

**EFFECTIVE STANDARDS-BASED  
PRACTICES FOR NATIVE AMERICAN  
STUDENTS:**

***A REVIEW OF RESEARCH LITERATURE***

Regional Educational Laboratory  
Contract #ED-01-CO-0006  
Deliverable #2002-06

*Prepared for*  
Institute of Education Sciences  
U.S. Department of Education  
Washington, D.C. 20208

*Prepared by*  
Helen S. Apthorp  
Elaine DeBassige D'Amato  
Amy Richardson

Revised June 2003



**Mid-continent Research for  
Education and Learning**  
2550 South Parker Rd., Suite 500  
Aurora, CO 80014  
303.337.0990 (phone)  
303.337.3005 (fax)  
[www.mcrel.org](http://www.mcrel.org)



©2003 McREL

To order copies of *Effective Standards-Based Practices for Native American Students: A Review of Research Literature*, contact McREL:

Mid-continent Research for Education and Learning  
2550 South Parker Road, Suite 500  
Aurora, CO 80014  
303.337.0990 (phone)  
303.337.3005 (fax)  
[www.mcrel.org](http://www.mcrel.org)

This document has been funded at least in part with federal funds from the U.S. Department of Education under contract number ED-01-CO-0006. The content of this publication does not necessarily reflect the views or policies of the Department of Education nor does mention of trade names, commercial products, or organizations imply endorsements by the U.S. Government.

## **ABSTRACT**

Research and related literature were reviewed to summarize evidence on the effectiveness of different instructional practices for helping Native American students meet standards. In English language arts, 16 reports were reviewed. In mathematics, 8 reports were reviewed. Findings were mixed for the effectiveness of teaching Indigenous language and literacy first, followed by English literacy and bilingualism. In some content areas, Native American students participating in these programs met grade-level expectations; in some areas, they did not. Findings were indeterminate with regard to the effectiveness of culturally congruent practices for Native American student achievement in reading and mathematics. Promising practices were identified, such as successful collaboration among community members, teachers, researchers, and teacher education faculty for creating culturally congruent classrooms with an emphasis on developing language and thought, but causal conclusions could not be drawn about the effectiveness of these conditions for helping students meet standards. Plans for further collaborative research are presented in an appendix, and a link to the Center for Research on Education, Diversity and Excellence (CREDE) is provided to assist readers in locating related and ongoing research and reviews.

## TABLE OF CONTENTS

Introduction .....	3
English Language Arts.....	4
Mathematics.....	10
Summary and Conclusions .....	14
References .....	16

Appendix A

## INTRODUCTION

One tenet of standards-based reform is that every student should have a quality education. A quality education is one that helps a student gain deep understanding of and ability to use important concepts, facts, skills, and habits of mind to improve his or her future (National Council of Teachers of Mathematics, 2000). To many Native American educators, developing and implementing content standards is a useful and positive process for improving education for Native American children (Alaska Native Knowledge Network, 1998; Fox, 2000). “Schools,” however, “must see themselves as accountable for providing the educational program and support necessary for Indian students to meet the standards” (Fox, 2000, p. 9).

To better understand the qualities of education programs and support necessary for Native American students to reach standards, researchers and technical assistance providers at Mid-continent Research for Education and Learning (McREL) have reviewed research and are conducting field studies. In this report, we synthesize research and related literature produced primarily, but not exclusively, by Native American scholars and educators. Our purpose is to establish access to Native American research by recognizing the educational innovations developed by Native American people, their purposes and outcomes, and lessons learned and to propose a plan of research services that will benefit Native Americans in the seven-state Central Region served by the regional educational laboratory at McREL. This report is written for educators, researchers, and policymakers working to improve educational opportunities and outcomes for children. In accordance with our obligations as a regional educational laboratory, this ongoing line of inquiry aims to generate and utilize evidence about how to transform low-performing schools into high-performing learning communities for Native American students. Our focus is on improving Native American students’ learning in reading and mathematics. Our sources of information are previous research reviews, case study reports, and program evaluation reports on innovative programs as identified in searches of the ERIC database and adjunct clearinghouses.<sup>1</sup> In addition, we reviewed research reports identified in the references of the initial set of reports and incorporated suggestions from educators who have practiced or observed culturally relevant pedagogy in schools serving Native American communities.

We originally planned to synthesize evidence about effective classroom practices for teachers of Native American students. We expected to provide guidance that was well grounded in results of research systematically linking classroom practices to academic learning. What we primarily found, however, were descriptions of curricula and very few reports on students’ academic achievement when the curricula were implemented. We did find case study and evaluation reports that included academic achievement results in association with multi-year, multi-component program innovations. These innovations were implemented and evaluated in schools serving Native American students. For the most part, the studies

---

<sup>1</sup> We searched publications between 1970 and 2002 at [http://ericir.syr.edu/Eric/adv\\_search.shtml](http://ericir.syr.edu/Eric/adv_search.shtml) and <http://www.indianeduresearch.net/> with the following keywords: instructional practices, effective instruction, teaching practices, learning styles, cultural compatibility, Native American students, American Indian students.

were conducted under naturalistic conditions with little systematic recording of the implementation procedures or conditions. Nonetheless, we draw our conclusions on the best evidence available, acknowledge limitations, and make recommendations when appropriate.

The content of this report is organized into two sections. Native American research and related literature on education practices and outcomes in English language arts are reviewed, followed by a review of Native American research and related literature on education practices and outcomes in mathematics. This report concludes with a summary of the findings and recommendations for future research. Appendix A introduces McREL's plans to conduct collaborative research in response to regional concerns about Native American student underachievement in mathematics.

## **ENGLISH LANGUAGE ARTS**

Research and evaluation findings support the effectiveness of two types of programs for developing Native American student literacy in English. One type of program teaches literacy in a community's Indigenous language first, then promotes bilingualism by maintaining that language while teaching English language and literacy. Evidence supporting this type of program primarily comes from demonstration projects in Navajo community-controlled schools. The second effective program creates cultural congruence for Native American students in school, but not necessarily bilingualism. Evidence supporting this approach primarily comes from evaluations of an elementary school program designed for Polynesian-Hawaiian children.

*Overview of Reports Related to English Language Arts.* As Table 1 shows (see next page), the literature reviewed for this section includes five research reviews, three case studies, two quasi-experimental studies, one critical-historical analysis, and one single-subject research study. In addition, one policy brief, one program description, and two case illustrations were reviewed.

*Indigenous Language and Literacy First, Bilingualism Second.* Federal policymakers supported the role of school in developing Indigenous language and literacy prior to World War II. John Collier, named Indian Affairs Commissioner in 1933, supported bilingual education for Native American students, initiated a retraining program for teachers to become knowledgeable and more sensitive to Native cultures, and closed some boarding schools, replacing them with day schools (Reyhner, 1992). Collier also assisted in the development of the Johnson O'Malley Act in 1934, which was amended in 1975 as the Indian Self-Determination and Educational Assistance Act (P.L. 93-638). Although cut short by World War II, Bureau of Indian Affairs (BIA) personnel in the 1940s worked with Native language speakers to develop bilingual programs and reading texts written in Indigenous languages for American Indian students (Lomawaima & McCarty, 2002).

It was not until the 1960s that federal policymakers again recognized the value of bilingual/bicultural curriculum and materials for Native American students. In the late 1960s, Rough Rock Demonstration School emerged as a tribally run, community-oriented school in the center of the Navajo Reservation in northeastern Arizona several hours drive from the nearest towns on the border of the reservation (McCarty, 1989). The Rough Rock education program was designed to expose children to important

values and customs of both Navajo culture and the dominant society. The school used “an innovative English-as-a-second-language program, Navajo language and social living classes, cultural presentations by community members, and the development of textbooks on Navajo life” (McCarty, 1989, p. 489). Both Navajo and English were used as languages of instruction (Holm & Holm, 1995).

**Table 1. Summary of Research & Reports Reviewed**

<b>Author(s)</b>	<b>Type of Research or Report</b>
Brophy (1986)	Review of research
Fox (2000)	Policy brief
Holm & Holm (1995)	Comparative case study
Jordan (1984)	Program description
Lomawaima & McCarty (2002)	Critical-historical analysis
Marzano (1998)	Review of research
McCarty (1989)	Case study
McCarty (1993)	Case study
McLaughlin (1995)	Case illustration
Reyhner (Ed.) (1992)	Review of research
Rosier & Farella (1976)	Quasi-experimental research
Sawyer (1988)	Review of research
St. Charles & Costantino (2000)	Review of research
Tharp (1982)	Quasi-experimental research
Tharp & Yamauchi (1994)	Case illustration
Wilcox (1996)	Single-subject research

The school’s heralded outcomes in the late 1960s were not about academic success, but rather, about improved economic vitality, Navajo pride, and self-governance in the community. School jobs at Rough Rock doubled the local per-capita income. School board members acquired leadership and administrative skills for operating federal programs, which led to new facilities and roads, opening the door to the wider community (McCarty, 1989). McCarty (1989) reports the sequence of changes that occurred in response to Rough Rock’s demonstration:

In 1968, Senator Robert Kennedy, then Chairman of the Special Senate Subcommittee on Indian Education, declared that “Rough Rock has proven its point . . . and should serve as a model for all Indian schools to study and emulate.” He also called for a “bold new statement of policy coupled with the commitment and resources necessary to carry it out.” Those resources followed in 1972 and 1975 when Congress passed, respectively,

the Indian Education Act (adopted as Title IV amendment to the Elementary and Secondary Education Act), and the Indian Self-Determination and Educational Assistance Act. The legislation provided funds for bilingual/bicultural and adult education, and formalized the procedure for tribes and Indian communities to contract directly with the federal government for education monies. By 1976, six Indian communities had followed Rough Rock in contracting with the Bureau to run their own schools, several tribes had community-controlled colleges, and hundreds of public schools across the country had Title IV funds for Indian education. (p. 492)

The story of the school's education program, however, is more modest. According to McCarty (1993), the bilingual/bicultural program at Rough Rock was difficult to sustain because of inconsistent federal funding and unstable and insufficient numbers of bilingual staff and curricula materials. Seeking stability in the early 1980s and an increase in student scores on norm-referenced tests, the Rough Rock school board adopted a commercial English basic skills program involving teacher-directed instruction (McCarty, 1993). During the period of its use, staff and parents observed that the students had "near-perfect English diction, but with little comprehension of oral English or text" (McCarty, 1993, p. 183). To move to a greater emphasis on comprehension, in 1987 Rough Rock partnered with the Kamehameha Early Education Program (KEEP). KEEP is an English language arts program (described in more detail in the next section) that emphasizes language and cognitive development through culturally congruent curriculum and activities and emphasizes comprehension rather than mechanics or phonics. In addition to the KEEP approach, teacher-researcher teams at Rough Rock developed and used thematic units and other curricula in Navajo. Classroom teachers also implemented "contextualized reading, process writing, cooperative learning centers, language experience activities, and questioning designed to encourage critical thinking (McCarty, 1993, p. 184). Three years later, between spring 1990 and spring 1991, K-3 students' percentile scores in reading vocabulary on the California Test of Basic Skills "more than doubled," though they were still below the national norm (McCarty, 1993).

Two schools that like Rough Rock, are tribally run, are Rock Point Community School and Fort Defiance Elementary School, both also serving Navajo communities in Arizona. In 1971, Rock Point Community School became a tribally controlled school and received Title VII Indian bilingual funds to implement a Navajo-English bilingual program. Students learned to read and write first in Navajo; in second grade, students began learning to read and write in English. Thereafter, students read and wrote in both languages. In each primary classroom, two teachers, a Navajo Language Teacher and an English Language Teacher, worked simultaneously at either end of the classroom. Holm and Holm (1995) reported that the students alternated between working with the two teachers and engaging in independent work. At first, the faculty included both degreed and non-degreed teachers. Over time, through collaboration with a regional university providing on-site and off-site courses and practicum experience, about 50 educators and community members earned their degrees.

Across the three core content areas of language arts, mathematics, and social studies (science was added later), instructional practices emphasized language and thought — "students were expected to show they knew what they were doing" (Holm & Holm, 1995, p. 147). The program also included curriculum-specific, criterion-referenced tests, high expectations, and coaching.

Results of program evaluation conducted at Rock Point Community School supported the effectiveness of the Navajo-literacy-first instruction. Rosier and Farella (1976) compared English reading comprehension of the fourth- and fifth-grade students who participated in this program with national average achievement levels. For the Rock Point students, the typical one-and-one-half-year gap in performance between Native Americans and the national average was reduced to one-half year in association with Navajo-literacy-first instruction. Moreover, rate of growth in English reading achievement for students at Rough Rock Community School was faster over the three years between second and fifth grade than that for students attending non-tribally controlled Bureau of Indian Affairs schools (Rosier & Farella, 1976). Finally, close to 50 percent of the fifth-grade group who received the Navajo-literacy-first instruction scored at or above a grade equivalent of 5.5 (Rosier & Farella, 1976). Prior to the program's implementation, no fifth-grade group averaged at or above a grade equivalent of 5.0.

At Fort Defiance Elementary School, kindergarten and first-grade instruction was almost entirely in Navajo, with 40 minutes a day of small-group instruction in English. In second and third grades, students began learning to read and write in English; half the day's instruction was in Navajo, half was in English. Thereafter, students read and wrote in both languages and mathematics was taught in both languages. Similar to the Rock Point curriculum, the Fort Defiance curriculum emphasized language and thinking. In addition, "process writing and cooperative learning approaches were extensively used" (Holm & Holm, 1995, p. 150).

Academic results at Fort Defiance Elementary School showed that although students participating in the Navajo-literacy-first instruction performed as well on English language tests as Navajo students taught in English, their performance on English reading tests was slightly behind. According to Holm and Holm (1995), however, the Navajo-literacy-first instruction students performed far above the English-only students on standardized tests of mathematics and on local assessments of writing-in-English.

Although not replicated at Fort Defiance Elementary School, the Navajo students' English literacy achievements documented at Rock Point Community School are consistent with other research findings confirming the facilitative role of becoming initially literate in one's first language before learning to read and write in a second language (Calderón, Hertz-Lazarowitz, & Slavin, 1998; Saunders, 2001).

The conditions necessary for successful implementation of an elementary school program that teaches Native language and literacy first supports maintenance of this language, and teaches English language and literacy include (1) a bilingual faculty with low turnover and ample, high-quality learning opportunities, and (2) sufficient learning materials aligned with the sequence of content and skills emphasized in the bilingual curriculum assessed by the accountability measures. At both Rough Rock Demonstration School and Rock Point Community School, ten or more years was needed to create these conditions (Holm & Holm, 1995; McCarty, 1989; McLaughlin, 1995). Moreover, the conditions were created by collaborative efforts between community leaders and university faculty in nearby teacher preparation programs, and the ongoing, time-consuming efforts of successful grant-writing administrators (Holm & Holm, 1995; McCarty, 1989; McLaughlin, 1995). Often, McCarty (1989) observed, the efforts required to secure school funding diverted attention and energy away from improving the pedagogical program and caused discord between board members as they became invested in a multitude of different initiatives.

***Culturally Congruent English Language Arts.*** Demmert's (2001) review of research concludes that cultural congruence between Native American students' home and schooling improves academic achievement. He bases this conclusion on the positive outcomes of four demonstration projects for Native students in Arizona, Hawaii, and New Zealand. In reports (e.g., Stiles, 1997), outcome measures did not include academic achievement; instead, measures indicated increased attendance, reduced dropout rates, increased community pride, and strengthened sense of identity. The Hawaiian project, however, measured academic achievement.

Cultural congruence, not bilingualism, characterizes the Kamehameha Early Education Program (KEEP) in Hawaii (Jordan, 1984). KEEP was developed in Honolulu in the early 1970s with the goal of improving achievement levels of low-income and at-risk Native Hawaiian students in grades kindergarten through three. As an English language arts program, KEEP includes a behavior management component that creates a social organization and peer interaction styles that are similar to Native Hawaiian sibling and companion group interactions at home. Four other features also distinguish KEEP: (1) a comprehension-oriented approach to reading instruction instead of emphasis on mechanics or phonics, (2) an emphasis on language and cognitive development, (3) use of individualized instruction with continuous monitoring of progress, and (4) a quality control system for teacher performance.

KEEP classrooms are organized around learning centers in which high rates of peer interaction and help occur and satisfactory task performance per individual is expected. In addition, children in KEEP classrooms are divided into five or six reading groups, according to level of reading competence, that meet daily with the teacher. Each child attends five centers each day, one of which is always focused on the reading group lesson (Jordan, 1984). Moreover, during reading group sessions, teachers spend as much time as possible interacting with and coaching the members of the group. Classroom norms also are established so that other children do not interrupt the teacher working with the reading group.

Tharp (1982) conducted two studies on the effectiveness of KEEP; one was conducted in a laboratory school, and the other in a sample of four public schools. After two years of implementation in the laboratory school, results supported the effectiveness of KEEP. Average standardized test scores in reading comprehension for children participating in KEEP were close to or above the 50th percentile compared to an average at the 23rd percentile or below for children in non-KEEP classrooms. When KEEP was implemented in 19 other classrooms spanning four public schools (serving mostly Native Hawaiian students in an urban locale), average scores on the Gates-MacGinitie and Metropolitan standardized reading tests were at the 53rd percentile, while the average scores for children in comparison classes were at the 32nd percentile (Tharp, 1982). Children were not randomly assigned to type of classroom or school, but all participating schools were in the same locale, "an economically depressed belt of the city" (Tharp, 1982, p. 511). Moreover, systematic observations of KEEP and comparison classrooms showed clear differences in the instructional practices. During the English language arts period, teachers in KEEP classrooms spent 66 percent of the time teaching comprehension, while teachers in comparison classrooms spent only 30 percent of the time on comprehension. KEEP teachers also used criterion-referenced tests more frequently to monitor students' progress and used small-group arrangements more often.

In the 1980s, KEEP program developers also worked with teachers at the Navajo Rough Rock Demonstration School in Arizona. Modeling KEEP practices in the classroom, and observing and listening to the children, program developers helped Rough Rock teachers incorporate learning experiences that were culturally compatible with their Navajo students. The third-grade children, for example “clearly preferred — and often demanded — to hear or read a story through to the end before starting discussion, rather than discussing it in piecemeal successive sections” (Tharp & Yamauchi, 1994, p. 7). Evidence on the effectiveness of these experiences for developing children’s reading comprehension, however, was not available.

With respect to written expression, our review identified culturally specific thinking patterns and discourse norms for Native American students, but found little evidence on the effectiveness of approaches that accommodated or built on these strengths. According to Sawyer’s (1988) review of reports written by teachers of Native American students, descriptive and narrative writing, for example, is easier for Native American students whose language tradition is oral. Unfamiliar to many Native American students, especially if accustomed to circular story grammars, may be the linear thesis-support-summary structure typical of the five-sentence paragraph and five-paragraph essay. “Most difficult for Indian students,” Sawyer (1988) suggests, “is comparison and argumentation because of a more harmonious sense of order that views certain Western cognitive processes (e.g., cause and effect, comparison/contrast, Aristotelian logic) as unnecessarily complicated and even untruthful” (p. 19).

Sawyer (1988) emphasizes the importance of student motivation in learning how to write effectively. He advocates for, as do St. Charles and Costantino (2000), holistic approaches to writing instruction for Native American students. Holistic approaches combine listening, speaking, reading, and writing and embed grammar lessons in the context of writing as a means of communicating something personal and vital, usually through the process of revision rather than as a prerequisite to writing. Use of authentic language and literature and embedded skills instruction are practices consistent with recommendations for improving the language arts skills of Native American students (Fox, 2000). However, we found no empirical evidence on the effectiveness of these approaches for developing Native American students’ writing.

An alternative approach, and perhaps one that would complement the holistic, personalized approach advocated by Sawyer (1988) and Fox (2000), is to teach directly, and scaffold students’ use of, the skills and strategies needed to successfully write in ways required for school success. Wilcox (1996) provides limited evidence that such explicit instruction on strategies may be effective for Native American students. Wilcox (1996) conducted case studies on the use of TOWER + EDITS with two Native American students, one in seventh grade and one in ninth grade, both attending the Winnebago Public Schools in Nebraska. TOWER + EDITS is an acronym for Think, Organize, Write, Edit, and Rewrite combined with teacher-assisted EDITS (i.e., Embellish, Delete errors, Insert corrections, Tally progress, and Submit for grading). The acronym and sequence of strategies it stands for help students visualize and monitor their writing process.

Wilcox (1996) analyzed the students’ writing samples from before and after TOWER + EDITS instruction for the number of words, number of sentences, length of sentence, and vocabulary grade level. The first student showed an increase in the number of words per essay, the number of sentences, and the

length of sentences. Vocabulary use remained at the fifth/sixth-grade level. The second student did not have a pre-intervention writing sample; however, over five months, the student moved from refusing to write anything to writing essays that exceeded 300 words.

***Summary of Language Arts Research and Related Literature.*** With respect to the study of Indigenous language and bilingual programs, results from the Rough Rock demonstration (McCarty, 1993), Rock Point Community School (Rosier & Farella, 1976), and Fort Defiance Elementary School (Holm & Holm, 1995) are mixed. In some areas of achievement, students performed at grade-level expectations; in other areas, they did not.

The discussion on culturally congruent practices was motivated by Demmert's (2001) review of research that has since been revised. In the revised review, Demmert and Towner (2003) carefully distinguish between experimental and non-experimental studies and the types of conclusions that are justified by the respective research designs. They conclude that the evidence to date is "best viewed as supporting or generating working hypotheses" (Demmert & Towner, 2003, pp. 31–32). They acknowledge the strong and widespread interest in preservation and revitalization of Native culture and language through culturally congruent programs in school and the "need to objectively evaluate the impact of these programs on school performance" (Demmert & Towner, 2003, p. 32).

Unfortunately, the instructional practices used and observed in the Wilcox (1996) and Tharp (1982) studies were not all necessarily culturally congruent practices, per se. However, explicit strategy instruction in writing, an emphasis on comprehension over phonics and mechanics, and frequent monitoring of student progress reflect principles of effective instruction (Brophy, 1986; Marzano, 1998).

Overall, this section reviewed evidence of the effectiveness of Indigenous language and literacy programs first, followed by English literacy and bilingual programs as well as culturally congruent curriculum materials and practices (without bilingualism). Important possibilities for literacy programs were revealed, including (1) successful collaborations between tribal leaders, community members, teachers, researchers, and teacher education faculty for educational change, and (2) teaching and learning communities that emphasize language and thought. The exact role played by creating cultural congruence between home and school, however, and the extent to which it makes an independent contribution to student achievement remains unclear. Further research is needed studying the impact of combinations of practices on Native American student achievement.

## **MATHEMATICS**

In mathematics, the recommended approach for connecting home and school and promoting academic success in classrooms and schools with culturally diverse groups of students is *ethnomathematics*. Although the principles of *ethnomathematics* for Indigenous populations are well articulated, and numerous curricular projects have been developed that are aligned with NCTM's (2000) *Principles and Standards* publication (see, for example, NCTM, 2002), research on the effectiveness of *ethnomathematics* for Native American students is limited.

*Ethnomathematics* is the study of traditional and everyday mathematics and the integration of findings from this study into the development and use of curricular methods and materials that are aligned with content standards (Brenner, 1998; Davidson, 1989). This approach “acknowledges the value of the knowledge base that children themselves bring to school” and engages children in activities based on everyday mathematics in ways that help them “develop meaningful problem solving and greater mathematical power” (Brenner, 1998, p. 239).

**Overview of Reports Related to Mathematics.** As Table 2 shows, the literature reviewed in this section includes two quasi-experimental studies, and one study that combined ethnographic and quasi-experimental methods. In addition, five reports were reviewed: an advocacy report, two program/practices descriptions, a policy brief, and a research agenda.

**Table 2. Summary of Research and Reports Reviewed**

Author(s)	Type of Research or Report
Alaska Rural Systemic Initiative (AKRSI)	Quasi-experimental research
Brenner (1998)	Ethnography and quasi-experimental research
Davidson (1989)	Advocacy report
Kawagley (1999)	Program/practices description
National Council of Teachers of Mathematics (2002)	Program/practices description
Nelson-Barber & Estrin (1995)	Policy brief
U.S. Department of Education & U.S. Department of the Interior (2001)	Research agenda
Zwick & Miller (1996)	Quasi-experimental research

**Application of the Principles of Ethnomathematics.** Brenner’s (1998) multi-year research and development in *ethnomathematics* led to several changes in a kindergarten and second-grade math program in the KEEP laboratory school in Hawaii. For one or two years, Brenner (1998) conducted ethnographic and cognitive research to learn about children’s everyday mathematics. She interviewed, observed, and assessed Native Hawaiian children attending the KEEP school during both in-school and after-school settings. Based on her findings, Brenner and KEEP teachers (1) altered the sequence of topics and textbook chapters to match what children had demonstrated was easier or more difficult to learn, (2) incorporated Hawaiian Creole English terms for some mathematics concepts into instruction, (3) added manipulatives to students’ independent work (e.g., block counting), and (4) added a game center with mathematical content to the classrooms. Compared to a control group, the children participating in the kindergarten classroom in which these changes took place scored significantly higher on a standardized math test. The control class averaged at the 54th percentile, while the experimental class averaged at the

82nd percentile (Brenner, 1998). Moreover, children in the classroom using the alternate sequence of topics and textbook chapters progressed faster through workbook exercises than children in the control classroom.

Brenner's (1998) experiences also revealed how use of everyday mathematics activities in the classroom can detract from developing children's greater mathematical power. In a second grade classroom, where a school store was established to engage students in purchasing and selling, Brenner (1998) observed a lot of contrived tasks and mundane work running the store, such as counting the inventory, that were not mathematically challenging. These observations are consistent with warnings that *ethnomathematics* must avoid trivial cultural connections (Dukepoo, 1993, as cited in Nelson-Barber & Estrin, 1995). To help students develop deeper understanding and move from concrete and semi-concrete levels to more abstract mathematics, Davidson (1989) suggests use of systematic language activities, such as having students describe and explain their procedures and solutions, and create and solve story problems in writing.

The work of the Alaska Rural Systemic Initiative (RSI), supported by National Science Foundation (NSF) grants, extends application of the principles and practices of *ethnomathematics* to the reform of science. Focusing on mathematics and science in rural schools, the Alaska RSI is a set of initiatives whose purpose is to study and document "the indigenous knowledge systems of Alaskan Native people and develop pedagogical practices that appropriately incorporate indigenous knowledge and ways of knowing into educational programs" (AKRSI, n.d., *Year Three Report*, p. 1). One component of the Alaska RSI is Elders and Cultural Camps, based on Kawagley's (1999) model of Alaskan Native camps.

The purpose of the Alaska RSI is to implement a set of initiatives to systematically document the indigenous knowledge systems of Alaska Native people and develop pedagogical practices that appropriately incorporate indigenous knowledge and ways of knowing into education programs.

For Kawagley (1999), content standards should specify Indigenous knowledge and Eurocentric knowledge as complementary rather than competing learning goals:

It is absolutely necessary that students learn Eurocentric concepts as well as their own ways of recognizing patterns, symbols, estimation/intuitive measurement, and ways of keen observation of place. Native students have to realize that our ways of measuring and knowing are identity-building processes, and that in-depth knowledge of these ways need not interfere with one's being and connection to the earth. Native students can then pursue careers in mathematics and the sciences buttressed by a Nature-way worldview giving them a kind and polite disposition to the world. (p. 49)

Kawagley (1999) proposes that learning activities in Alaskan Native camps be planned so traditional and Eurocentric mathematics and science are compatible with one another. Content for the camps should be selected judiciously, and students should evaluate its utility. He proposes three types of camps: Language Development Camp, Immersion Camp, and Bridging Camp. At Bridging Camp, for example, Yupiaq knowledge is taught by elders and augmented with useful Eurocentric science and mathematics. The following practices are used at Bridging Camp:

- Traditional estimation/intuitive measurement is used; recognition of patterns and symmetry is stressed (without mathematical equations to confuse the issue — the universe is not all numbers).
- The most useful Eurocentric scientific terms are determined and Native words for those terms are coined with help from elders and students.
- In using the Eurocentric science knowledge and theories, students determine whether that knowledge will add to or detract from one's Native identity.
- Youth determine whether Eurocentric knowledge is useful and applicable locally; or whether it is just show and tell/extraneous knowledge. (Kawagley, 1999, p. 48)

Although evidence was not found on the impact of student learning when these particular practices have been implemented, the Alaska RSI evaluation results offer some evidence for the effectiveness of a similar camp. After participating in a regional science camp that exposed students to knowledge embedded in many traditional activities of the local Native people, middle school students showed a significant gain over their previous year's academic performance and over the performance of a control group of students who did not attend camp (AKRSI, n.d., *Year Four Report*). Similarly, in a Montana school district serving a population with 49 percent of the students from the Crow tribe, Zwick and Miller (1996) found that culturally relevant, field-based science activities in a nearby wildlife preserve were effective for improving fourth-grade student achievement.

Overall, the Alaska RSI outcomes are positive. Dropout rates have declined in Alaska RSI partner schools and the percentage of eighth-grade students scoring in the top quartile on standardized achievement tests in mathematics increased in Alaska RSI Partner schools, while the percentage stayed the same in non-Alaska RSI Partner schools during 1996 and 1997 (AKRSI, n.d., *Year Four Report*). The Alaska RSI evaluators concluded that “the cumulative effect of increasing the connections between what students experience in school and what they experience outside school appears to have a significant impact on their academic performance” (AKRSI, n.d., *Year Three Report*, p. 3).

The conditions necessary for successful implementation of the principles and practices of *ethnomathematics* include time and resources to (1) identify culturally specific and everyday knowledge, (2) develop and field-test responsive curricular materials and learning activities, and (3) use formative evaluation to make adaptations and revisions. In both Brenner's (1998) project and the Alaska RSI, collaborative working relationships between researchers, community members, and teachers allowed access to elders and families for the study of culturally specific and everyday knowledge, and development of methods, materials, and programs that were aligned with both this knowledge and content standards from the more formal school curricula.

***Summary of Mathematics Research and Related Literature.*** In conclusion, the research and evaluation findings in mathematics education for Native American students show that curricula and practices that acknowledge and build on traditional and everyday mathematics are associated with improved academic success for students. The evidence reviewed here, however, is limited to studies from only three sites:

kindergarten and second-grade classrooms in Hawaii, a network of rural schools in Alaska, and two fourth-grade classrooms in one district in Montana. More research is needed to find, generate, and disseminate knowledge gained from studies in schools in a variety of locales and jurisdictions.

## SUMMARY AND CONCLUSIONS

This report reviewed the available evidence on the effectiveness of particular education programs and practices for improving Native American student achievement in English language arts and mathematics. Our interest was learning what practices effectively improve opportunities for Native American students to meet standards. Positive relationships between improved student achievement and certain program characteristics and classroom practices were found, including:

- Teaching Indigenous language and literacy first, followed by instruction in learning to read and write in English and promotion of bilingualism (Holm & Holm, 1995; Rosier & Farella, 1976)
- Emphasizing reading comprehension and peer interactions and frequent monitoring of student progress (Tharp, 1982)
- Using culturally congruent curriculum materials and instruction in mathematics (AKRSI, n.d., *Year Four Report*; Brenner, 1998)

Although findings such as these do not allow casual inferences about program impact on student achievement, nonetheless they are valuable. Findings from studies that used control groups of students with comparable demographics help to rule out certain background characteristics as rival explanations for why students in the classrooms and programs using culturally relevant pedagogy outperformed students in the control conditions. To draw causal conclusions, however, further research is needed about the extent to which culturally relevant pedagogy impacts Native American student achievement.

Unquestionably, the generalizability of the evidence reviewed in this report also is limited by type of school and locale. Often the type of school where the reviewed research was conducted was tribally controlled or had a student population characterized by a Native American majority. In contrast, the majority of Native American students do not attend tribally controlled schools, but, rather, attend public schools where they are in the minority (U. S. Department of Education & U. S. Department of the Interior, 2001). In response to these limitations, the *American and Alaska Native Education Research Agenda* (U.S. Department of Education & U. S. Department of the Interior, 2001) calls for large-scale, multi-site research on the education experiences and outcomes of Native American students. A priority research topic is the level of Native American and Alaskan Native student achievement on standardized

assessments by type of school and grade (U.S. Department of Education & U. S. Department of the Interior, 2001).<sup>2</sup>

To conclude this review, the available evidence indicates that cultural congruence seems to be an important factor in academic success, however, the evidence does not indicate what role it plays, nor how influential it would be beyond Alaskan, Hawaiian, and Navajo communities. We also do not know if cultural congruence directly and independently affects student learning and achievement or if its impact depends on a combination of factors. These possible pathways to academic success for Native American students are the focus of ongoing research being conducted by McREL and others (in particular, see Center for Research on Education, Diversity and Excellence's website at [www.crede.ucsc.edu](http://www.crede.ucsc.edu); Demmert & Towner, 2003).

---

<sup>2</sup> Researchers and technical assistance providers at McREL are planning to contribute directly and indirectly to this agenda by conducting research on Native American student achievement in one or more of the seven Central Region states: Colorado, Kansas, Missouri, Nebraska, North Dakota, South Dakota, and Wyoming. An overview of our plan for this research is provided in Appendix A.

## REFERENCES

- Alaska Native Knowledge Network. (1998). *Alaska standards for culturally responsive schools*. Anchorage, AK: Author. Retrieved August 15, 2002, from <http://www.ankn.uaf.edu/standards/standards.html>
- Alaska Rural Systemic Initiative (AKRSI). (n.d.). *Year four annual progress report: Executive summary (1998-1999)*. Retrieved August 1, 2002, from <http://www.ankn.uaf.edu/YearFourExecSum.html>
- Alaska Rural Systemic Initiative (AKRSI). (n.d.). *Year three annual progress report (1997-1998)*. Retrieved August 1, 2002, from <http://www.ankn.uaf.edu/YearThreeReport.html>.
- Brenner, M. E. (1998). Adding cognition to the formula for culturally relevant instruction in Mathematics. *Anthropology & Education Quarterly*, 29(2), 214–244.
- Brophy, J. (1986). Teacher influences on student achievement. *American Psychologist*, 41(10), 1069–1077.
- Calderón, M., Hertz-Lazarowitz, R., & Slavin, R. (1998). Effects of Bilingual Cooperative Integrated Reading and Composition on students making the transition from Spanish to English reading. *Elementary School Journal*, 99(2), 153–165.
- Davidson, D. M. (1989). An ethnomathematics approach to teaching language minority children. In J. Reyhner (Ed.), *Effective language education practices and Native Language Survival*. Proceedings of the Annual International Native American Language Issues Institute (9th, Billings, Montana, June 8–9, 1989). (ERIC document Reproduction Service No. ED 354 776)
- Demmert, W. J., Jr. (2001). *Improving academic performance among Native American students: A review of the research literature*. Charleston, WV: ERIC Clearinghouse on Rural Education and Small Schools.
- Demmert, W.G., Jr., & Towner, J. C. (2003). *Final paper: A review of the research literature on the influences of culturally based education on the academic performance of Native American students*. Portland, ORE: Northwest Regional Educational Laboratory.
- Deyhle, D., & Swisher, K. (1997). Research in American Indian and Alaska Native education: From assimilation to self-determination. In M. W. Apple (Ed.), *Review of research in education, volume 22* (pp. 113–194). Washington, DC: American Educational Research Association.
- Fox, S. J. (2000). *Standards-based reform and American Indian/Alaska Native education*. Retrieved August 5, 2002, from <http://www.indianeduresearch.net/SJFox.pdf>

- Holm, A., & Holm, W. (1995). Navajo language education: Retrospect and prospects. *The Bilingual Research Journal*, 19(1), 141–167.
- Jordan, C. (1984). Cultural compatibility and the education of Hawaiian children: Implications for mainland educators. *Educational Research Quarterly*, 8(4), 59–71.
- Kawagley, A. O. (1999). Alaska Native education: History and adaptation in the new millennium. *Journal of American Indian Education*, 39(1), 31–51.
- Lomawaima, K. T., & McCarty, T. L. (2002). When tribal sovereignty challenges democracy: American Indian education and the democratic ideal. *American Educational Research Journal*, 39(2), 279–305.
- Marzano, R. J. (1998). *A theory-based meta-analysis of research on instruction*. Aurora, CO: Mid-continent Research for Education and Learning.
- McCarty, T. L. (1989). School as community: The Rough Rock demonstration. *Harvard Educational Review*, 59(4), 484–503.
- McCarty, T. L. (1993). Language, literacy and the image of the child in American Indian classrooms. *Language Arts*, 70, 13–34.
- McLaughlin, D. (1995). Strategies for enabling bilingual program development in American Indian schools. *The Bilingual Research Journal*, 19(1), 169–178.
- National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: Author.
- National Council of Teachers of Mathematics. (2002). *Changing the faces of mathematics: Perspectives on Indigenous people of North America*. Reston, VA: Author.
- National Center for Education Statistics. (1999a). *The nation's report card: NAEP 1998 mathematics state report: North Dakota*. Retrieved August 2, 2002, from <http://nces.ed.gov/nationsreportcard/states/profile.asp?state=ND>
- National Center for Education Statistics. (1999b). *The nation's report card: NAEP 1998 reading state report: Kansas*. Retrieved August 2, 2002, from <http://nces.ed.gov/nationsreportcard/states/profile.asp?state=KS>
- Nelson-Barber, S., & Estrin, E. T. (1995). Bringing Native American perspectives to mathematics and science teaching. *Theory into Practice*, 34(3), 174–185.
- Reyhner, J. (Ed.). (1992). *Teaching American Indian students*. Norman, OK: University of Oklahoma Press.

- Rosier, P., & Farella, M. (1976). Bilingual education at Rock Point — Some early results. *TESOL Quarterly*, 10(4), 379–388.
- Saunders, W. M. (2001). Improving literacy achievement for English learners in transitional bilingual programs. In R. E. Slavin & M. Calderón (Eds.), *Effective programs for Latino students* (pp. 171–206). Mahwah, NJ: Lawrence Erlbaum.
- Sawyer, D. (1988). The writing process and Native students. *Canadian Journal of Native Education*, 15(2), 15–21.
- St. Charles, J., & Costantino, M. (2000). *Reading and the Native American learner: Research report*. Olympia, WA: Washington Office of the State Superintendent of Public Instruction. Office of Indian Education. (ERIC Document Reproduction Service No. ED 451 026)
- Stiles, D. B. (1997). *Four successful indigenous language programs*. (ERIC Document Reproduction Service No. ED 415 079)
- Tharp, R. G. (1982). The effective instruction of comprehension: Results and description of the Kamehameha Early Education Program. *Reading Research Quarterly*, 17(4), 503–527.
- Tharp, R. G., & Yamauchi, L. A. (1994). *Effective instructional conversation in Native American classrooms*. National Center for Research on Cultural Diversity and Second Language Learning (Educational Practice Report: 10). Retrieved May 22, 2002, from <http://www.ncela.gwu.edu/miscpubs/ncrcdssl/epr10.htm>
- U.S. Department of Education & U.S. Department of the Interior (2001, November). *American Indian and Alaska Native education research agenda in response to Executive Order 13096*. Washington, DC: Author.
- Wilcox, D. J. (1996, October). *A visual strategy for teaching written expression: Meeting the challenge presented by students of Native American heritage*. Paper presented at the Annual Conference of the Northern Rocky Mountain Education Research Association, Detroit Lakes, MN.
- Zwick, T. T., & Miller, K. W. (1996, January). A comparison of integrated outdoor education activities and traditional science learning with American Indian students. *Journal of American Indian Education*, 35(2). Retrieved June 20, 2002, from <http://jaie.asu.edu/v35/V35S2com.htm>

## APPENDIX A

The consequences of standards-based reform for Native American students are unclear. Some observers contend that the reform's emphasis on stronger assessment and accountability systems has escalated pressures for standardization (Lomawaima & McCarty, 2002). From Lomawaima and McCarty's (2002) perspective, high-stakes testing devalues the knowledge that American Indian students bring to school and jeopardizes their "life opportunities by threatening to deny them a high school degree" (p. 298). Our review suggests that in order to achieve equity and excellence through standards-based reform, implementation of culturally congruent curricula and practices needs to become a higher priority than implementation of high-stakes testing. For the Alaska Rural Systemic Initiative, the development and implementation of culturally congruent curriculum and practices is top priority. The progress of this initiative and other standards-based reforms for American and Alaska Native children needs to be carefully observed. Fox (2000, p. 11) proposes that research on the implementation of standards for American and Alaska Native students be designed to answer such questions as:

- Were content and performance standards developed with the input of Indian people?
- Are Indian students receiving standards-based instruction?
- Are Indian students being assessed with multiple measures?
- Has Indian student achievement increased as a result of standards-based instruction?

McREL researchers and technical assistance providers plan to conduct collaborative research to address questions such as those posed by Fox (2000) and to strengthen the evidence base regarding effective practices for Native American student achievement. In some of the Central Region states, assessment results suggest that many Native American students are not meeting standards. In Kansas, on the fourth-grade reading test of the National Assessment of Education Program, 22 percent of Native American students performed at or above proficient (National Center for Education Statistics [NCES], 1999b). In North Dakota, on the fourth-grade mathematics test, 42 percent of Native American students performed at or above proficient (NCES, 1999a). In a year 2000 survey, local educators in the Central Region identified effective instruction for students with diverse backgrounds as a critical issue for which their districts needed assistance. McREL is addressing this need.

Our research will be conducted according to procedures presented by Deyhle and Swisher (1997): (a) "formation of an advisory committee, (b) selection of trained Indigenous, bilingual interviewers, (c) preparation of culturally sensitive instrumentation, and (d) consent from tribal officials representing target communities" (p. 179). Initially, the research will focus on gathering demographic data to document numbers and distributions of Native American students across the region by type of school, grade, locale, accountability system, and achievement. Next, the advisory committee will identify and select key research questions about the effectiveness of education programs, supports, and practices for improving Native American student achievement. A research design will be developed and implemented in selected schools during the 2003–2004 academic year. It is expected that the process and findings will benefit Native American clients in the Central Region states.