the above list of factors.

Scale one key indicator items, "minds-on science," focus on the instructional level of the class lesson. The intellectual rigor of the lesson, portrayal of science as a dynamic body of knowledge, lesson connections to real world applications, and degree of sense making in the science lessons are all important in this factor. The mean of the six items in this factor was the lowest at 2.82, and this factor contained four items a one sample t-test revealed to be significantly lower than the other key indicator items. This would indicate an area where data indicates there is a need for improvement.

Scale two contained three items from the lesson design category. One of items, D1, revealed that teachers tended to design lessons that were consistent with investigative science (mean = 3.19), but item I2 indicates that the lessons lost some effectiveness when the teacher implemented these lessons with their students (mean = 2.74).

Main topics in scale three, lesson implementation, were teacher questioning skills and classroom management. The reservation teachers observed were very good at classroom management (3.73), and student behavior was never mentioned in interviews as a source of frustration for reservation teachers. Three additional areas in this scale earned lower scores. The first was in implementing lessons that encouraged students to generate ideas, questions, and propositions. The second was in allowing adequate time for sense making in the lesson, and the third was in providing stronger lesson closures. The average rating of these three items was 2.54, which indicates a need for improvement in these areas.

Scale four, student / teacher relationships, contains items from the classroom culture category, and this factor has the highest overall mean score rating (3.62). Teachers achieved high ratings for creating a classroom atmosphere that values students' ideas and questions. Students were encouraged to participate in the lessons observed; and the teacher / student working relationship was observed to be strong. The most highly rated key indicator item in the observations occurred within this factor. Item C2 measured the climate of respect for students' ideas, questions, and contributions (mean = 4.13).

The last scale, scale 5, pertains to an area that received low overall ratings (2.98). This scale deals with the cooperative nature of learning in the classroom. As indicated previously, students spent a great deal of time in working in pairs (43%). The lower

rating indicates that the quality of the paired interactions could be improved. Lessons could be designed that involve students working together to understand science concepts, which could then be assessed by the teacher. With the exception of high scoring teachers, these types of lessons were not being designed and implemented often by teachers on reservation schools. In many cases, science concepts were being taught by the teacher with little opportunity for students to work cooperatively to gain more understanding. Collaborative learning strategies seldom observed include techniques in which the teacher presents a lesson and students work in teams to master the lesson prior to assessment. Lessons were observed during which students worked on worksheets or science problems, and then, following the teacher's instructions, students checked each other's work prior to submitting it. Group investigations, "Jigsaw," activities in which individual students become "experts" and return to the group to share knowledge, along with some of the many other cooperative learning techniques (Slavin, 1992), were not observed except in the classrooms of the highest scoring teachers. Cooperative learning strategies when designed correctly provide a strong teaching tool applicable to many lessons.

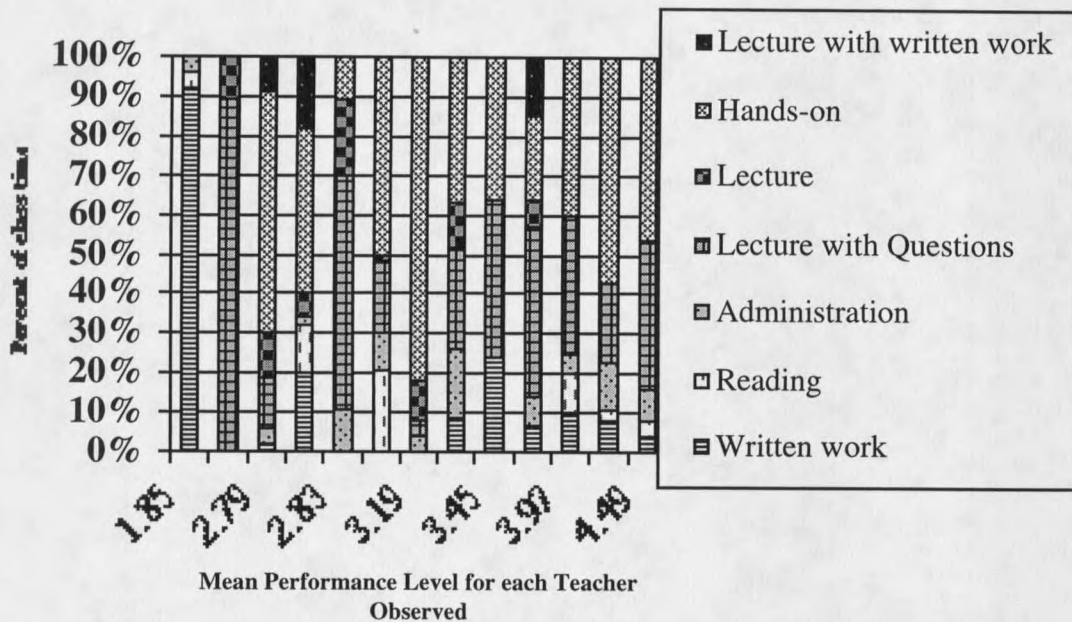
The factor analysis provides a technique for identifying and interpreting the strengths and weaknesses in middle school science lessons observed in the reservation schools. This information could allow professional development facilitators, school administrators, and the teachers themselves the opportunity to target key lesson improvement areas.

Comparing a teacher's mean lesson ratings with the ratings for the teaching strategies observed in his or her classroom allows exploration of possible relationships

between the quality of the teacher's overall performances and the quality of individual teaching strategies observed for that teacher. Figure 3 illustrates this relationship.

Figure 3. Observed Teaching Strategies of Individual Teachers

Number of teachers = 13; and Total Number of Observed Lessons = 68



Some general patterns observed in the above chart include the number of teaching strategies used as compared with the teacher observed mean score. With the exception of the lowest scoring teachers (1.85 and 2.15), all of the teachers used a variety of teaching strategies, including hands on strategies. This may indicate that the number of teaching strategies used and the types of strategies utilized do not necessarily indicate the overall strength of a teacher's performance. Effective teachers present hands-on learning in a challenging, rigorous fashion stimulating learners to mentally engage with the content. This is in contrast to hands on learning that simply allows learners to share equipment with a partner. The percent of time that learners engage in hands on learning is not

reflected in the overall mean score. A teacher with a high score (4.49) was observed to spend 45 percent of class time in hands on activities while teachers scoring 2.81 and 3.19 spent 61 percent and 82 percent of class time, respectively in hands on activities. All teachers earning high average scores across classroom observations used a variety of teaching strategies, but not everyone who used a variety of strategies scored high. teachers were surveyed and interviewed on numerous occasions regarding the challenges, barriers and positive support available for their teaching.

Challenges and Barriers in Teaching Native American Students

Teachers in this study recognized a number of challenges and barriers in their classrooms. When asked during the interview process what they considered their greatest challenge, answers varied. Several patterns emerged including challenges dealing with student motivation, student reading levels, and various individual teacher challenges. No patterns emerged, however, with regard to years of teacher experience, reservation or non-reservation schools, or the number of students in a class.

Six of the 13 teachers indicated that student apathy and lack of motivation in school was the major barrier they face. They described many students who don't wish to be in school, and often the teachers felt that many families do not support school.

Teachers from schools with high Native American populations and those from schools with low Native American population differed in their use of the word "motivation." For teachers in schools with high numbers of Native American students, low motivation meant that students often missed school, did not come prepared to work

in class, and generally were apathetic about the class. For teachers in schools with lower populations of Native American students, low motivation tended to indicate that it was difficult to engage students and convince them to complete their studies. For example, a teacher in a school near the reservation with a Native American population of 28 percent described low motivation by stating:

The lesson you just watched on blood typing (statement made to observer) is usually one that arouses a lot of student interest. It didn't do that today with this group. It's difficult for me to engage students to get them to do their work and learn. Sometimes, they just don't seem interested (7th grade teacher).

Teachers from schools with Native American populations of 90 percent or higher express low motivation in other terms. These teachers when interviewed talked about many students not caring about most of their work. Instead of the students not being interested in a single lesson or one unit, some teachers expressed that students were not interested in many lessons and not interested in school. Some comments from these teachers that reflect this point of view include:

Regardless of what I seem to do in class, each class period I have large numbers of students who just aren't interested in what is happening. It's very frustrating to me, as I wonder why I'm putting all this work into planning lessons and activities, only to have many students not care (8th grade teacher).

My biggest barrier is that my students don't think science is fun. They come into my room dreading science, and I have an uphill battle to convince them that it is fun (7th & 8th grade teacher).

Students have such apathy towards school. They just don't seem to care. They don't bring pencils to class, don't turn homework in, and I don't feel there is any support from home. I can almost tell in the first couple of weeks what the student is going to be like as it's during that time that I contact each of my student's parents (8th grade teacher).

A sub category of the attendance issue includes a teacher who is challenged by students who work the absentee system to avoid certain consequences of not coming to school. The teacher is frustrated that he is putting time and effort into lessons that he perceives are not appreciated.

It's difficult to get students to come to school. (pointing out a student in the room, the teacher quietly says) He's been gone for nine days. They have a policy in this school that if you miss ten days, a letter is sent to the tribal council, so every tenth day he comes to school. When I have large numbers of students doing this, how am I supposed to prepare lessons that build sequentially on each other (8th grade teacher)?

The second most frequently cited challenge reported by teachers revolved around the reading level of the students. Two teachers believed that student reading levels were the biggest challenge they faced in school.

It's very difficult getting kids up to reading levels that are appropriate so they begin to understand the material. I find that a large part of my science period is devoted to reading and reading strategies (6th grade teacher).

Teachers often build in strategies within their class lessons to deal with this reading problem.

I use a lot of hands-on strategies because that's the only way that students seem to learn the material. This year's class reading levels are so low that reading from a textbook would be difficult (8th grade teacher).

I use a lot of oral communication and a lot of drawing activities partly because it provides a way for students of lower reading ability to succeed in my class. I even give oral assessments so that I can find out what students actually know. If I gave a written test, it would be the same as giving a reading test and I already know what they will score on that test (6th grade teacher).

A teacher who listed motivation as the top challenge also brought in students' lower reading ability with a second comment. "They have such low reading abilities that they can't understand the material (7th & 8th grade teacher)."

Reading and mathematics sometimes impacted science in a different way. One school (three grades) did not teach science partly because they wanted to work on the students' reading and mathematics scores. This school had double periods of reading and mathematics but did not have a science curriculum (Note: A science teacher was hired for the 2003-2004 school year).

Each of the other five teachers interviewed had a variety of ideas on the biggest challenge in their classrooms. These ranged from having a small science room to the lack of a science curriculum in their school.

During the interview, teachers were asked how they approach their greatest challenge. Teachers who listed lack of student motivation as a challenge usually did not have any solutions to offer. In a few cases, the feeling was that this lack of motivation was caused by a family or society condition beyond the scope of a classroom setting. Teachers who cited a concrete challenge like the size of their classroom, or an inadequate science curriculum did offer solutions.

Capsule ratings were averaged across all the lessons observed for each teacher, and these were ranked in order from the teacher with the lowest overall capsule rating to the teacher with the highest capsule rating (Figure 3). It is interesting that the four teachers with the highest average capsule scores did not mention student motivation as a challenge and the bottom six scoring teachers did.

An observer in the classroom easily notices low reading levels and lack of motivation because students have difficulty reading out loud. When students are asked to read silently, some students will not even open the book. During interviews, teachers indicated these students have difficulty with reading. In classrooms where instruction is

focused on a lecture or worksheet strategies, some students are observed putting their heads down on the desk and generally disengaging with the learning process.

Classrooms were also observed where students were excited and anxious to come into class. Although the lower reading levels were still evident, one could not help but sense the motivation of these students who enjoyed coming to class and were engaged in the class lessons. Some of these lessons revolved around hands-on manipulatives, but others were discussion oriented with high levels of questioning strategies being present throughout the lesson. They were engaging even to the observer. These observations more commonly occurred in the lessons of teachers having the highest overall capsule ratings.

Table 18. A Comparison of Cumulative Mean Scores on Observed Lessons with Teacher Perceptions of Challenges, Positive Resources, Effective Teaching Strategies and Culturally Based Lessons.

Mean Score of Obser.-ved Lessons (0-5)	Standard Deviation	Years teaching	Major challenge in working with the population you teach	Best resource to help you with your teaching	Most effective teaching strategy	Degree you include cultural activities in your lessons
1.85	1.35	21-25 years	Students just won't do the work.	My fellow colleagues.	Anything that is visual.	None as of this time.
2.15	.97	6 - 10 years	Students don't think science is fun.	A high school teacher.	Bringing in real life examples,	Some topics like plants, astronomy, and animals.
2.79	1.04	16 - 20 years	Students just aren't motivated.	Fellow colleagues.	Hands-on learning.	Not as much as I should.
2.81	.82	26+ years	Students aren't motivated.	Classes from the Tribal College.	Hands-on learning.	My goal is to do more of this.
2.83	.94	26+ years	Native students don't wish to work on academics.	Resource books.	Hands-on learning.	This may come up once in awhile, but I don't plan lessons around it.

Mean Score of Observed Lessons (0-5)	Standard Deviation	Years teaching	Major challenge in working with the population you teach	Best resource to help you with your teaching	Most effective teaching strategy	Degree you include cultural activities in your lessons
2.93	1.01	3 – 5 years	Apathy towards school.	The diversity of the student body.	Hands- on learning.	Some units like health; bring in herbal medicine.
3.19	.96	3 – 5 years	There is a great deal of information to cover and not a lot of time.	Fellow teachers and community members.	Hands- on learning.	Most lessons contain a cultural element.
3.34	1.24	11 – 15 years	Some students' home lives are very difficult.	Colleagues.	Hands- on learning.	Present lessons with cultural themes, plus science fair projects.
3.45	.85	0 – 2 years	Motivation of students.	Computer and technology.	Different strategies work with different groups.	Occasionally it will come up.
3.74	.69	26+ years	Discipline and class control.	Montana Education Association conferences.	Drawing and art lessons.	Include culture in most lessons.
3.97	.75	0 – 2 years	Our school needs a science curriculum.	Resources from the Tribal College.	Hands- on.	Limited – had a speaker come in to talk.
4.15	.67	6 – 10 years	Students' reading levels are low.	The Internet.	Engage students with hands- on.	Include culture in many science lessons.
4.49	.50	11 – 15 years	Need a larger classroom.	One day workshops.	No one strategy: contin- ually evolving strategies	Do more in geography than science.

Positive Resources

Teachers were asked to describe the resource that helps them the most in working with their students. The answers were varied, but could be categorized into support by individuals, support by technology, and support by attending workshops.

Two teachers felt that their fellow colleagues were their strongest resource, and two other teachers cited a specific resource person, the science instructor at a local tribal college. This instructor conducts weekly science method classes, plus makes an effort to get into the schools and work with the students on science projects.

I can't imagine where I'd be without the help of (name of tribal college instructor). He's always available to answer my questions and provide my students with resources. Currently my classes are designing an experiment that will go up on a NASA airplane, and students are really excited about this (8th grade teacher).

Two other teachers talked of the support that the Internet and technology provided.

The biggest help in my teaching is the use of the Internet. I'm on every day helping to supplement my curriculum and class lessons. Our school is so rural that without this I'd be lost. Not only do I use it, but my students do also. If they are working on a research project or don't understand how something works, the Internet is where they do their research (7th grade teacher).

Each of the classrooms observed had at least one computer, and many had five or six computer stations complete with Internet connections. Two teachers talked of workshops and conferences being their best resource.

I really get a lot out of workshops. With my family, I can't afford to go away to weeklong or summer programs, but morning or daylong workshops are perfect. Whenever I go to a workshop, I make it a point to bring one thing back to my class, and I make it a point to use this technique the day I come back, then I follow up with a technique that I

learned in a previous workshop. Using this system, I find I can incorporate many new ideas for my students (6th grade teacher).

Another teacher talked of the valuable ideas she obtained from attending the annual state education conference. The highest scoring teachers tended to cite helpful resources from professional meetings, the Internet, or workshops while the lower scoring teachers tended to cite help from colleagues as their strongest resource.

The remaining four teachers each had different resources that allowed them to implement strong science lessons in their respective schools. Two of the teachers were in a teaming situation with two teachers for one class. They both thought this was the strongest resource, and they would advocate this model for all schools. Field notes from one observed lesson demonstrated the strength of having two teachers for one class.

The lesson was on Continental Drift, and one of the teachers had taken an ArcView computer program and devised a series of questions that allowed students to find various geographical and geomorphic features relating to earthquakes and volcanoes. As one teacher presented the lesson, the other teacher went to each computer station helping the group of students when help was needed. At one point, new material needed to be presented so one teacher took small groups of four students aside for instructional time with a laptop computer. During this time, the other teacher facilitated the class (notes from an observer in the classroom).

This teaming situation observed during ten lessons provided many examples in which class lessons were improved by having both teachers present. While one teacher presented instruction for the class, the other teacher worked with a student or groups of students who were having an especially difficult time. Two teachers in the classroom meant that varied needs of students could be accommodated. The two teachers related well to one another and worked together well. However, this model might not be as effective if the paired teachers do not work together well.

Eight of the thirteen teachers believed hands-on learning is the strongest teaching strategy. When questioned why, the most common reply was:

I've tried many techniques in my 31 years of teaching, and Native American students remember lessons that they are able to manipulate objects. Hands on is the only way to teach (8th grade teacher).

When teachers were probed as to how they know hands-on learning seems to work, most teachers replied that this was based on their prior experiences in teaching.

Over the years, I've found that if students are doing hands-on science, they are more engaged and remember information longer (7th grade teacher).

Through experience, teachers discover what appear to be the most effective teaching strategy to use with their learners. The teachers see themselves as adjusting their teaching to fit the needs of their students (Doyle, 1985). Most of the teaching strategies mentioned as effective during the teacher interviews were strategies that research indicates produce strong achievement gains in Native American students.

I find that anything visual is effective. If students can see the material they are in a better situation to understand it (7th grade teacher; visual learning is cited in 19 research studies as producing achievement gains with Native American students).

If teachers include real life examples in their lessons, these students will more likely remember the lesson (6th grade teacher; need for practical applications cited in two policy guidelines and two research studies as producing achievement gains with Native American students).

Two of the top scoring teachers responded similarly when asked about their most effective teaching strategies by stating that there is not one most effective strategy, but a variety of effective approaches depending on the circumstances. One of the teachers made this point as follows:

There isn't one strategy. I need to continually evolve and evaluate with works and what doesn't work. My personal goal is to stay energized and excited about teaching. When I get to the time that I'm not excited, then it's time for me to get out of teaching (6th grade teacher).

Teachers were asked the degree to which Native American culture was included in their lessons, and also the approaches they used when integrating culture with science. Table 18 shows that four teachers indicated that they do very little inclusion of culture in the science curriculum. Most of the teachers who stated this also expressed a desire to include more culture in their lessons.

I don't do as much with culturally based lessons as I should. Science really lends itself to this with topics like astronomy, rocks, plants and animals. A goal I have is to include more of this in the future. I'm especially interested in straw bale houses. These houses are practical and utilize a lot of science concepts that I think Native students would find enjoyable (7th & 8th grade teacher).

Many examples were observed of culturally related lessons and most of these were interwoven into the traditional science lesson.

When we do our unit on plants, I always have the students go home and talk with their parents and grandparents to find out home-remedy medicines and tea. My students bring back the recipes and as a class we take a look into the science concepts and facts that are found. We end up learning a lot about the medicines and herbal teas, plus we learn a lot about science (7th grade teacher).

Some examples of culturally related lessons that were observed include:

- During a unit on motion, students calculated velocity readings for various arrows thrown by other students.
- In a unit on archeology, students dug up Indian artifacts from a simulated Custer battlefield.

- In a unit on sound, drums were constructed and the diameter of the drum was compared to the sound the drum produced.
- During a unit on rocks and minerals, the students listed past cultural uses and values of the rocks and minerals.

Of the 68 lessons observed, only the four lessons described above had significant cultural emphasis. There were other times in which cultural material or vocabulary was included to a smaller degree in a lesson. In general, teachers who earned higher capsule ratings included more culturally relevant material in their lessons than teachers who did not score as high.

Science fairs and science fair related lessons were conducted during the spring, and three of the eleven schools were observed while science fair projects were being developed. Science fair projects were sometimes used as a method to interweave culture with science. A title of the student's science fair project often reveals the nature of the project and the cultural implications behind the project. A list of some of the 2003 science fair projects observed in one school include:

- Does Green Sage Tea Treat Parasites?
- Does Yarrow Clot Blood and Cause Wounds to Heal Faster?
- Can Yucca be Used as an Antibacterial Soap?
- Dating Petroglyphs
- Determining what the 'morning star' is physically, spiritually and politically
- Determining if Sweat Rocks hold more Heat than other Rocks
- Diabetes in Native Americans
- The Social Behavior of Bison

- Investigating the Types of Wood for Bows and Arrows

Science fair projects were observed to be a strong technique for combining students' personal interests, cultural knowledge, and science concepts. The most elaborate science fair projects came from a school that supported two science teachers for one class. One of the teachers worked to help organize the science fair and helped individual students on their projects. Classroom teachers who conducted science fairs in addition to teaching their classes generally had a more difficult time working with individual students on the students' science fair projects.

In addition to culturally based lessons, cultural references within a lesson, and science fair projects, several other culturally relevant events took place in the schools. Native American community members were invited to speak to students. While none of these lessons were observed, two science classes used these speakers sometime during the year. One teacher was a part of a community campout, the purpose of which was to bring community members (mostly Native in this community) together with students.

Schools and classrooms were decorated with Native American emblems, quotes, and historical artifacts from local tribes. Inspirational quotes, words, and pictures of famous Native American chiefs hung in the classrooms. Large tribal insignias could be seen as one approached the entrances of the schools. All of this may help to instill a sense of pride to anyone who enters these schools or classrooms.

The use of culturally relevant activities in Native American classrooms on the Crow and Northern Cheyenne Reservations is evident in some teachers' lessons. However, this is an area which teachers could address more effectively. Teachers expressed a desire to

improve in this area, but often lacked adequate lesson and unit plans, or the time to develop these.

Conclusion

Community members, administrators, and teachers are concerned about quality education for students. Each group brings its own concerns and experiences together in deciding what is best for the school. The diverse community groups like parents, business owners, health care professionals, and tribal elders all place different emphases on the meaning of quality education. The prior experiences of parents with their children's school experiences help them to formulate opinions and ideas on school influences. Parents are aware of the high drug and alcohol problems in their communities and hope education will help their children in dealing with and avoiding these problems.

Business owners are concerned that schools help produce a quality work force. Employees who can perform math and language arts skills required for many jobs and who maintain regular attendance are important to the business community.

Health care professionals work daily with reservation health care issues like Fetal Alcohol Syndrome. Students who start school with medical and mental deficiencies have a more difficult time being successful, and health care providers would like to see education help to prevent some of these problems.

Tribal elders are concerned with preservation of the Native American culture. They watch as less Native language, fewer customs, and fewer traditions are being practiced in their communities and they turn to the school for help in preserving the culture. Some elders would like to see a K-12 curriculum in which the traditions of

Native American culture are deeply embedded, and which is delivered in the language of the tribe. Other tribal elders are more concerned with the apparent breakdown of youth discipline and values in society.

Administrators have concerns regarding their school and community.

Administrators from schools experiencing difficulties like poor school community relationships, poor attendance rates, high dropout rates and poor standardized test scores are faced with many issues. It was found that often such schools do not have a science curriculum, and administrators at these schools have a high turnover rate. Some of these administrators report difficulty hiring and retaining staff members, a problem that is actually quite complex. Solutions that work in schools that have strong community support do not seem to work in schools that do not have strong community support. In most of the schools observed for this study, the school is the main focus of the community. Events that happen in the community generally are held at the school, and the schools often are the largest physical building in the community. Most of the schools provide visual highlights in the community with decorations, a large physical structure, and beautiful Native American insignias on display on the outside walls. This high visibility of the schools in the communities on and near the reservation, and the accompanying potential for the school to play a positive role in the community, makes poor relationships between some schools and their communities even more poignant

Professional development opportunities, sometimes with nationally known presenters, are provided for the teachers. Teachers enjoy working in the schools. Most interviews included statements from school personnel that reflected the enjoyment and appreciation of working with a diverse population of students.

Teachers are, in many respects the interface between students, administrators, and the community. The teachers on the Crow and Northern Cheyenne Reservations have more classroom experience, more semester credits of science coursework and higher capsule ratings than other middle school teachers observed in a small scale national study. Despite this positive information, the current skill levels and efforts of the teachers may not be high enough to produce strong achievement gains for Native American students. The data analysis indicates that a majority of the reservation teachers observed are at the beginning stages of effective instruction. The research studies reviewed in this dissertation show that achievement gains for Native American students are more likely to happen when teachers have attained the advanced teaching skills associated with accomplished, effective instruction. Professional development, whether led by others or by the teachers themselves, needs to be targeted towards techniques and strategies required to help reservation teachers reach more advanced levels of effective instruction.

Reservation teachers of middle school science utilize a variety of teaching strategies with hands-on activities being the strategy most frequently used. There was not a clear relationship between use of a particular teaching strategy and the overall performance of the teacher. Although both high scoring teachers and low scoring teachers used hands-on strategies, the higher scoring teachers also emphasized questioning strategies and investigative approaches. An analysis of the 68 lessons observed revealed several teaching practices that were used often with apparent success and other areas that need further development or emphasis.

Strong teachers implement techniques that develop a climate of respect for students' ideas, questions, and contributions to the class. The reservation teachers observed were good at creating a classroom culture that encouraged active participation by all students and creating a strong collaborative working relationship between teachers and students. Classroom behavior management and teachers' subject area knowledge also appeared to be solid in the lessons observed.

Analysis of the data collected in the classroom observations indicates several areas needing improvement. Teachers working to create "minds-on" lessons is one area needing improvement. In this area, the teacher needs to increase the rigor, constructive criticism, and challenging of ideas in his or her daily lessons. When teachers are provided with techniques and strategies to create classroom lessons that immerse students in a classroom climate which encourage students to generate ideas, questions, and propositions, the overall quality of science lessons will improve, and hopefully student learning will improve. A specific time and structure should be provided for students to take these ideas and apply them to real world applications, and this approach will strengthen education for students. Data analysis shows that another area needing improvement is the teacher's use of cooperative learning. Teachers trained in using a collaborative approach to learning may be able to help students gain a better understanding of the content material. The data also indicated a need for the teachers to design and implement lessons that recognize the similarities and differences among their students, creating a classroom culture that is responsive to all students.

CONCLUSION

This final chapter of the dissertation briefly restates the research problem and reviews the major methods used in the study. The major sections of this chapter then summarize the results and discuss their implications.

Achievement levels for Native American students in schools on and near reservations in Montana are well below those of other students. This study identifies teaching and learning practices that research studies and policy guidelines suggest help raise achievement levels with Native American students. These practices were then compared to observations made by the researcher of lessons taught by middle school science teachers on the Crow and Northern Cheyenne Reservations in Montana Southeast. Additionally, the results of teacher interviews are presented regarding challenges the teachers encounter, the strategies they find effective, and resources that they find useful as Indian and non-Indian instructors of Native American students. School administrators and community members were also interviewed, and their viewpoints about Native American student learning are presented as well. Improving Native American students' academic achievement in science and other subject areas is a complex problem with many components. A key factor is the preparation and quality of teachers, and one of the factors helping to raise achievement level is the quality of the lessons that are designed and implemented in the classroom.

As explained in Chapter Two, a list of criteria was established for selecting research studies on Native American students' academic achievement. This study reviewed research studies, as well as three national or regional policy guidelines

pertaining to teaching and learning in Native American classrooms. These sources described teaching strategies, teacher characteristics, and aspects of the school and classroom environment that produced achievement gains with Native American students. Highly recommended practices included creating a holistic curriculum that makes connections between subject areas, as well as between the school and community. Student-centered approaches such as cooperative learning, and group inquiry or problem solving were also recommended. Some studies supported the use of visual instruction. Others recommended that teachers encourage students, and exhibit a warm, personal teaching style.

Recommendations for all students presented in the National Science Education Standards (NSES) were then compared and aligned with the recommendations for Native American students. This produced a template for what teachers need to do in Native American classrooms to produce achievement gains. A classroom observation instrument, the Horizon Classroom Observation Protocol (2002), was selected, and items from the instrument that aligned with the practices recommended in Native American classrooms were identified. Sixty-eight middle school science lessons were observed. These lessons were taught by 13 teachers in 11 schools on or near the two reservations. As described earlier, the science teachers and their school administrators were interviewed, as well as 21 community members identified by a "snow ball" sampling technique (Patton, 2002). These interviews were included so that local views regarding teaching Native American students could be compared to practices recommended in the research and policy literature, and to the lessons observed. The classroom observation and interview data was analyzed using a variety of techniques discussed in Chapter Four.

Discussion of the results

Since research shows that integration of the school and community is important to Native American student success, it is especially pertinent that interview data was also gathered from community members, administrators, and teachers. The 21 community members were a diverse group, and included parents, business owners and managers, health care groups, and tribal elders. These individuals talked of their personal experiences with schooling, and their concerns and suggestions regarding local students' education. Tribal elders recommended that schools teach, model, and preserve the culture. Business owners and managers were concerned that schools educate students with skills needed in the workplace. Health care professionals work in environments where many of their patients' daily problems are preventable, and they wanted the schools to become a vital source of preventive health education. Parental views of schools were both positive and negative and tended to mirror their own and their children's experiences. Their recommendations to improve schools were also closely tied to specific experiences of their children.

Administrator responses varied regarding (a) successful approaches that support Native American students' academic achievement, and (b) challenges and barriers. The responses also reflected the administrator's experience level, and particular conditions in each school. For example, administrators reporting successful community / school relations tended to have two or more years of experience in their current assignment. This group also reported higher daily attendance rates than did newer administrators, and were more likely to report that their school had a formal science curriculum. School

attendance was often reported as the primary issue facing administrators, and different approaches were used to deal with this problem.

Compared to a national sample of middle science instructors, teachers on the Crow and Northern Cheyenne Reservations have more teaching experience, have completed more semesters of undergraduate or graduate science coursework, and received higher ratings on their observed lessons. Despite these positive results, the performance of the reservation teachers may need to change to best support learning among Native American students. The teachers observed in this study spent the highest percentage of time in the classroom using hands-on science instruction (43 percent). Interestingly, there was not a strong relationship between the use of hands-on teaching strategies and the overall quality of a teacher's performance. Teachers with lower performance scores often used hands-on strategies more often. A factor analysis of the scores revealed patterns of strength and weakness in the lessons observed. The teachers scored high in creating a classroom atmosphere of respect for students' ideas and questions. They encouraged active participation of all students and had established strong relationships with their pupils. The observations indicated that, as a group, the teachers observed needed to increase the rigor, intellectual challenge, and engagement level of the lessons. Use of formative assessment was not observed often, and observations of science investigations that involved students in higher level thinking were uncommon. Teachers whose cumulative ratings were highest tended to score consistently high in all lessons, and in all areas of lesson design, implementation, content, and classroom culture. These teachers' methodologies aligned well with teaching strategies

recommended in research studies and policy guidelines pertaining to Native American student learning.

Teacher perceptions of challenges and barriers varied, with low student motivation as the most often cited barrier. During interviews, teachers with higher classroom performance scores tended to focus more on relatively remediable barriers like the size of the room or the curriculum content. Lower scoring teachers tended to cite low student motivation as the major challenge. Positive teaching resources cited by teachers in this study included help from colleagues, and professional development activities, as well as classes and resources from a local tribal college. Interviews revealed that higher scoring teachers tended to seek out workshops and professional development opportunities more often than lower scoring teachers who tended to cite their colleagues as their best support system.

Research studies and policy guidelines indicate that student centered approaches like group work, inquiry in which students learn inductively, and informal classroom settings raise achievement levels of Native American students. Although these indirect teaching strategies are effective with many types of learners, with students who experience difficulty in school, they become even more important. Teachers in reservation areas who rely on direct instructional techniques like lectures, worksheets, notes, outlines, and reading assignments may have a more difficult time raising achievement levels of learners.

The use of a small number of research-based strategies may not be enough. In this study, the most frequently used strategy was hands-on instruction, yet the average performance rating of all the teachers was 3.12. Although higher than the rating of 2.62

attained by a national sample of middle school science teachers, the reservation teachers scored well below the "perfect score" of 5.00. One can hypothesize that a "near" perfect score" of 4.00, signifying "accomplished, effective instruction" according to norms established for the Horizon Classroom Observation Protocol (2002), is the rating needed to produce strong achievement gains with Native American students. The use of a few teaching strategies does not guarantee that lessons will be strong overall. Teachers on the Crow and Northern Cheyenne Reservation schools used instructional techniques they felt were meeting the needs of their learners. In many of the interviews, when teachers were asked why they designed and implemented the lessons they did, and why they used the teaching strategies they selected, the answer was, "it's the only thing I've found that works." A problem with this self-teaching approach is that teachers may not be trained or seek training on their own regarding effective instruction. A teacher may be using cooperative learning strategies, but not in ways that research studies find are most effective in raising achievement. In this study, high scoring teachers tended to use a variety of teaching strategies, and they tended to use them in ways that were observed to be effective. Lower scoring teachers sometimes used a variety of teaching strategies, but the effectiveness of these strategies was not observed to be as strong.

School and community relationships were reported to be strained in some schools, with a number of different examples given. School attendance, as well as student mobility between schools, was also reported to be problems in some schools and communities. Solutions that worked in one school did not necessarily work in a school 25 miles down the road. Schools known to have problems with attendance, student mobility, or in related areas had a difficult time retaining administrators and teachers.

In such situations, the teachers and administrators often perceived that there was little community support. In two of the schools experiencing such problems, a science curriculum was not being taught. Community members and school personnel working together to set and reach goals will help in changing the success of these schools. It is not a process that will happen quickly, but one involving small steps, including trust building.

Recommendations for Educators

Although a single study cannot provide definitive recommendations to improve middle school science teaching in Native American schools, in this study several strong patterns emerged in the data leading to the following recommendations.

Schools that effectively promote student learning are the product of communities, administrators, and teachers all working together. This was a theme voiced repeatedly during interviews. Administrators need to provide support to teachers seeking better ways to help their students. Teachers need to recognize they are not in isolation in a classroom, but rather part of the larger community. They need to recognize the importance of bringing community participation into their schools. Interviews, surveys, and field observations revealed that the majority of the teachers and administrators in this study could not describe a specific plan for increasing community support or participation in their school. Community members in this study recalled instances in which they or their children were helped or not helped by school experiences. Positive and negative school experiences were recalled many years after they occurred. The teacher as a "sales

person” for education helping parents and student “customers” is a metaphor that teachers may need to remember to help insure positive school / community bonds.

This study indicates that additional professional development, mentoring, or graduate courses are needed to help teachers use advanced strategies like cooperative group work and continuous formative assessment, and to develop a curriculum enriched with examples that are relevant to their students. The curriculum should be connected to the local culture and community. Pre-service education for teachers prepares them to design lessons, manage classes, provide for summative assessment, and begin a career of teaching, but does not necessarily prepare them to implement the advanced teaching strategies recommended to achieve significant success with Native American learners.

Many of the lower scoring teachers in this study remained at or near this pre-service level of teaching; that is, they exhibited basic – but not advanced – instructional skills.

Teachers need modeling and instruction in how to incorporate more advanced teaching, learning, and assessment strategies in their classrooms. It is important for professional development to integrate pedagogy and science content. Field observations and interviews in this study revealed that, although teachers in this study perform well compared to their national counterparts, they need training in both pedagogy and content.

Optimal results will probably be obtained if teachers are given the opportunity to experience the implementation of strong lessons first hand. During the 2002-2003 school year, seven of the 13 teachers in this study did not attend any non-district workshops even though funding was provided for them, and several grant projects made professional development available locally. The in-district professional development they did participate in was not directly tied to science or science teaching. Workshops can be an

important source of training as the top scoring teacher in this study cited workshops as the primary source of professional development. Workshops, graduate level education courses, and school sponsored inservice targeted toward science content, as well as advanced teaching and assessment strategies in science, need to be included in teachers' professional development.

Field observations and interviews revealed that the science teachers did not receive appreciable training in the culture of the students they are teaching. This training could include topics like tribal customs, language, learning styles, spiritual beliefs, historical background, and family values. Teachers currently working in these environments have limited knowledge of key features of the local culture, and few resources available to learn more. Most of what they learn is through informal experience that is sometimes inaccurate and incomplete. Cultural training might begin with an induction program for new teachers introducing them to characteristics of local tribes, including features like social structure, culture and values, as well as the school and community context. This professional development for all teachers could be offered throughout the year. It would be important to invite local community members, including tribal elders, to assist with the development and implementation of this training. Seminar sessions and panel discussions where tribal members are invited into the school to discuss and explain cultural beliefs and customs to teachers might provide strong forums for strengthening and building community relationships. These sessions might begin dialogues that continue throughout the year. As a result participants might better understand one another's perspectives.

The National Science Education Standards (NSES) are a generic blueprint for successful science content instruction in our K-12 schools. Teachers are encouraged to follow this blueprint in order to produce students who become scientifically literate adults. The NSES does not address the needs of Native American learners or any other specific cultural group, so teachers working with Native students either improvise culturally relevant lessons, or leave out such connections in the science curriculum. In order to overcome this deficiency, one possible resource might be an addition to the National Science Teachers Association *Pathways to the Standards* series. The audience would be instructors who teach in predominately Native American areas. This guide would provide educators with techniques and methodologies for working with Native American learners that are supported by research findings and policy guidelines. Like the *Changing the Face of Mathematics* series recently published by the National Council of Teachers of Mathematics, which includes separate volumes on teaching African Americans, Latinos, Native Americans, and students from other backgrounds, this would be an important next step in helping science teachers achieve optimal results with Native American learners. Just as the NSES was developed by a diverse group of scientists and science educators, the Native American guidebook should also be developed by educators, tribal leaders, and other resource people familiar with Native American culture and values.

The design used in this study should be applicable in other studies of science instruction for students from particular culture, language or income groups. This study first identified the teaching and learning practices identified as effective in raising achievement among Native American students. The degree to which these principles

were being used in classrooms was determined through classroom observations. Identification of these recommended practices -- and the alignment of this information with the teaching approaches called for in the NSES -- helps educators working with underrepresented students to understand the best strategies to implement in their lessons. If educators are going to help narrow the achievement gap, it will be necessary to use teaching techniques that produce optimal achievement gains with the population of students they are teaching. As learned in this study, the use of a single recommended strategy, for example, hands on learning, is not enough. Multiple strategies are generally needed, and these must be implemented with rigor and skill to create the hoped for results.

Suggestions for Additional Research

This study examined the use of research based practices in Native American middle school science classrooms. Equally important as the correct use of these practices is the curriculum that teachers are using. Implementation of a strong curriculum in alignment with recommendations from research studies and policy guidelines pertaining to Native American education, as well as with the NSES, is necessary to improve Native American students' science performance. In one classroom, lessons were observed on simple machines, and four weeks later the teacher was still teaching lessons on simple machines. There were questions as to how much of the science curriculum was being covered in this and similar classrooms. A descriptive study looking into middle school science curriculum actually being implemented in classrooms serving Native American students would be worthwhile.

Native American education policy guidelines indicate a need for culturally based curricula that meet the requirements of state and national standards. There is also some evidence in the research literature that culturally based curricula support Native American students' academic performance (Demmert & Towner, 2003; Demmert, 2001). There are numerous examples of culturally relevant lesson plans and modules from a variety of sources (Boss, 2003; Stephens, 2003; Cajune & Sievert, 2001), but nothing with a comprehensive alignment with the NSES. For example, the *Handbook for Culturally Responsive Science Curriculum* (Stephens, 2003) contains many suggestions on cultural relevance and assessment of standards based lessons, but it does not provide a standards based curriculum. The practicing classroom teacher does not have adequate time or resources to develop, pilot, and refine this needed curriculum. Consequently, culturally based lessons and curriculum were not observed at the frequency they should have been. Most of the teachers interviewed did not have knowledge on culturally based curriculum or culturally based lessons that align with the NSES. These models need to be developed, and once developed they need to be assessed with research studies as to the effectiveness.

This culturally based curriculum should be developed with tribal elder input as this study indicated that tribal elders' biggest concern is providing "a school curriculum that preserves and maintains our culture." Dialogue and research are needed to find out the relationship between the concern expressed by tribal elders in this study that traditional culture be maintained through the schools and the concerns of society in providing a literate and educated group of citizens. If these groups' views are in alignment, then curricula specific to Native American students must be developed and

researched. If the views are not in alignment, then consensus building must occur to bring the needs and expectations of the groups together. Native knowledge and ways of knowing must be integrated with western science. The differences between traditional Native knowledge with its emphasis on practical application of skills, trust in inherited wisdom, and reliance on verification through a qualitative oral record, and western science, with its use of a disciplined-based quantitative written record, must be acknowledged and explored (Deloria & Wildcat, 2001). Because tribal elders represent the leadership and past history of Native Americans, successful school / community relationships are more likely to develop if the views of the elders are sought and incorporated from the beginning.

Attendance and student mobility, with some students transferring between schools three to four times annually, are problems in many reservation schools. Students who miss days of school early in their education have a more difficult time understanding the work when they do return and some of these students fail to graduate. The 42 percent high school drop-out rate on the Crow Reservation and 38 percent drop-out rate on the Northern Cheyenne Reservation is an indication of this problem. Research is needed to find solutions to this problem, and possible solutions may be found in studying the techniques of successful schools. Administrators from some reservation schools in this study reported 92 -- 96 percent daily attendance rates. Attendance policies which allow students to miss only a specified number of days without consequences, as well as policies defining limited enrollment times throughout the year, have worked in some reservation schools. Some of these techniques may continue to work if applied in other schools. Family and community members must value attendance if school attendance

policies are to be effective. Determining how to create support for school attendance is another challenge for school administrators and for the research community.

Research is also needed regarding the conditions that lead to, or that can potentially reduce, clusters of problems observed together in several schools in this study. These problems included low student attendance and high rates of student transfer between schools, high teacher and administrator turnover, and lack of a formal curriculum in science and other core subject areas. Research is needed to find out why such problems appear together in certain schools and to explore how such conditions may be addressed individually or collectively. The best solutions may require regional approaches in which schools on or near a given reservation work together to establish common curricula and common attendance policies. If these policies are designed and implemented with the consideration and help of community members and tribal councils, they will more likely succeed. Further studies are needed to identify the most effective methods.

A final suggestion is that more research be conducted in Native American classrooms. As noted in Chapter Two of this dissertation, very few researchers have conducted studies that involve observations in classrooms serving Native American students. As a result, there is little research demonstrating the links between the use of various teaching strategies with Native American students and factors such as student engagement, motivation, and achievement. In addition, most of the existing research involves students from one tribe, limiting the usefulness of the results in understanding learning among Native American students from other tribes. There are many gaps in Table 2 (see p 47 in this dissertation), which presents research studies and policy

guidelines for Native American education. The current research studies have a limited number of themes, and many of the themes have been explored with just a small number of studies. This knowledge base needs to be expanded. In addition to more research on the indirect teaching strategies supported by the current literature on Native American education, additional studies are needed to test a wider range of strategies, perhaps including certain direct instructional strategies such as traditional lectures adapted to reflect Native American oral traditions.

This study examined middle school science instruction on two Montana reservations. These locations were selected in part because students in these reservation schools performed below the state averages in science, mathematics, and reading. Identifying common problems and possible shared solutions in schools in which science performance is low is important. So is the identification of unique problems in some settings that require novel solutions. The more we are able to learn about each educational setting, the better our chances will be to provide solutions that help learners. Secada (1992) poses the following:

If reform is to matter, it must begin with the populations for whom we have drawn these special categories. Curriculum and instruction should first be effective with these students, and then applied to other populations... the notions of disadvantage and compensatory education that are linked to these populations should be replaced by notions that acknowledge their competence (p. 654).

Addressing issues relevant to Native American achievement is of vital concern. As Nelson-Barber (1995) indicates, democracy is threatened when some groups are denied access to the highest quality education. Education can be the gateway towards success, wealth, happiness, and health. The degree that a society

supports education and educational reform for all citizens may be an indication of the society's commitment to the people.

Community members, administrators, teachers, policy makers, and researchers need to continue to work together to make a difference in educational settings like those in this study. Their efforts will form stronger schools and a stronger society.

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APPENDICES

Appendix A

Table 19. Relationships between Native American Classroom Research Studies, Policy Guidelines and the National Science Education Standards

Theme for Recommendation	Source of Recommendation Research Study, Policy Guidelines and Books	Corresponding NSES Standard letter, ref. number
Communities and School		
Community involvement in curriculum development	3 policy guidelines; 1 book; 6 research studies	Teaching Standard D5 - Identify and use resources outside of school. Program Standard B2 - Science content must be embedded in a variety of curriculum patterns that are developmentally appropriate, interesting, and relevant to students' lives. Program Standard E1 - All students in the K-12 science program must have equitable access to opportunities to achieve the NSES. System Standard A1 - Policies that influence the practice of science education must be congruent with the program, teaching, professional development, assessment, and content standards while allowing for adaptation to local circumstances. System Standard B1 - Policies that influence science education should be coordinated within and across agencies, institutions, and organizations. System Standard E1 - Science education policies must be equitable.
Parental involvement in school related activities.	1 policy guidelines; 4 research studies	Teaching Standard C5 - Use student data, observations of teaching, and interactions with colleagues to report student achievement and opportunities to learn to students, teachers, parents, policy makers, and the general public.
Broader family influences outside of school	1 policy guideline; 4 research studies	Content Standard F5 - As a result of activities in grades 5-8, all students should develop understanding of science and technology in society. Program Standard D5 - Good science programs require access to the world beyond the classroom.
General Approaches to Content, Instruction, and Assessment		
Use of formative performance assessments	2 policy guidelines; 1 book and 1 research study	Teaching Standards A3 , - Teachers of science plan an inquiry-based science program for their students. In doing this, teachers select teaching and assessment strategies that support the development of student understanding and nurture a community of science learners. Teaching Standard C1 - Teachers of science engage in ongoing assessment of their teaching and of student learning. In doing this, teachers use multiple methods and systematically gather data about student understanding and ability. Teaching Standard C3 - Teachers should guide students in self-assessment. Assessment Standards B3 - Achievement and opportunity to learn science must be assessed. Equal attention must be given to the assessment of opportunity to learn and to the assessment of student achievement. Assessment Standard C4 - Students have adequate opportunity to demonstrate their achievements. Assessment Standard D1 - Assessment tasks must be reviewed for the use of stereotypes, for assumptions that reflect the perspectives or experiences of a particular group, for language that might be offensive to a particular group, and for other features that might distract students from the intended task. Assessment Standard D2 - Large-scale assessments must use statistical techniques to identify potential bias among subgroups.

Theme for Recommendation	Source of Recommendation Research Study, Policy Guidelines and Books	Corresponding NSES Standard letter, ref. number
Use of formative performance assessments (continued)		Assessment Standard D3 Assessment tasks must be appropriately modified to accommodate the needs of the students with physical disabilities, learning disabilities or limited English proficiency. Assessment Standard D4 - Assessment tasks must be set in a variety of contexts, be engaging to students with different interests and experiences, and must not assume the perspective or experience of a particular gender, racial or ethnic group.
Student-centered classrooms	1 book; 3 research studies	Teaching Standard A2 – Select a science content and adapt and design curricula to meet the interests, knowledge, understanding, abilities, and experiences of the students. Teaching Standard D2 – Create a setting for student work that is flexible and supportive of science inquiry, Teaching Standard D6 – Engage students in designing the learning environment. Teaching Standard E3 – Nurture collaboration among students.
Inclusion of culturally related activities	<i>3 policy guidelines; 2 research studies.</i>	Teaching Standards A2 – see above, Teaching Standard B4 – Recognize and respond to student diversity and encourage all students to participate fully in science learning. Teaching Standard E1 – Display and demand respect for the diverse ideas, skills, and experiences of all students. Professional Development Standard D5 – Recognize the history, culture, and organization of the school environment.
Use of strategies to address limited English skills	<i>1 policy guideline</i>	Assessment Standard D3 – See above.
Inclusion of a variety of teaching strategies	<i>1 policy guideline; 1 book; 6 research studies</i>	Teaching Standards A2 & C1 – See above.
Presenting curriculum in a holistic fashion	<i>1 policy guideline; 2 research studies</i>	Teaching Standards A2 – See above, Professional Development Standard B1 - Connect and integrate all pertinent aspects of science and science education. Content Standard F5 – Students should develop an understanding of science and technology in society, Content Standard G1 – Students should develop an understanding of science as a human endeavor, Program Standards B1, B2 & B4 – The program of study in science for all students should be developmentally appropriate, interesting, and relevant to students' lives; emphasize student understanding through inquiry; and be connected with other school subjects. It should include all of the content standards. Science content must be embedded in a variety of curriculum patterns that are developmentally appropriate, interesting, and relevant to students' lives. The program of study should connect to other school subjects.

Theme for Recommendation	Source of Recommendation Research Study, Policy Guidelines and Books	Corresponding NSES Standard letter, ref. number
Students' need to feel competent prior to engaging.	5 research studies	
Activity-rich, motivating classrooms	1 book	Teaching Standard A2 – See above.
Student learning through observation and modeling.	15 research studies	Teaching Standard B5 – Teachers should encourage and model the skills of scientific inquiry, as well as the curiosity, openness to new ideas and data, and skepticism that characterize science.
Specific Teaching Strategies		
Group problem solving	2 policy guidelines; 1 book	Teaching Standard A2- See above. Teaching Standard B1 – Teachers of Science guide and facilitate learning. In doing this, teachers focus and support inquiries while interacting with students. Content Standards A1 & A2 – As a result of activities in grades 5-8, all students should develop abilities necessary to do scientific inquiry and understand about scientific inquiry.
Use of nature activities and outside activities	2 research studies; 1 book	Teaching Standards A2 – See above, Teaching Standard D5 – Identify and use resources outside the school..
Cooperative group work	1 policy guideline; 2 books; 9 research studies	Teaching Standards A2 – See above, Teaching Standard B2 – Orchestrate discourse among students about scientific ideas. Teaching Standard E4 – Structure and facilitate ongoing formal and informal discussion based on a shared understanding of rules of scientific discourse. Professional Development Standard B2 - Learning experiences for teachers must occur in a variety of places where effective science teaching can be illustrated and modeled, permitting teachers to struggle with real situations and expand their knowledge and skills in appropriate contexts.
Use of technology to Provide additional instructional and learning resources.	2 policy guidelines	Content Standard E1 & Content Standard E2 – All students should develop abilities of technological design and understandings about science and technology - Professional Development Standard A3 – Introduce teachers to scientific literature, media, and technological resources that expand their science knowledge and their ability to access further knowledge.

Theme for Recommendation	Source of Recommendation <i>Research Study, Policy Guidelines and Books</i>	Corresponding NSES Standard letter, ref. number
Use of inductive reasoning & inquiry	<i>1 policy guideline; 1 book; 1 research study</i>	Teaching Standard A2, B1, D2; Professional Development Standard B4; Program Standard B3. - See above.
Use of visual learning approaches	<i>1 policy guideline; 1 book; 19 research studies.</i>	Teaching Standard A2 & C1 -See above.
Extended "Wait Time"	<i>1 research study</i>	Teaching Standard A2 – See above.
Respond to students' field dependence/ field independence	<i>1 book; 4 research studies</i>	Teaching Standard A2 – See above.
Making practical applications	<i>2 policy guidelines; 1 research study</i>	Teaching Standard A2 – See above, Professional Development Standard A2 – Science learning for teachers must address issues, events, problems, or topics significant in science and of interest to participants. Professional Development Standard B2 – See above
Use of approaches that understand and respect silence in Native American students	<i>1 research study</i>	Teaching Standard A2 – See above
Use of open ended questions	<i>1 research study</i>	Teaching Standard A2 – See above
Teacher characteristics		
Warm personal teaching style, teacher is friendly, uses humor and is encouraging; behavior management is calm and "matter of fact."	<i>2 policy guidelines; 3 research studies</i>	

Classroom physical environment		
Classroom decorated with student art or other projects.	<i>1 policy guideline</i>	
Informal classroom structure	<i>1 policy guideline; 1 book; 3 research studies</i>	Teaching Standard D6 - See above.

Table 20 organizes each of the above standards and displays the frequency that each standard appears in the research studies, policy guidelines and books.

Table 20. Frequency of Native American Research Studies and Policy Guidelines as they relate to the National Science Education Standards.

NSES Standards	Teaching Standards	Prof. Develop.	Assessm.	Content	Program	System
A1				1		1
A2	15	1		1		
A3	1	1				
B1	1	2			1	1
B2	1	2			2	
B3			1			
B4	1	1			1	
B5	1					
C1	2					
C3	1					
C4			1			
C5	1					
D1			1			

NSES Standards	Teaching Standards	Prof. Develop	Assessm.	Content	Program	System
D2			1			
D3			2			
D4			1			
D5	1	1	1		1	
D6	1					
E1	1		1	1	1	1
E2	1		1	1		
E3	1					
E4	1					
F5			1	1		
G1				1		
G2	1					

Appendix B
Copies of Instruments used in the Study

Classroom Observation Form

Horizon Research 2001-2002

Background Information

Date of Observation _____ Time of Observation: Start _____ End _____

Subject Observed _____ Observer _____

Grade Level _____ Teacher's Name _____

Contextual Background and Activities

In this section, fill in the circles that best describe the class. **For each item, be sure to fill in all responses that apply.**

1. Classroom Demographics and Context

A. What is the total number of students in the class at the time of the observation?

- ☐ 15 or fewer
☐ 16 – 20
☐ 21 – 25
☐ 26 – 30
☐ 31 or more

B. What is the approximate percentage of Native American students in this class?

- ☐ 0 – 10 percent
☐ 11 – 25 percent
☐ 26 – 50 percent
☐ 51 – 75 percent
☐ 76 – 100 percent

C. Indicate the teacher's:

1. Gender
☐ Male ☐ Female

D. If applicable, indicate the teacher aid's:

1. Gender
☐ Male ☐ Female

1. Rate the adequacy of the physical environment.

1. Classroom resources:

- | | | | | |
|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| Sparsely equipped | | | Rich in Resources | |

2. Classroom Space:

- | | | | | |
|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| ☐ 1 | ☐ 2 | ☐ 3 | ☐ 4 | ☐ 5 |
| Crowded | | | Adequate space | |

3. Room arrangement:

O

O

O

O

O

1

2

3

4

5

Inhibited interactions
among studentsFacilitated interactions
among students.**Key Indicators on a Quality lesson.****I. Design****A. Ratings of Key Indicators**

	Not at All					To a Great Extent	Don't Know	N/A
D1. The design of the lesson incorporated tasks, roles, and interactions consistent with investigative mathematics / science.	1	2	3	4	5		6	7
D2. The design of the lesson reflected careful planning and organization.	1	2	3	4	5		6	7
D3. The instructional strategies and activities used in this lesson reflected attention to students' experience, preparedness, and / or learning styles.	1	2	3	4	5		6	7
D4. The resources available in this lesson contributed to accomplishing the purposes of the instruction.	1	2	3	4	5		6	7
D5. The instructional strategies and activities reflected attention to issues, equity, and diversity for students (e.g. cooperative learning, language-appropriate strategies / materials).	1	2	3	4	5		6	7
D6. The design of the lesson encouraged a collaborative approach to learning.	1	2	3	4	5		6	7
D7. Adequate time and structure were provided for "sense-making."	1	2	3	4	5		6	7
D8. Adequate time and structure were provided for wrap-up.	1	2	3	4	5		6	7
D9. Formal assessments of students were consistent with investigative mathematics / science.	1	2	3	4	5		6	7
D10. Design for future instruction takes into account what transpired in the lesson.	1	2	3	4	5		6	7
D11. _____	1	2	3	4	5		6	7

B. Synthesis Rating

1	2	3	4	5
Design of the lesson not at all reflective of best practice in mathematics / science education				Design of the lesson extremely reflective of best practice in mathematics / science education

C. Supporting Evidence for Synthesis Rating

II. Implementation

A. Ratings of Key Indicators

	Not at All				To a Great Extent	Don't Know	N/A
11. The instruction was consistent with underlying approach of the instructional materials as outlined in the Standards	1	2	3	4	5	6	7
12. The instructional strategies were consistent with investigative mathematics / science	1	2	3	4	5	6	7
13. The teacher appeared confident in his / her ability to teach mathematics / science	1	2	3	4	5	6	7
14. The teacher's classroom management style / strategies enhanced the quality of the lesson.	1	2	3	4	5	6	7
15. The pace of the lesson was appropriate for the developmental levels / needs of the students and the purposes of the lesson.	1	2	3	4	5	6	7
16. The teacher was able to "read" the students' level of understanding and adjust instruction accordingly.	1	2	3	4	5	6	7
17. The teacher's questioning strategies were likely to enhance the development of student conceptual understanding / problem solving (e.g. emphasized higher order questions, appropriately used "wait time," identified prior conceptions and misconceptions).	1	2	3	4	5	6	7
18. The lesson was modified as needed based on teacher questioning or other student assessments	1	2	3	4	5	6	7
19. _____	1	2	3	4	5	6	7

B. Synthesis Rating

1	2	3	4	5
Implementation of the lesson not at all reflective of best practice in mathematics / science				Implementation of the lesson extremely reflective of best practice in mathematics / science

C. Supporting Evidence for Synthesis Rating

III. Mathematics / Science Content

A. Ratings of Key Indicators

	Not at All					To a Great Extent	Don't Know	N/A
L1. The mathematics / science content was significant and worthwhile.	1	2	3	4	5		6	7
L2. The mathematics / science content was appropriate for the developmental levels of the students in this class.	1	2	3	4	5		6	7
L3. Students were intellectually engaged with important ideas relevant to the focus of the lesson.	1	2	3	4	5		6	7
L4. Teacher-provided content information was accurate.	1	2	3	4	5		6	7
L5. The teacher displayed an understanding of mathematics / science concepts (e.g. in his her dialogue with students.)	1	2	3	4	5		6	7
L6. Mathematics / science was portrayed as a dynamic body of knowledge continually enriched by conjecture, investigation analysis, and / or proof / justification.	1	2	3	4	5		6	7
L7. Elements of mathematical / science abstraction (e.g. symbolic representations, theory building) were included when it was important to do so.	1	2	3	4	5		6	7
L8. Appropriate connections were made to other areas of mathematics / science, to other disciplines, and / or real-world contexts.	1	2	3	4	5		6	7
L9. The degree of "sense-making" of mathematics / science content within this lesson was appropriate for the developmental levels / needs of the students and purposes of the lesson.	1	2	3	4	5		6	7
L10. _____	1	2	3	4	5		6	7

B. Synthesis Rating

1	2	3	4	5
Mathematics / Science content of lesson not at all reflective of current standards for mathematics / science education.				Mathematics / Science content of lesson extremely reflective of current standards for mathematics / science Education.

C. Supporting Evidence for Synthesis Rating

IV. Classroom Culture

A. Ratings of Key Indicators

	Not at All				To a Great Extent	Don't Know	N/A
C1. Active participation of all was encouraged and valued.	1	2	3	4	5	6	7
C2. There was a climate of respect for students' ideas, questions, and contributions.	1	2	3	4	5	6	7
C3. Interactions reflected collegial working relationships among students (e.g. students worked together, talked with each other about the lesson).	1	2	3	4	5	6	7
C4. Interactions reflected collaborative working relationships between teacher and students.	1	2	3	4	5	6	7
C5. The climate of the lesson encouraged students to generate ideas, questions, conjectures and / or propositions.	1	2	3	4	5	6	7
C6. Intellectual rigor, constructive criticism, and the challenging of ideas were evident.	1	2	3	4	5	6	7
C7. _____	1	2	3	4	5	6	7

Respect for Diversity

Based on the culture of a classroom, observers are generally able to make inferences about the extent to which there is an appreciation of diversity among students (e.g. their gender, race / ethnicity, and / or cultural background). While direct evidence that reflects particular sensitivity or insensitivity toward diversity is not often observed, any examples should be listed.

B. Synthesis Rating

1	2	3	4	5
Classroom culture interfered with student learning				Classroom culture facilitated the learning of all students

C. Supporting Evidence for Synthesis Rating

Scoring the form: As you observe the class, you are to place a checkmark in each appropriate category whenever you witness a particular style trait. A tally in each category or the checkmarks should be representative of the total numbers of times the teaching style characteristic was witnessed.

Classroom lesson	
Direct Instructional style	Indirect style
Student questions	
Teacher generated questions	Student generated questions
Classroom activities	
Direct Instruction style	Indirect style
Overall impression	
Evidence of Formative Assessment Direct Instructional style	Indirect style

Additional Comments:

Type of Instruction

- | | | | |
|----------------|----------------------------------|------------|----------------------------------|
| L | Lecture | WW | Written work/problem set |
| LWD | Lecture with discussion | D | Demonstration |
| CD | Class discussion | CL | Cooperative learning |
| HOA | Hands-on activity | TIS | Teacher interacting with student |
| AD | Administrative tasks | OTH | Other _____ |
| LWQ | Lecture with questions | LWW | Lecture with worksheet |
| SR / RA | Silent reading, reading out loud | | |

Number of students in class _____ Type of Class _____

0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50-55	55-60
-----	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

Teacher Questionnaire

1. Race – Are you (please check one or more)

☐ American Indian

☐ Asian

☐ Black or African-American

☐ Hispanic or Latino

☐ Native Hawaiian or Other Pacific Islander

☐ White

2. For each of the following subjects please indicate (a) the number of semesters of college coursework you have completed and (b) whether you are certified to teach in Montana at the secondary level.

	Number of semesters college coursework				Certified	
		1-3	4-7	8 or more	Yes	No
a. Life Science / Biology	☐	☐	☐	☐	☐	☐
b. Earth / Space Science	☐	☐	☐	☐	☐	☐
c. Chemistry	☐	☐	☐	☐	☐	☐
d. Physics / Physical Science	☐	☐	☐	☐	☐	☐
e. Engineering / Technology	☐	☐	☐	☐	☐	☐
f. Mathematics	☐	☐	☐	☐	☐	☐

3. How many years have you taught in your content area prior to this school year?
(please check one)

0-2	3-5	6-10	11-15	16-20	21-25	26 or more
☐	☐	☐	☐	☐	☐	☐

4. When did you last complete a science course for college credit? (please check one)

☐ In the last 5 years ☐ 6-10 years ago ☐ 11-20 years ago ☐ More than 20 years

5. Which of the following courses have you taught in the last 3 years (check all that apply)

☐ Life Science / Biology

☐ Physical Science

☐ Advanced Physics

☐ Advanced Biology

☐ Chemistry

☐ Integrated Science

☐ Earth / Space Science

☐ Advanced Chemistry

☐ Technology Ed.

☐ Environmental Science

☐ Physics

About how often do **you** do each of the following in your science instruction?

	Never	Rarely, Few Times a Year	Sometimes twice a month	Often twice a week	All or almost all science lessons
1. Use group problem solving.	☐	☐	☐	☐	☐
2. Use performance assessments.	☐	☐	☐	☐	☐
3. Use nature activities in lessons	☐	☐	☐	☐	☐
4. Use technology in teaching	☐	☐	☐	☐	☐
5. Use inquiry-based activities	☐	☐	☐	☐	☐
6. Use cooperative group work	☐	☐	☐	☐	☐
7. Display student work in the classroom.	☐	☐	☐	☐	☐
8. Introduce content through formal presentations.	☐	☐	☐	☐	☐
9. Demonstrate a science-related principle or phenomenon.	☐	☐	☐	☐	☐
10. Teach science using real-world contexts.	☐	☐	☐	☐	☐
11. Encourage students to explain concepts to one another.	☐	☐	☐	☐	☐
12. Allow students to work at their own pace.	☐	☐	☐	☐	☐
13. Arrange seating to facilitate student discussion.	☐	☐	☐	☐	☐

Please indicate how well prepared you feel to do each of the following. (Darken one oval on each line.)

	Not Adequately Prepared	Somewhat Prepared	Fairly Well Prepared	Very Well Prepared
1. Lead a class of students using Investigative strategies	☐	☐	☐	☐
2. Involve the school with Community activities.	☐	☐	☐	☐
3. Manage a class of students engaged in hands-on/project work.	☐	☐	☐	☐
4. Provide a variety of teaching strategies for your classes.	☐	☐	☐	☐
5. Help students take responsibility for their own learning.	☐	☐	☐	☐
6. Presenting curriculum in a holistic fashion.	☐	☐	☐	☐
7. Recognize and respond to student diversity.	☐	☐	☐	☐

	Not Adequately Prepared	Somewhat Prepared	Fairly Well Prepared	Very Well Prepared
8. Use open ended questioning techniques with students.	☐	☐	☐	☐
9. Encourage students' interest in science.	☐	☐	☐	☐
10. Run high activity / motivating classrooms.	☐	☐	☐	☐
11. Include culturally relevant lessons with your students.	☐	☐	☐	☐

About how often do **students** in this class take part in each of the following types of activities as part of their science instruction? (Darken one oval on each line).

	Never	Rarely, Few Times a Year	Sometimes twice a month	Often twice a week	All or almost all science lessons
1. Participate in student-led discussions.	☐	☐	☐	☐	☐
2. Make formal presentations to the class.	☐	☐	☐	☐	☐
3. Read from the science textbook in class.	☐	☐	☐	☐	☐
4. Design or implement their own investigation.	☐	☐	☐	☐	☐
5. Participate in fieldwork	☐	☐	☐	☐	☐
6. Answer textbook / worksheet questions.	☐	☐	☐	☐	☐
7. Follow specific instructions on an activity or investigation.	☐	☐	☐	☐	☐
8. Prepare written science reports.	☐	☐	☐	☐	☐
9. Use computers	☐	☐	☐	☐	☐
10. Record, represent, and/or analyze data.	☐	☐	☐	☐	☐

Pre-Classroom Observation Interview

Horizon Research, Inc., 2001-2002

This interview can be done in person or in the form of a phone interview. Be sure to express appreciation to the teacher for allowing you to observe the class, and answer any questions s/he might have about confidentiality, use of results, etc. Teaching styles is a non-threatening observation area as all types of styles are necessary for different types of learners.

1. What has this class been doing in mathematics / science recently?

PROBES: What unit are you working on?
What instructional materials are you using?

2. What do you anticipate doing in your mathematics / science class on the day I will be observing?

PROBES: What do you hope students will learn as a result of the work you have planned?

3. What is the next step for this class?
4. Is there anything in particular that I should know about the group of students that I will be observing?

Post-Classroom Observation Interview

Horizon Research, Inc., 2001-2002

This interview can be done in person or in the form of a phone interview. Be sure to express appreciation to the teacher for allowing you to observe the class, ask the following questions:

1. Were there any ways in which the lesson was different from what you had planned?
2. What did this lesson tell you about what your students are learning and still need to learn in mathematics / science?

PROBE: How do you plan to further assess the students' learning?

3. What challenges have you faced in encouraging your students to be actively engaged in this mathematics / science class?

PROBE: How have you approached these challenges?

4. What is the next step for this class?

5. What might be some of the ways that you come to understand what your student needs are?

PROBE: What might be some needs in terms of science education.

6. Could you tell me about parent's involvement with their students' education?

PROBE: What are some of the barriers in this area?

7. Do you have any suggestions as to how you might improve this area?
8. Have you noticed any particular teaching strategies that are more successful with Native American Students?

PROBE: What is it about these strategies that you find helpful?

9. Are there any particular teacher characteristics that seem more successful with Native American students?

PROBE: Do you notice any teacher characteristics in other teachers which Native American students can relate to.

10. In what ways to you bring Native American culture in your lessons?
11. In what ways have standardized test scores affected what you do in your classroom?

Thank you very much not only for answering some of these questions, but also for letting me observe your classes. It's been very helpful and I've learned a great deal of information.

Interview Questions for Administrators

Thanks for joining me today for this interview. I am Walt Woolbaugh, and I am a jr. high science teacher from Manhattan, MT. I'm currently on a year sabbatical from my school district in order to finish up a degree at MSU and to learn about teaching and learning in other science classrooms.

We know that an important part of what happens in classrooms and in schools is related to educational leadership, so that's why I'm interested in your opinions regarding your school.

With your permission, I'll tape record the interview just so I don't lose any thoughts or ideas.

WARM UP QUESTION

1. Could I please find out a little bit about you by asking what your past experiences in education have been?

PROMPT: How long have you been at this school or where Native American students make up large populations?

STUDENTS IN YOUR SCHOOL

2. What is the daily student attendance like at the school?

PROMPT: If the attendance is not good, what might be some reasons why?

FOLLOW UP – (If the attendance isn't good) Do you have any ideas as to how it might be improved?

3. What is student mobility like at the school in terms of students coming or leaving in the middle of the semester.

PROMPT: Has this been a problem, and in what ways has it been a problem?

4. What about student grades?

PROMPT: Student behavior?

TEACHER EXPERIENCE

5. Could you please tell me about your experience in terms of being able to hire teachers in a content field area?

PROMPT: Do you have any ideas on some possible solutions that might help you out?

6. How stable does your teaching staff remain from year to year?

PROMPT: (If this is a problem) Do you have any ideas on some possible solutions that might help you out?

7. What types of Professional Development opportunities does your staff have?

8. Do you have any mentoring programs?

9. What standardized tests is your school using?

COMMUNITY / SCHOOL RELATIONSHIPS

10. What about the community's support of the school, do you find that generally there are good community / school relationships?

PROMPT: What about the community colleges, do they provide classes and resources?

11. Do you have any recommendations as to how the school and community might work together to provide a stronger science education for students in your community?

FINAL THOUGHTS

12 Any final comments or suggestions regarding the community and the school?

THANK YOU for sharing your time and ideas. Your information will be very helpful to me.

Focus Group / Individual Interview Questions for Tribal Elders or other Community members

Thanks for joining me today for this interview. I am Walt Woolbaugh, and I am a jr. high science teacher from Manhattan, MT. I'm currently on a year sabbatical from my school district in order to finish up a degree at MSU and to learn about teaching and learning in other science classrooms.

We know that an important part of what happens in classrooms and in schools is related to community involvement, so that's why I'm interested in your opinions regarding the school in your community.

With everyone's permission, I'll tape record the interview just so I don't lose anyone's thoughts or ideas.

Although this is a group interview (or individual), it is important to hear the views of each of you. I will encourage several of you to respond to each question to make sure that we don't just hear one point of view. So be sure to jump into the conversation!

WARM UP QUESTION

1. Could I please find out a little bit about you by asking where you grew up?

PROMPT: Where were you born? How long have you lived in this community? Do you have grandchildren in school here? Did you go to school here?

2. What is or what has been your involvement in the school?

THE ROLE OF COMMUNITY IN SCHOOL

3. From your thoughts and experiences, what do you see the role of the community in the school?

PROMPT: What should the community input be into the school, and what do you see the school giving back to the community?

FOLLOW UP – What might be some recommendations for accomplishing some of these ideas?

SCIENCE AND SCIENCE UNDERSTANDING

4. What are some of your ideas as to what might be important in teaching a science class?

PROMPTS: What might be some topics that you view as important in a science class? What might be some of your ideas as to how modern thinking in science might blend in with the culture views of Native Americans?

5. Do you have any recommendations as to how the school and community might work together to provide a stronger science education for students in your community?

6. Is there anything taught in the schools that you feel should be better left to the tribe?

PROMPT: Any areas like plant science?

FINAL THOUGHTS

7. Any final comments or suggestions regarding the community and the school?

THANK YOU for sharing your time and ideas. Your information will be very helpful to me.

APPENDIX C

Transcripts of Tribal Elders on the Crow and Northern Cheyenne Reservations

Tribal Elder – Northern Cheyenne

Grew up in MT, tells of working hard, no vacations, no time for themselves; 86 years old. Feels that youth don't listen to their elders. The most important concern is to have some type of structure – youth have fast cars, they go everywhere, do everything and they don't listen to their elders. Clarence tells a story of driving and he tells his grandson there are holes in the road, but the grandson won't listen and he ends up hitting the holes. Kids seem to know everything. He feels we currently, we have knives and drugs in the schools – discipline is lacking. We have so many activities in the school and community that it becomes difficult for students to learn. There is competition towards learning. Everyone is trying to get students to do more and more. Things were different in his day. There wasn't as much competition, people worked together to accomplish goals. Got up, started the fire, got things ready to go to school, had breakfast (a detailed description of his home life and daily routine occurred at this point. There wasn't a lot to do. His parents taught him great values and his feeling is that these values aren't being taught these days. Parents taught the difference between right and wrong. When he wanted something he had to work for it. Now days, when kids want something, they end up getting it. They aren't being taught the difference between right and wrong. The job of teaching values becomes that of the parents and that just isn't happening the way that it should be.

Suggestions on improving the school – Identify elders who can talk and bring these people into schools to talk with the students. The elders should talk about life history and culture to the students. They should talk of what makes them successful, and what students should do to improve. Felt that schools should follow a prescribed curriculum. The tribe has had some definite ideas about what should be in the curriculum, and this material should be included (he wasn't sure what these might be). Thought science fairs were excellent – helped to motivate all students. Didn't know of any science areas that shouldn't be included in school. Native Americans feel the land is important and science is about the land; science is important.

Getting kids to school - This is the job of the parents. The parent also needs to be sure the child is ready for the particular grade they are in. Students should learn good discipline – currently there doesn't seem to be any consequences. If students do something, there should be some consequence. If students have discipline, they can do many things in life.

We should have many available resource people in schools. Through the eyes of many people, we tend to learn more.

Pat – Northern Cheyenne.

25 years ago, helped at a local school instituting a program called "Follow through." This was a program that attempted to make students want to come to school. The approach was to bring in outside resource people (like Pat) so students would begin to understand that all of the community is behind education. Made kids want to come to school. Good attendance meant that students would be learning. The frustrating thing was the lack of parental support in the school. He just didn't see many of his neighbors that were suppose to come to school (this was from 25 years ago). If he saw somebody down town, he would tell them to come, and they would attend school about one time

after that, but that was about it. He feels the community is the answer to helping with Native Education and helping to stop high Native drop out rates (note: He quoted as saying that most Native students drop out of school, but in the community that he was in, that wasn't true though the drop out rate was about 35 %). He felt if parents would get involved with schools, then so would their children. He felt that many Native Americans didn't have good experiences in school so they were afraid to come to school. He thought if fellow community members would all work to get their fellow neighbors out to school, then things would greatly improve. Pat talked at great length on how frustrated he was 25 years ago on not having parents come to the school, he felt he was trying to improve things and he felt that many of his fellow community members weren't trying hard enough.

Areas of science – Botany maybe shouldn't be taught. Pat didn't have a lot of experience with science. When questioned about "ways of knowing" for Native Americans, he talked of the stories that his grandfather told him, and that he told to his children. He came a full circle going back to the idea that students should spend time with elders. If this happened, he felt that everything would work out OK.

Dean – Northern Cheyenne

Grew up in the area (80+ years) ; Attended school until the 4th grade. Dean respects educated people and throughout his interview he talked of fellow friends who graduated from high school. It was a sign of respect for someone to graduate from high school. "A whip got him to school." His feeling is that students need to be made to go to school. When I talked to him about making school enjoyable or worthwhile so that students would want to go to school, he just laughed. "Students need to be made to go, and if a whip is required, then that's what should happen." Feels that discipline in the schools is going down – Dean has grandchildren in the schools and basis his decisions and comments on what his grandchildren do. He feels his grandchildren and their friends aren't disciplined. "Anything they wish, they seem to get." Dean feels that students have so many options and get so many things that alcohol and drugs become a natural way to go. Instead of this routine, Dean recommends that parents and schools provide structure and discipline for children.

Dean doesn't have any ideas on science curriculum that should be taught. He wasn't sure what was being taught, and I got the idea that he didn't truly know what was meant by a science course. When I talked about plants and animals and the possibility of these areas having some cultural implications, Dean indicated that maybe teachers should be aware of some of the cultural implications of these topics. Dean thought it was important that community and school become one. The school was an outgrowth of the community. He therefore thought it was important to get people into school. "we went to school many years ago (30+ yrs), and we were surprised how few parents attended the school function. He hoped that more parents were involved these days, and that more students stayed in school longer. Dean had some ideas on getting parents into school. Idea for getting people in school – get parents to school by celebrating the accomplishments of their children. Every time there is an opportunity to recognize students, there should be an open house. When asked how often this should occur, Dean talked of several times each week as being a time frame. If this would happen, then

everyone comes out to school. Native American's enjoy gatherings so this bring entire families into the school especially grandparents as they like to see the grandchildren perform.

Tribal Elder: - Crow

Money rules what happens in many schools. Dennis started his interview this way. "If you want to see what drives schools, take a look at the money." Many things that he'd like to see happen would need more money. He prefaced all of his comments with this money disclaimer. He knew what he was suggesting would cost money and he wanted to be sure I knew that. His main point is that he would like to see Crow culture in the curriculum. Traditional values should be taught in the classroom. Classes should be taught in the Native tongue, history Native ways of doing things all should be incorporated within the school day. If students understood the Crow language and traditions, then they would be successful in their culture so they could have a basis to be successful in another culture. He knows this comes back to money. Students educated in Native American ways would help to improve the quality of life for everyone. Would like to see Bilingual programs improved and brought back into the schools. NA legends, stories and history should be handed down through time and teachers should teach these in school. Stories of the moon, stars, spring and summer seasons, new life – mother natures way of life, we need to celebrate things with this new way of life. All this should be in the school curriculum. Traditional ways of life. Suggests extra courses for teachers to help them understand how to teach these traditional ways of life to students. Indians use animals to survive and we need to pass this information on to our youth. Would like to see a high school in Crow Agency. A community school would help both the community and the students. Would like to see a land grant approach to science – what is needed to survive from the land? The science would be based on a study of the land. Courses like horsemanship would be taught in the schools. Dennis ended his interview the same way he started by saying, this all takes money to do.

Tribal Elder - Crow – Former tribal judge, and former tribal chairmen (even though the interview questions were asked in a sequential order, Don's interview jumped around, and this explanation follows the order of his talk). – feels that Crow language should be in the school in all classes and all grades. Talked of how the "Head Start" program this next year would include Crow language, and this needs to happen in a K-12 setting (all through school). Global problems like alcohol and drugs are rampant in reservation areas. Young people are getting into drugs and alcohol, and going on to crime. The culture is being destroyed. We need Native culture groups to come into schools to do programs for children. There are too many Native parents these days that don't know the traditions and the culture so the school/community needs to step in. The families no longer pass on these traditions so if the culture is to survive, then the school and community must help out. A high school is needed in Crow Agency. Don begins talking about the problems with the school at Hardin and the Hardin community (where Crow Agency students currently go to high school). He says that the school/community (he uses these words interchangeably) are not serving the needs of the Crow culture. He feels that large segments of the school/community are racists. They look down on Crow

children and they feel that Crow children can't learn as well as white children. This comes out in the feeling (s) of the high school teachers and fellow students. Crow students need to be with other Crow students. They all share a common culture, common history and common traditions. The only way to have this made sense is to have everyone together in the same class and school. We need tribal elders who will serve as role models for youth. The public deserves to be heard in our schools and currently they aren't. What Native people wish in Crow Agency isn't happening, and they aren't happy with the present school situation. The Crow people are losing their culture and the school/community becomes a need to preserve the culture.

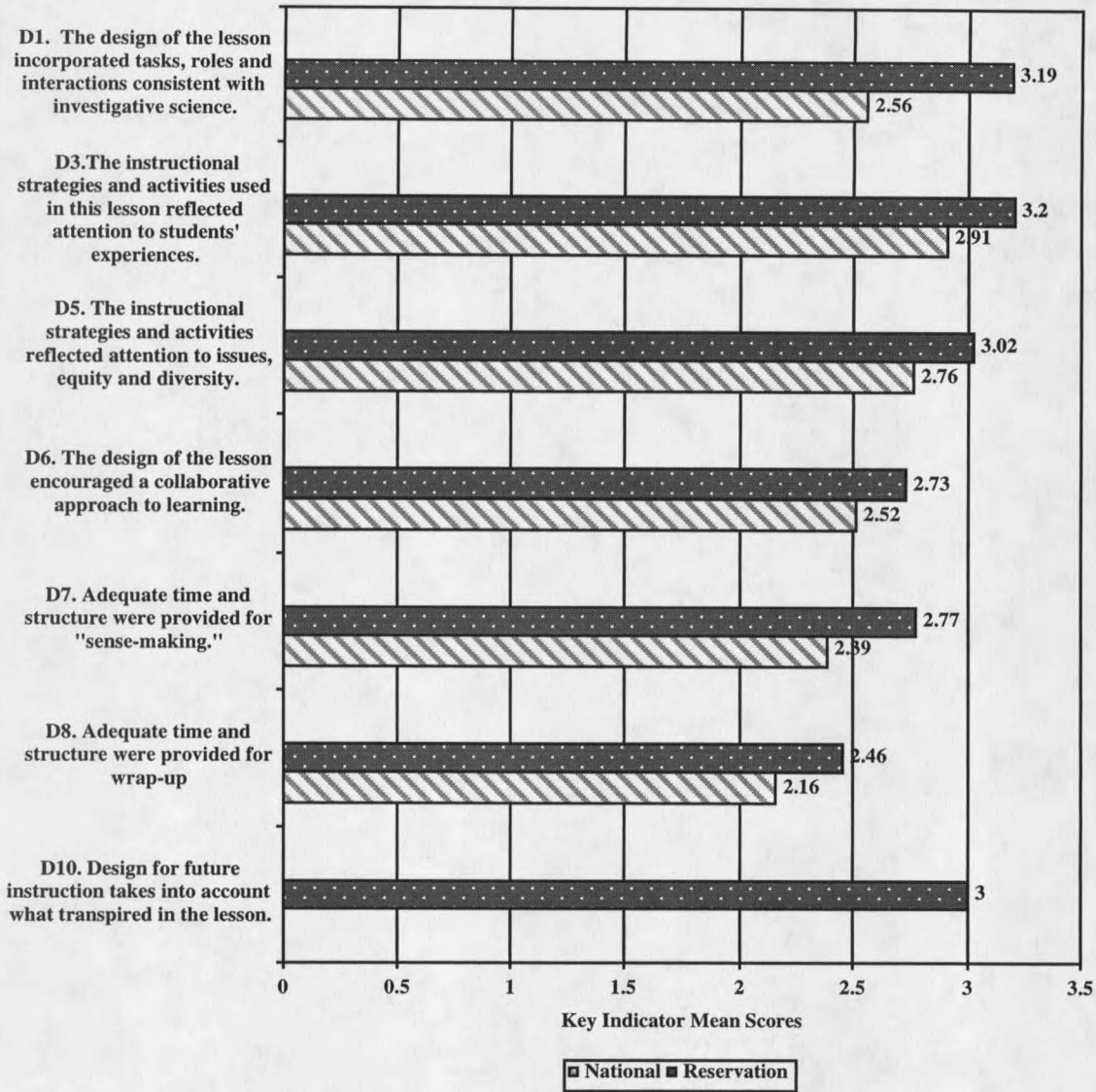
Regarding Science education in the schools, Don doesn't feel he is familiar enough with science to provide any insights. He goes back to stating that culture and language are the two most important items to consider when trying to help the Crow people.

APPENDIX D

Figure 4. Comparisons of Ratings on Individual Key Indicator Items in Four Categories
for Teachers from the Two Reservations and a National Sample

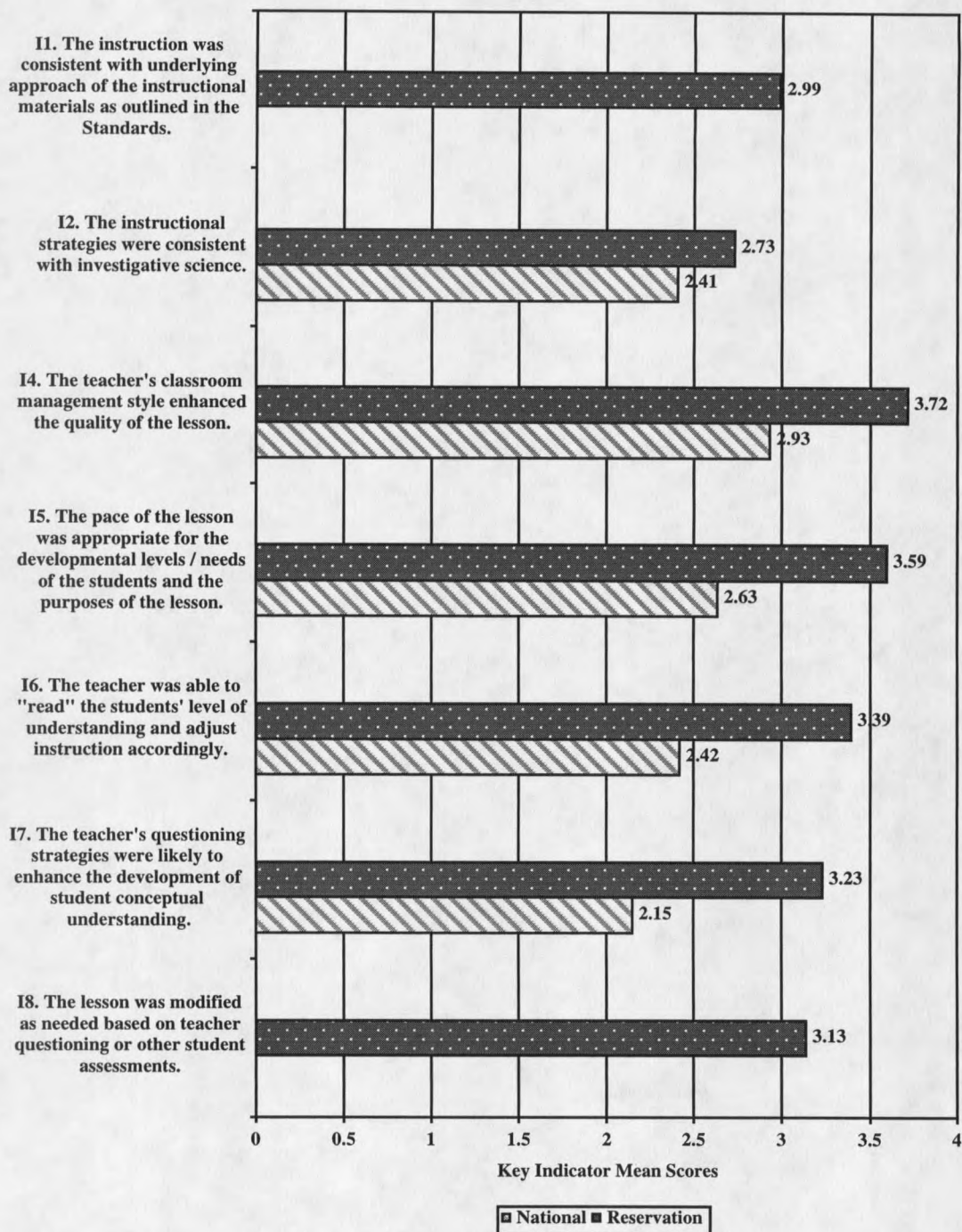
Mean Indicators of Lesson Design

N= Reservation 68; National 31



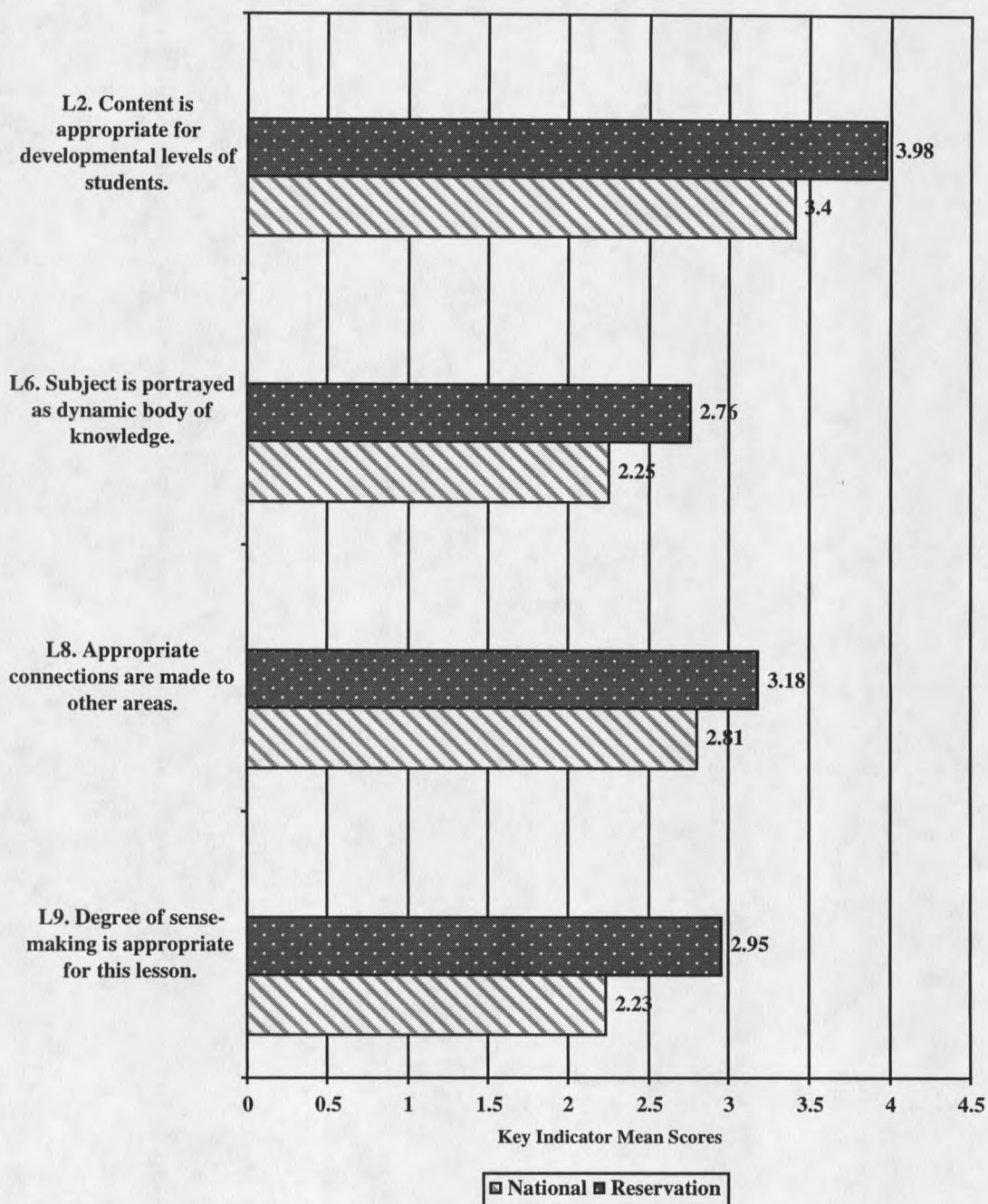
Mean Indicators of Lesson Implementation

N= Reservation 68; National 31



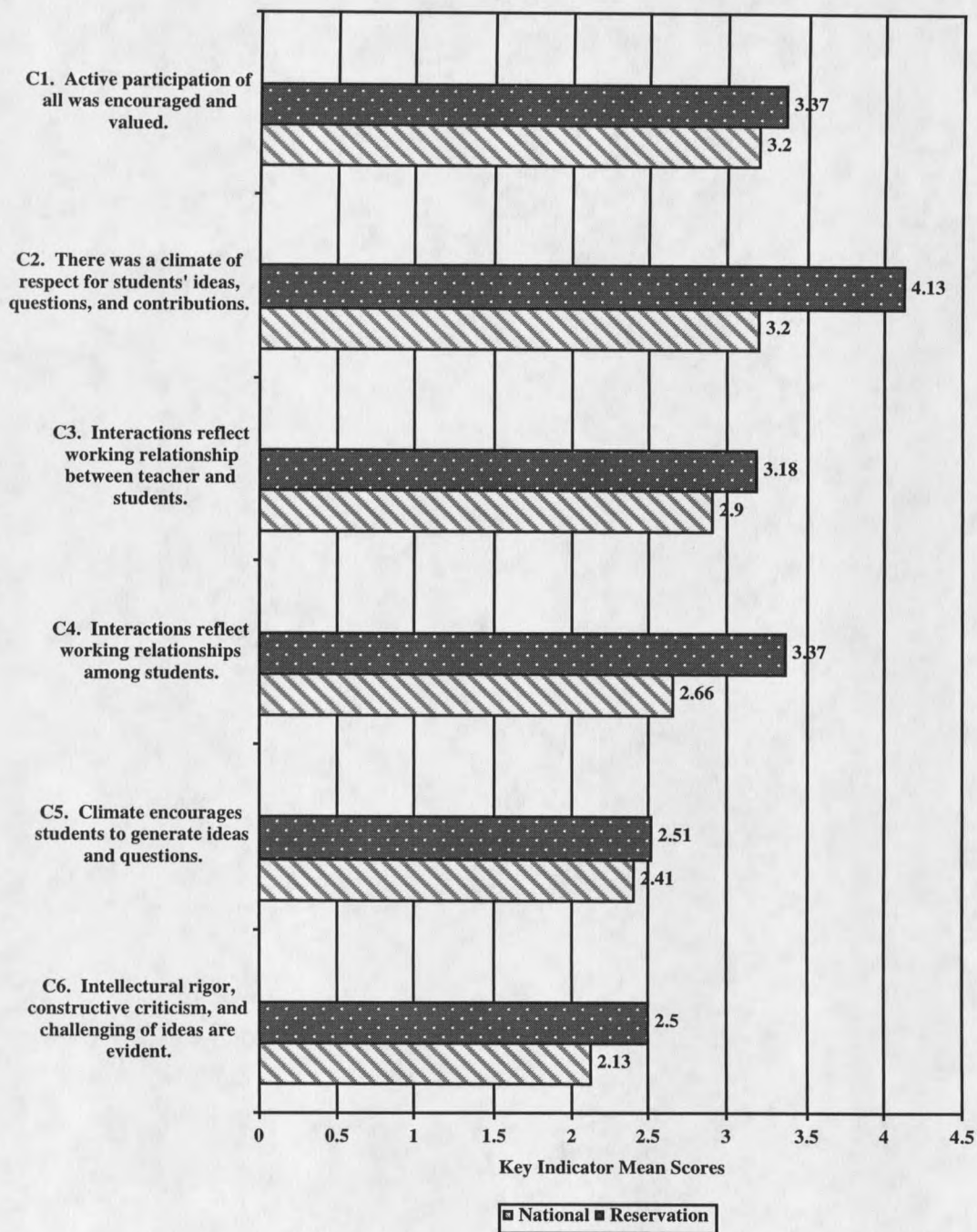
Mean Indicators of Science Content

N= Reservation 68; National 31



Mean Indicators of Classroom Culture

N= Reservation 68; National 31



APPENDIX E

Table 21. Results of Rotated Solution for Factor Analysis

Factor Analysis of Classroom Observation Instrument

Key Indicator Item	Factor One	Factor Two	Factor Three	Factor Four	Factor Five
D1	.143	.865*	.186	.220	.215
D3	.129	.723*	1.92E-04	.509	4.336E-02
D5	3.452E-02	.325	.181	.285	.799*
D6	.124	.357	9.911E-04	.234	.785*
D7	.447	.501	.508*	.167	.298
D10	.368	.682*	.361	2.46E-02	.329
D11	.341	.314	.687*	.209	.158
I1	.635*	.491	5.627E-02	.338	.304
I2	.645*	.427	.142	.299	.166
I4	6.945E-02	.311	.642*	.129	.443
I5	.135	.475	.343	.235	.532*
I6	.199	.170	.719*	.254	4.400E-02
I7	.319	9.352E-03	.820*	.275	9.018E-02
I8	.497	.163	.603*	.523	.142
L2	7.342E-02	.837*	.128	2.445E-02	.112
L6	.862*	.217	.236	.249	2.423E-02
L8	.883*	5.100E-03	.128	1.213E-02	.284
L9	.785*	.121	.395	8.874E-02	.219
C1	.206	7.570E-02	.403	.756*	3.487E-02
C2	.196	.149	8.065E-02	.794*	.220
C3	.113	.271	.208	.567	.665*
C4	2.862E-02	.413	.136	.743*	.279
C5	.467	5.381E-02	.532*	.508	.304
C6	.630*	3.926E-02	.346	.371	.505

Extraction Method: Principal Component Analysis

Rotation Method: Varimax with Kaiser Normalization

* Indicates factor selected for factor analysis

APPENDIX F

Table 22. Results of One Sample t-test

**One Sample t-test of Key Indicator Items from Crow and Northern
Cheyenne Teacher Observations**

Test Value = 3.12

N = 68

Key Indicator Items	t	df	Sig. (2- tailed)	Mean Difference	Mean	Standard Deviation
D1	.382	67	.704	.070	3.19	1.19
D3	.512	67	.611	.082	3.20	1.04
D5	-.497	67	.622	-.096	3.02	1.25
D6	-1.85	67	.072	-.394	2.73	1.06
D7	-2.122	66	.040*	-.352	2.77	1.06
D8	-3.731	58	.001*	-.787	2.33	1.26
D10	-.557	34	.583	-.120	3.00	1.03
I1	-.648	67	.520	-.132	2.99	1.32
I2	-1.913	67	.063	-.382	2.74	1.29
I4	4.276	67	.000*	.606	3.73	.919
I6	2.156	66	.037*	.270	3.39	.802
I7	.546	66	.588	.112	3.23	1.32
I8	.096	61	.924	.015	3.14	.962
L6	-1.854	63	.071	-.620	2.76	1.22
L8	.320	61	.751	.064	3.18	1.24
L9	-1.118	66	.270	-.169	2.95	.967
C1	1.369	67	.179	.249	3.37	1.18
C2	8.470	66	.000*	1.01	4.13	.767
C3	.306	66	.761	.063	3.18	1.32
C4	1.39	67	.173	.249	3.37	1.16
C5	-3.077	67	.004*	-.608	2.51	1.28
C6	-3.639	67	.001*	-.620	2.50	1.10

* Significant at the .05 Confidence Level

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