

How do you get the numbers to dance?

**EFFECTIVE EDUCATIONAL PRACTICES IN
MATHEMATICS
FOR NATIVE AMERICAN LEARNERS:
A CONFERENCE SUMMARY**

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I. INTRODUCTION

Background

In late May 2007, a two-day “think tank” event was held at the Crazy Horse Monument in the Black Hills of South Dakota that brought together expert educators from throughout the United States to discuss effective educational practices in mathematics for Native American students. The participants included mathematics educators from universities and tribal colleges, educators from school districts with high Native American populations, state-level policy makers, and researchers.¹

The event was sponsored by the Promoting Reflective Inquiry in Mathematics Education (PRIME) project, a National Science Foundation (NSF) funded Math Science Partnership project involving the Rapid City Area Schools, Technology in Education (TIE), and Black Hills State University. The project represents a concerted effort to improve K-16 mathematics education in the school district and at the university. Begun in 2002, the work of PRIME has focused on professional development for teachers and principals and the implementation of more inquiry-based mathematics instructional materials. In addition, one of the main goals of the PRIME project has been to narrow the achievement gap between Native and non-Native American students. In year four of the project, faced with troubling and persistent disparities, project leaders wondered what more they could do to address the particular needs of Native students in mathematics. They sought supplemental funding from NSF for a conference that would bring together experts to share promising strategies in helping Native American students learn mathematics.

Inverness Research Associates has served as the external evaluator to the PRIME project for the past five years, documenting and studying the efforts of the project. In part, our evaluation has included conducting classroom observations of mathematics lessons, interviewing teachers and principals, and conducting focus groups with students, with a special focus on interviewing Native American students. Five senior researchers from Inverness Research Associates attended the conference. During the

¹ A complete list of participants is attached in an appendix to this report.

conference, we participated in all sessions. Our role in the conference was to carefully listen to and document the discussions and to summarize the main ideas that emerged.

This Paper

In this paper, we will share the main ideas that emerged during the two-day conference. We have drawn in large part upon the discussions at the conference, but also from our experiences studying and evaluating many other mathematics education projects.²

We start with a few caveats. First, it is important to note that this conference was intended as a beginning. The PRIME project leaders solicited help from a variety of people, and in the course of the two-day conference, participants, in essence, began a conversation. There simply was not time for participants to share in an in-depth way the essence of their individual work. And Inverness Research Associates' role in the conference was as listeners and documenters of what the experts who were presenting had to say. Thus, what we say will not be comprehensive. However, we will convey as accurately as possible the big ideas that emerged over the course of the two-day conference.

It is also important to note that the conference participants came from very different places and situations. However, all participants shared the reputation of being successful in the educational system. During the conference, both Native American and non-Native participants alike shared their personal experiences and lessons they have learned from their work within schools serving Native communities.

This paper is organized into sections that generally follow the flow of the conference events. In the first section, we describe the nature of the problem, focusing in particular on the descriptions of mathematics education for Native American students that emerged during the conference. This will be followed by a summary of strategies – those that have been found to be successful in specific instances and locations – that were shared during the conference. Then we summarize the implications – the collective thinking of the group about the most important ideas to come out of the conference. Finally, from our own perspective, we offer some closing thoughts.

II. THE NATURE OF THE PROBLEM

Before delving into strategies and solutions for addressing the needs of Native American students in mathematics, it is important to clearly identify the issues. Thus, the conference started with a discussion of the nature and context of the problem.

In this section, we begin with a discussion of the complexity of the issue. Then we follow with specific factors of the educational landscape that hinder progress in better serving Native American students in mathematics.

² For more about Inverness Research Associates, see our website at www.inverness-research.org.

The Complexity of the Issue

From the conference discussions, it was clear that the issue of how to better serve Native American students in mathematics is complex and multi-layered. Traditional western schooling methods have not served Native American students well: there is a persistent gap in the achievement scores of Native and non-Native American students and Native American students have a higher drop-out rate than non-Native students. Traditional western approaches to schooling in general, and to the teaching and learning of mathematics in particular, often do not mesh well with the culture of Native students and Native parents are often skeptical of what schooling has to offer their children. Adding complexity to the issue is the condition of poverty many Native Americans face.

Achievement Gap and Drop-outs

Many Native American students struggle in the current education system. There is a persistent achievement gap between Native American students and non-Native students. For example, data from the 2005 National Assessment of Educational Progress (NAEP) showed Native students having lower average scores in mathematics than the average score for white students.³

In addition, there are high drop out rates for Native American students; typically, the drop-out rate for Native American students is twice the national average. High absenteeism and low graduation rates for Native students are indicators of the seriousness of the problem for Native students in school.⁴

In Rapid City Area Schools, the 9th grade class of 2001-2002 included 300 Native American Students. Four years later, in 2004-2005, there were 80 American Indian 12th graders and only 50 of them graduated high school. In 2005, of the 42 Native American students who received grades in 9th grade math, more than half (24) received grades of a D or F. In terms of ACT scores in South Dakota, 52% of White students met the benchmark of 18 in Math compared to 18% of Native American students.⁵

Mathematics seems to be a particularly important subject area in this issue because of its role as a “gatekeeper” course – one of the key subject areas in which students are tested, and a subject that fewer and fewer students find success with as they go through school. As a gatekeeper course, success in mathematics either limits or opens up the possibilities and choices throughout high school, college and post-college.

³ *The Nation's Report Card: Mathematics 2005*. National Assessment of Educational Progress. U.S. Department of Education, National Center for Education Statistics. Washington, DC: U.S. Government Printing Office, p. 4.

⁴ Reyhner, John. *Dropout Nation*. Indian Education Today. June 2006.

⁵ From a data packet developed by The Red Stone Group, titled “Strategic Plan for Indian Success,” Rapid City Area Schools, 2006.

Moreover, several participants talked about their Native American students not being able to see themselves in the mathematics, and therefore, not finding an entry into the subject. This alienation is true for many students in the United States, but it is particularly acute for Native Americans. Native students find it difficult to see the relevance and importance of mathematics in their lives, partly because when it is taught, it is rarely taught in a way that ties it to their experience or culture. One conference participant related this story:

I asked a colleague up in Alberta why so many Natives are struggling with math. He said, "For many, the numbers don't dance." I started thinking about that because numbers didn't dance for me either. They didn't dance for me until I became a cabinet maker. That's when I started to see that the way I did math suited me in the shop and I could build things with it, without the teacher telling me I didn't do it the right way. How do you get the numbers to dance?⁶

Native and Western Cultures In Education

There are fundamental elements that are different between Native and non-Native viewpoints on the world, and even between worldviews among the different Native tribes. The one-size fits all approach to schooling, prevalent in the traditional western education system, seems incompatible with many Native cultures.

In particular, the history of Natives in education, even fairly recent history, is one of forced assimilation that has left open wounds for generations. Many of the Native participants at the conference spoke passionately about their own families' painful experiences in boarding schools and in the contemporary American school system. They described how schooling was a place where they often had to make a choice between their Native heritage and the western world. It wasn't simply a matter of being able to embrace both; they had to give up one to enter the other.

Historically, the education of Indian children has never really been to educate an Indian child; schools were about changing the Indian child. The curricular program was to take away a language and supplant it with a new language, take away your Navajo'ness, your Navajo language and supplant it with an English language and take away your Navajo history and supplant it with a new history... [this] put Indian people and the Indian child in a situation where there was, you might say, a split, a dichotomy in their thinking. In order to achieve in education, having to give up their language and their culture, or if they wanted to maintain their Indianness, then they had to give up the possibility of a good education. So, this is a fundamental problem that Indian people face. This is a problem that non-Indians do not face.

Not surprisingly, many Natives view western education as something that takes their children away from their Native culture and family. One participant summarized the

⁶ The quotations that appear in this paper are not specifically identified and are taken from notes and transcripts of the conference discussions. They have been lightly edited for the sake of clarity.

issue as that of “gaps and disconnects: between families and schools, between students and schools, the disconnects between cultural values and education pedagogy and values.”

Expectations and Stereotypes

Conference participants spoke of the low expectations that teachers and administrators have of Native children and their ability to succeed in the current school system. Stereotypes and misunderstandings about culture that key school authority figures in school hold have a great effect on the experience of Native students. Many teachers, administrators and policymakers who are working in the traditional western education system are there because they have been successful in this system and they find it difficult to envision and embrace change in a system that has served them well. And if a person is successful in an education system, it is difficult to understand the experiences of those who are not.

We have a lot of teachers who say, “Well, some kids can get it and some kids can’t, and they are not here everyday and that is why they are failing.” It is easy to give all kinds of other reasons why Native students aren’t successful in schools. But until we really come to expect every kid to learn, we are not going to make any progress.

This is a classic example of a negative feedback cycle. In some places, an indication of this is Native students being over-assigned to special education classrooms. A recent study investigating this problem found that more Native students are identified as learning disabled than students of any other culture group. Typically, Native learning disabled students receive instruction in pull-out programs where behaviorist-based instruction focuses on drill and practice rather than reasoning and problem solving advocated by the National Council of Teachers of Mathematics (NCTM) driven reform of mathematics.⁷

Issues of Poverty

The culture of poverty adds another layer to the issue here.⁸ Many Native students live in impoverished conditions which have a profound impact on their lives. According to 2005 census data, 29% of Native American children are living in poverty, compared with 10% of white children.⁹

Because economic opportunities for Native Americans are limited on many reservations, those students who succeed in school feel that to find a good job, they

⁷ Reschly, Daniel J. National Research Center on Special Education, Vanderbilt University. From a slide presentation: *Disproportionality in Special Education*.

⁸ For a more thorough discussion of the culture of poverty, see Payne, Ruby D. *A Framework for Understanding Poverty*. Highlands, TX: aha! Process, Inc. 1996.

⁹ Fass, Sarah and Nancy Cauthan. *Who are America’s Poor Children? The Official Story*. National Center for Children in Poverty, Columbia University, Mailman School of Public Health. December 2006. http://www.nccp.org/pulbications/pub_html.

have to leave the reservation. But leaving the reservation is difficult. The “power of place” is an important notion within many Native American cultures. From a western viewpoint, moving from one place to another, or from one situation to another, is not uncommon. For Native Americans, where you are -- where you come from, your home, community, and your family -- is central, and moving away from that is not necessarily desirable. Also, the notion of “moving up” or “getting ahead” is prevalent in western society, but not so much in Native societies where being “better” than one’s family is not something to be strived for.

I was sitting in a meeting with my school teachers about two months ago, in the heart of the reservation, with 99% of the population Native American, and one of the teachers said, “All I want them to do is just get this so they can get out of here.” I looked at him and said, “Who said they wanted to get out of here?” His idea was, get out of here. Their idea is to stay here. Educators keep telling our kids, “Well, you can get out of here. You can be better than your family.” No, we are not raised to be better than our family. Who wants to be put aside from your family?

Thus, the nature of the problem is complex, multi-faceted and ongoing. Simply implementing a new tool – professional development, a new curriculum – is not going to address the underlying cultural clashes that exist. That is not to say that something cannot or should not be done. The solution will have to include a deep and ongoing look at and response to the current situation – who the students are, what is being tried, how it is impacting the students – an approach that runs counter to the traditional standard culture of schooling and reforms.

Barriers to Making Progress

The complex and multi-layered issues described in the previous section are situated within an educational system that raises barriers and hinders progress to better serving Native students in mathematics. The issues that Native American learners face within this educational landscape are not new; they have been studied and debated for many years and while some progress has been made, the issues remain. In the discussions throughout the conference, the following barriers to making progress were noted.

Lack of Trust and Understanding

One notable barrier is a lack of trust on the part of Native families and lack of understanding on the part of school administrators and teachers. Many Native Americans don’t trust western education because of the long history of forced assimilation imposed during the boarding school era. And western educators often lack understanding as to why Native children transition in and out of reservation and public school districts; why Native parents may choose not to enforce school attendance; and how the prevalence of poverty and substance abuse in many reservation communities affects the lives of students. This lack of trust and understanding leads to a lack of

communication between home and school, and a lack of relationships. This lack of relationship is a fundamental cornerstone of the negative feedback cycle we noted earlier.

High Turnover Rate

Another barrier is the high turnover rate among teachers and administrators in schools with high Native populations. We heard numerous stories during the conference about how schools on the reservation have teachers, frequently recent college graduates, who only stay for one to three years. It is hard to build meaningful relationships between teachers and students when the teachers are always new. And there becomes less institutional memory, where people have no knowledge about what has been tried and what worked or didn't work. As one participant said:

...the turnover rate is... so rapid, that it creates a school where nobody knows what has been taking place....we have a summer math institute coming up real soon and we are working real hard to get this one district to participate. The superintendent left, the curriculum coordinator left and a half dozen teachers left... I step back and say, "Wow. Is this rare?" No. Then I think that is a general factor, and it makes it real difficult.

Teaching Assignments

It is a general problem throughout the United States that the neediest students get the newest and least proficient teachers; again, that phenomenon is exacerbated in the schools serving high Native American populations. Thus, another barrier is having the best teachers teaching the best students instead of having the most experienced teachers where the need is greatest.

I want, somehow, effective policy. Let's get some teachers that have been out there for 10 or 15 years and who already have a lot of the issues down with classroom management and some of the content. Now they can go in and really grapple with the other issues that we have in places where other things are happening with low SES [socio-economic status].

Compartmentalization

Another complicating factor is that special populations frequently are compartmentalized and departmentalized within school districts. In many districts, Indian Education is its own department. When these separated departments exist, others in the school district may feel they don't have to think about or deal with the issues around working with those special populations.

Cultural Bias in Test Questions

Another barrier to progress that was mentioned by several conference participants was the cultural bias that persists in standardized test questions. Researchers note that the majority of high-stakes tests are in “formal register,” a form of discourse that minority and poor students do not usually have access to at home or the ability to use.¹⁰

More specifically, participants noted several examples of questions where Native students answer incorrectly not because they don't know the answer, but because their cultural background allows for an interpretation of the question that is different than what the test makers intended. One participant related this illustration:

There is a classic old problem about designing a fenced-in lot. In this particular context, it was for the dog pen and you had X amount of fencing and you had to derive what would be the largest amount of square footage so you could put your dog in a pen. One of the teachers told me that this problem made no sense for her students. She said nobody on the Rez keeps their dog in a fenced-in lot. So the students attend to the context and not to the mathematics, because they are trying to understand why people keep their dogs in a fenced-in lot.

This kind of cultural mismatch between students and the high-stakes tests places extra pressure on the teachers who must help students understand the context of the questions.

As educators, if we look at the context that these problems are situated in, I think we have a responsibility to help our students understand that it might not make sense in their world view...

III. STRATEGIES FOR BETTER SERVING NATIVE AMERICAN STUDENTS IN MATHEMATICS

The solutions and strategies are very complex and they are very much interwoven like the warp and weft of a woven blanket. There is no magic bullet and we are all aware of that, or we would have used it a long time ago, and we wouldn't have to have this think tank. However, I think we are starting to see some possibilities emerge.

All conference participants agreed that serving Native American students better in schooling in general, and in mathematics in particular, was a complex issue. Many have been working for years on strategies and solutions in their local contexts. As members of the group presented and discussed approaches and lessons learned, some common themes emerged.

¹⁰ Payne, Ruby D. [A Framework for Understanding Poverty](#). Highlands, TX: aha! Process, Inc. 1996. p. 28.

Cultural Responsiveness

A central, cross-cutting theme during the conversations about strategies and solutions was the idea of cultural responsiveness. In education, this means taking into account the background and local culture of the Native students when making decisions about what to teach and how to teach it. Good education for all children involves finding ways to acknowledge and build upon students' experiences and prior knowledge. In this way students can identify with what happens in the classroom because the experiences are regionally, culturally, and personally relevant. Their lives are reflected in what happens there. Learning at school becomes less of an experience of a foreign culture and place.

What does culturally responsive teaching look like? I think it is really based on the lives of children. It is based on their own traditions, and acknowledges that students do bring prior knowledge to the classroom. Of course they do. Children are brilliant. In a K-1 class in my school, the teacher was just awarded the Presidential Award for science teaching. I would walk in there every day and I wish I was a student in her classroom. She looks at kids and learns from them and that is how she decides what to do next. That is one of the signs of a culturally responsive teacher. Culturally responsive teaching is place based. It acknowledges that where we are in the world makes a difference. It builds on what we see around us. It is tied to the values of the people.

Curriculum

Cultural responsiveness applies to all aspects of teaching and learning. Several participants had developed or were developing culturally responsive curriculum materials in mathematics. A key design feature of the materials is that the mathematics is rigorous and relevant to the students – the mathematics problems are contextualized and draw upon local culture and experience.

We have written a total culture based curriculum K through 12. The teachers there who are not Native have access to volumes of possible activities that are culture based to American Indians in general, or their local Miwok, Maidu or to the Sacramento Kings who are also part of our culture. So we have that written for every teacher.

Math in a Cultural Context is a fabulous example of a culturally responsive curriculum. It is literacy and math together and it is rigorous mathematics. It is high expectations and it is relevant to the life. It is built on Yup'ik culture.

The math content in part actually comes from community and local knowledge. It is both context and knowledge, and we are calling it a third space between western and the Yup'ik world and so it is kind of a creative process.

A central tenet of creating culturally responsive curriculum is the importance of project leaders and local school districts developing close working relationships with the local Native populations, elders and parents alike, over a very long time. For example, in Alaska, the *Math in a Cultural Context* curriculum has been developed over the past twenty years through collaboration with the Yup'ik tribe.

We have worked with the elders and the community bases; we have gone from the ground up. We have worked together with the elders since about 1987. That is a long way to keep walking We are walking together.

Curriculum is one area in which schools and districts can address the need of cultural responsiveness. However, there are many other areas that could and should be assessed in terms of cultural responsiveness. For example, The Alaska Native Knowledge Network has published the *Alaska Standards for Culturally Responsive Schools*. The booklet, which has been endorsed by numerous Alaska Native associations, councils and the Alaska State Board of Education, present standards in five areas – students, educators, curriculum, schools and communities. The standards offer definitions and guidance so schools, districts, and communities “can examine what they are doing to attend to the cultural well-being of the young people they are responsible for nurturing into adulthood.”¹¹

Pedagogy/Teaching Strategies

Many participants felt that a constructivist approach to teaching mathematics was more compatible with the notion of being culturally sensitive, in particular when considering traditional Native teaching styles. Constructivism certainly focuses attention on the student experience of understanding and learning mathematics. The timing and pacing of the class is based on students’ needs. In addition, students are encouraged to trust their own thinking in finding ways to solve contextualized mathematics problems. This increases their conceptual understanding of the mathematics and assists them in making meaning of the content.

However, simply using a constructivist approach does not meet all of the needs of Native students. Teaching strategies must take into account the specific learning styles and cultural context of Native American students. Research indicates that “there are some differences in learning styles among cultural groups”.¹² At the conference, participants presented their work and experience with successful teaching strategies for Native American students. These strategies are based on Native ways of learning. They include modeling, joint productive activity, and seeing the big picture instead of focusing solely on the pieces.

¹¹ Alaska Standards for Culturally Responsive Schools, Alaska Native Knowledge Network, 1998.

¹² Hilberg, Soleste R. and Roland G. Tharp. *Theoretical Perspectives, Research Findings, and Classroom Implications of the Learning Styles of American Indian and Alaska Native Students*. ERIC Clearinghouse on Rural Education and Small Schools. September 2002.

Modeling

One of the strategies mentioned by several participants was learning by watching and modeling. Modeling is a central teaching strategy advocated by culturally responsive curriculum.

One way the Indian children learn at home is by watching their parents do things, or their grandparents, grandmother. So modeling, we think, is very important; so the more the teacher will model something for the kids, the better. We are not ones who say, "Here is how you do it, now practice."

One participant has deemed this "expert apprentice modeling."

We have worked with the elders, it is expert apprentice modeling and almost every elder who teaches uses expert apprentice modeling. Without much talk, you don't ask questions, you learn through observation.

Joint Productive Activity

The strategy of "joint productive activity" or students and teachers working on problems together was another strategy highlighted during the conference. Math teachers model the attitudes and behaviors of a good problem solver by demonstrating how to analyze situations carefully, by demonstrating tolerance for ambiguity, by reflecting on and talking about solution strategies, and demonstrating task persistence.

...we are finding that teachers and students producing together, meaning the teacher gets in there and solves problems with the kids and comes down to their level is a way that our kids are really picking up on things, by watching how adults solve problems.

... we term it joint productive activity – teacher and student working on the same task. It does wonders for the relationship between teacher and student. Students see the teacher and the teacher really takes this task seriously and so it makes connections, particularly if the task relates to the community and community knowledge. And then, there is cognitive apprenticeship. The teacher authentically speaks aloud, when the teacher authentically gets stuck. They have a math problem and they don't quite know how to do it.

Again the issue of relationship is highlighted here. Good strategies are symbiotic with the development of productive, respectful relationships.

The Big Picture Before the Pieces

Many participants have worked with and learned from tribal elders about how best to serve Native students. They have realized that the traditional Western approach to

mathematics of skill building, practice, and application is oppositional to traditional Native ways of problem solving.

I think we are going to find students who are responding to what the elders are telling us. They say, "Show the results to our kids before you do something, before you teach them how to do it." From my sort of Eurocentric, northern Colorado, former Catholic perspective, that wasn't the way the nuns taught me. We build the skills and then we will do the project and the Native elders say, no it is backwards, because it has to be the motivation.

Other strategies emerging from the conference included the notions of giving students choice in determining what they will work on, and building from the cognitive strengths of the children.

We include a lot of choice. We use the menu approach so that we will say to the kids at the beginning of the week, here are all of the things you can do. You can choose which ones you want to do, or the order that you want to use them and choice really seems to turn the kids on.

We find out what the kids know and build from there. We avoid creating barriers that keep us from getting to the math. We make an effort to have them feel safe, we work with what is familiar and then incorporate the math.

CREDE Standards

Conference participants noted several resources and tools that are available to educators who want to better serve Native students.¹³ In particular, many of them mentioned the Center for Research on Education, Diversity and Excellence (CREDE)¹⁴ and the standards the Center has developed. They are particularly significant given the focal topic of the think tank meeting and the fact that they encapsulate many of the ideas discussed at the conference. The standards are based on decades of research and "are critical for improving learning outcomes for all students but especially for those of diverse ethnic, cultural, linguistic and economic backgrounds." As with much of the findings presented by participants, the approach to pedagogy has demonstrated effectiveness with Native students.

We also abide by the CREDE standards. The more I work with it, the more convinced I am of it that it will really, really help Indian children.

¹³ A list of references, resources and tools that surfaced during the conference discussions is attached as an appendix to this report. This list is not meant to be comprehensive.

¹⁴ www.crede.berkeley.edu

CREDE Standards¹⁵

Seven Principles for Effective Pedagogy

- Teacher and Student Producing Together
- Developing Language Across the Curriculum
- Making Meaning: Connecting School to Students' Lives
- Teaching Complex Thinking
- Teaching Through Conversation
- Demonstration and Modeling*
- Student Initiative and Student Choice*

**added from the Zuni Project Research*

Professional Development for Teachers

Talking about teaching strategies quickly leads to the topic of preparation and training of teachers. Many of the conference participants were involved in projects related to teacher preparation and professional development and efforts to address these two important areas.

To me teaching is this open-ended problem solving activity that can't be reduced to some sort of algorithmic behavior. You really do have to be a reflective practitioner ... the professional development of teachers, both in content and pedagogical knowledge, [has] to talk about, what are the answers to those hard questions? What is mathematics?What is my role? What does it mean to learn? How can I find out what students have learned? What resources do I have or need or what are the barriers to becoming more effective?

In order to implement a culturally responsive curriculum, teachers need to learn to be culturally sensitive themselves. Too often this idea is treated simplistically or superficially and does not address the core ideas or issues.

A lot of times teachers go into the classroom or come to the reservation and we say we want you to be a culturally responsive teacher. They think they need to go learn how to powwow or they need to learn how to shoot a bow and arrow and all of these things that they think are culture. When in reality, it is the value system. It is how you treat each other, that is the culture and trying to teach teachers to do that. I had a teacher who was a Native teacher and I would ask the other teachers to go watch her talk with students. It really wasn't about her teaching half of the time; it was really about how she visits with her students.

The training of teachers is a complex endeavor. Teachers must not only know the content and how to effectively teach it, they must also be able to assess whether students understand what they are being taught. Today's assessment pressures can

¹⁵ crede.berkeley.edu/standards/standards.html

drive much of what happens in classrooms. How to make sense of these demands and meet the needs of a diverse student population is challenging. For professional development to be effective, it must address the realities of diversity and prepare teachers to effectively apply what they learn in their own classrooms.

When preparing today's teachers, whether pre-service or in-service, it is not enough to simply talk about assessment. Teachers must first know and understand how to teach the content that their students are expected to master; they must understand the NCTM process standards and the content standards, and they must understand how assessment is linked with those standards. Additionally, if teachers are being prepared to work with Native students, the assessment must be culturally responsive. It isn't a simple intervention, just do this and it will work. A complex staff development model is necessary.

One staff development model that several conference participants mentioned as being compatible with traditional Native teaching practices is Cognitively Guided Instruction (CGI). Specific tenets of CGI, a constructivist-based approach for teaching mathematics, include: problem solving based on sense making; problem solving that is culturally situated and based on the lived experiences of the student; cooperative rather than competitive instruction; time-generous rather than time-driven instruction; and instruction that is holistic and focuses on conceptual understanding rather than on procedures.

Of course, this type of staff development should begin even before teachers arrive in the classroom. Teacher preparation is an important area that must be addressed.

I personally feel that we need to look closely at how elementary teachers are prepared to teach math because that is where it begins, at the elementary level....When inadequately prepared and math phobic teachers are in the classroom, the teacher's dislike of math will negatively influence how the children feel ...

Simply increasing the number of Native American teachers is not enough. All teachers will need the necessary content, pedagogy, and supports to meet the needs of their students.

I think we are at the point now that we can't just be satisfied with seeing a brown face in the classroom. What we need to be seeing is a person that is excellent in all subject areas.

Systemic Change

Strategies and solutions related to teaching, teacher preparation and professional development are essential to providing high quality mathematics learning opportunities for Native students. And yet, there are many other aspects of the education system that

need to be addressed. Change is needed at all levels of the system to support meeting the needs of Indian children. This includes all levels of the K-16 system from student to superintendent and provost and all aspects of that system – policy, funding, leadership, vision, curriculum and assessment, professional development, etc.

We have to pay attention to all of these different parts.... We have to pay attention to teacher practice, CGI, constructivist teaching, all of the great best practices of mathematics. We have to pay attention to policy, like how many credits do you need to graduate from high school? That is really important as well.

Hence, the improvement of mathematics education demands a much broader improvement of educational practices and conditions. These improvements, in turn, demand changes and simultaneous improvements in multiple dimensions of the system. Change in the system comes both from top down and bottom up actions and pressures. Grassroots efforts can ultimately lead to important policy changes, and vice versa.

Looking at Personal and Institutional Biases

Perhaps most importantly, one presenter spoke of the need for teachers and administrators to look inside themselves and address their own biases. Without this, any effort to address the needs of Native students will fall short. Finding a solution will involve more than a change in program and policy. Teachers and administrators need to become more aware of and reflective about their biases, attitudes and approaches. This is difficult and sometimes threatening work that needs to be done. The current traditional structure of schooling and professional development makes this difficult. This is long term work that takes more than a workshop or a half-day professional development session to address the challenge.

This is the hardest part to change, the teacher's heart. I think we probably all could agree on that. It is the critical piece and I think it is hard and so we kind of pushed it aside and it is the part that we haven't paid attention to and yet it is the one, if we ignore it, we are going to still be here. Because teachers have to truly believe that students come to school knowing something ... our job is to figure out what it is, what mathematical understanding do you have and then how do I fit what I am doing so that I help you in your growth?I think teachers have to unpack their own baggage in terms of understanding that if you are white in this country, the world looks different to you and if you are Native in this country, the world looks really different to you. Until we grapple with that, on a personal level, I just don't think we are going to get anywhere.

IV. IMPLICATIONS

The final session of the conference asked participants to summarize the most important implications arising from the issues and strategies discussed. Specifically, participants were asked to generate ideas that would help the PRIME project in planning future work. The group articulated numerous ideas. We summarize here the major themes: teacher preparation; belief systems and values; recognizing students as individuals; building relationships with local Native American communities; and the role of data. It is important to note that many if not all of the participants felt strongly that addressing only one or two of these items would not in and of itself solve the problem. There is no “silver bullet,” no one thing that will work.

Better Teacher Preparation

Many of the implications generated by participants in the conference had to do with the important role of the teacher and the importance of good teacher preparation. Participants stressed the need for more careful content preparation in mathematics for teachers and a closer collaboration between K-12 school districts and higher education in teacher preparation. Other participants stressed the need for teachers to be better prepared in the area of how to teach Native American students specifically.

Building Better Cultural Awareness and Understandings

Participants also stressed the importance of looking carefully at belief systems and values, and building understandings, so that everyone involved can have more productive conversations about values and can build better understandings of different cultures. Through this, classrooms can be created where the individuality of each student is recognized and where all students’ prior knowledge is validated.

Building Relationships

An important piece of this work is also building relationships with the local Native American communities. Successful strategies that participants discussed were built from long-term and ongoing relationships between those involved in educating Native students and representatives from the local Native communities. These strategies were based on in-depth knowledge of the local community and belief systems.

Collecting and Using Data

Finally, participants stressed the importance of collecting and analyzing good data to drive efforts. Participants noted the importance of disaggregating standardized testing data to glean as much information as possible about what local efforts have and have not been successful, and using that to drive future decisions. Many of the participants also spoke of the difficulty in a grant-funded time period to create the relationships and trust needed to do this work, to carry out the project, and to gather the kinds of data that would be useful not only to the specific project but also to others.

V. CLOSING THOUGHTS

The key question emerging from the conference was this: What's going to keep us from having this same conversation five years from now? Participants expressed frustration at the amount of study that has been done on Native populations and the lack of direct impact resulting from those studies. At the same time, they expressed frustration at the lack of research and data that is available about strategies that have been tried in mathematics with Native populations.

There may be two fundamental problems to be addressed. The first is to identify the actions and strategies that will be most effective in improving schooling for Native American children. What clearly emerged from the conference is that, because the systems and cultures in each place are unique and complex, there is no one simple solution.

I think there is not one curriculum that works for everybody. The Native peoples are vast and very different and I would hate if what came out of this think tank was that we endorsed this one program... I really think that we need to think about what are the elements of this program that seem to be working, and how can we replicate them and make them relative to the region or the people that they are going to be used with.

...And because it is collaborative, there are many ingredients and it can't be boiled down through strategies, techniques, or any little ism's or big ism's.

The second fundamental problem to be solved, which may even be more difficult than identifying successful strategies, is to generate the will to tackle the problem in a serious way. Real intentionality is required. It is clear that it is going to take a committed and sustained effort. Work toward solving the problem will require a real relationship with Native American parents and students. Absent such relationship, we will probably continue to bemoan, and to study, but not to solve, the problems this conference identified.

Many people have been working on the issue for years and those making progress say it takes a long time and needs to be thoughtful, careful work. Any effort to better serve Native American students will need to be culturally relevant and responsive, carefully rooted in and growing out of the local context and needs. It must include collaborations with parents and community members, teaching methodologies that are well-suited to Native students, and the support and coordination of all layers of the system.

Figuring out how a western education system can better serve Native American students in mathematics is an incredibly complex endeavor. For the PRIME project, the conference was one step in addressing this issue. It gave the participants the

opportunity to share some of their own thinking and specific approaches, to learn from others involved in similar efforts, and to highlight some useful resources and tools.

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Appendix A
List of Conference Participants

Regional and National Participants:

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Angela Lunda, Principal, Juneau School District

John Koker, Professor of Mathematics and Interim Dean, University of Wisconsin, Oshkosh

Keith Moore, Director of Indian Education, South Dakota Department of Education

Mandy Broaddus, Achievement Specialist, Indian Education Division, Montana Office of Public Instruction

Jan Martin, NAEP Coordinator, Office of Curriculum, Technology, and Assessment South Dakota Department of Education

Billie Brown, Regional Trainer, Montana Center for Teaching and Learning, Bozeman

Anselm Davis, Special Assistant, Navajo Nations RSI/White House Initiative on Tribal Colleges and Universities

Mitchell Stone, Executive Director, The Red Stone Group

Connie Ahrens, Middle School Math Coach, Todd County School District

Jerry Lipka, Professor, School of Education Research, University of Alaska, Fairbanks

Patrick Weasel Head, Director of American Indian Students Services, University of Montana

Rosemary Ackley Christiansen, Associate Professor of Humanistic Studies and First Nation Studies, University of Wisconsin, Green Bay

James Barta, Professor of Education, Utah State University

Jonathan Brendefur, Faculty, Boise State University

Sandra Fox, Indian Education Specialist, Center for Research on Education, Diversity and Excellence

Dwight Gourneau, Consultant

Donovin Sprague, Education Director, Crazy Horse Memorial

Richard Sgarlotti, Projects Coordinator, Hannahville Indian School

Karma Nelson, Regional Trainer, Montana Center for Teaching and Learning, Bozeman

Shannon Amiotte, Elementary Education Instructor, Oglala Lakota College

Ida Red Bear, Mathematics Instructor, Oglala Lakota College

Nancy Ward, Rapid City Area Schools

Tod Shockey, Assistant Professor in Department of Mathematics and Statistics, University of Maine

Running Horse Livingston, Math Professor, University of Minnesota, Duluth

PRIME Leadership:

June Apaza, Center for the Advancement of Mathematics and Science Education,
Black Hills State University (BHSU)

Ben Saylor, BHSU

Pat Peel, Rapid City Area Schools (RCAS)

Maggie Austin, TIE

Nancy Ward, RCAS

Jami Stone, BHSU

Conference Personnel:

Kris Baldwin, TIE

Doug Rowe, TIE

Marlene Rothermel, TIE

Inverness Research Associates:

Pam Tambe

Becky Carroll

Laurie Lopez

Elizabeth Horsch

Heather Mitchell

Appendix B

Resources and Recommended Readings

This is a list of resources, books and articles that were noted by conference participants. It is not meant to be comprehensive.

Resources

Alaska Standards for Culturally Responsive Schools, published by the Alaska Native Knowledge Network, University of Alaska Fairbanks, 1998.

American Indian Science and Engineering Society

www.aises.org

Center for Research in Education, Diversity & Excellence (CREDE)

www.crede.berkeley.edu/index.html

Creating Sacred Spaces for Children, on the CREDE website:

<http://crede.berkeley.edu/links/nativeam.html>

Educators of Native American Students

www.eonas.org

National Indian Education Standards

www.ldoe.org/cetia/aics.htm

Society for the Advancement of Chicanos and Native Americans in Science (SACNAS) www.sacnas.org

Using Native Legends to Teach Mathematics

www.coehs.uwosh.edu/Anishinabe/Curriculum/legend1.htm

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Mathematics Lesson Interactions and Contexts for American Indian Students in Plains' Region Schools: An Exploratory Study. www.mcrel.org

Books

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