



Closing the Mathematics Achievement Gap (CMAG) of Native American Students Identified as LD and EBD

A Wisconsin Improving Teacher Quality Grant (approximately \$82K per year/3 years) was awarded to the **Closing the Mathematics Achievement Gap for Native American Students (CMAG) Project** in January 2008 and a Mathematics and Science Partnership Grant (approximately \$224K per year/3 years) was awarded for the same project in July 2008.

Primary Investigator and Director:

Judith Hankes, Professor, Mathematics Education, UW Oshkosh

Co-Directors:

Gerald Fast, Professor, Mathematics Education, UW Oshkosh

Wayne Swanger, Professor, Special Education, UW Oshkosh

Stacy Skoning, Associate Professor, Special Education, UW Oshkosh

John Beam, Associate Professor, Mathematics, UW Oshkosh

External Evaluator:

William Mickelson, Associate Professor, Mathematics, UW Whitewater

Participating Schools

Grant-funded participants - 30 teachers from 9 Wisconsin school districts serving Native American communities: Bayfield, Bowler, Crandon, Menominee Indian, Lac du Flambeau, La Courte Orielles, Seymour, Wabeno, Winter,

Self-funded schools: Ho Chunk Nation After School Youth Services (13 teachers), Naytawauash Charter School, MN (school-wide).

Student Participants

Students with IEPs: approximately 150 (each project teacher will track progress of 5 students);
Inclusion classrooms: 4 classrooms (approximately 60 students); Control classrooms: 8 classrooms (approximately 120 students)

PROBLEM SITUATION

Development of the **Closing the Math Achievement Gap Project** was motivated by the documented educational underachievement of Native American students in numerous core subjects. Low test scores, low graduation rates, and alarmingly high truancy rates reflect the fact that something is seriously wrong with the type of education offered to Native children. Researcher Lydia Whirlwind Soldier (2005) proposes that culturally biased materials presented through culturally insensitive instruction contributes directly to the fact that high school drop-out rates in Indian Country still number 50% or higher. Tragically, the consequences of such failure have contributed to the condition of tribal communities burdened with poverty, illness, and addiction.

PROJECT PURPOSE

The purpose of the CMAG project is to begin to resolve the problems addressed above by working to increase the mathematics achievement of special needs Native American students. This population is targeted because of the disproportional numbers of Native students receiving special education services. The intention of the project intervention described in this paper is to prepare special education teachers to effectively teach mathematics to their Native students. The study hypothesis is that by heightening the mathematical problem solving and reasoning abilities of Native American learning disabled students, the students will perform significantly better on the reasoning-based Wisconsin Knowledge and Concept Exam, and this improved performance will reduce the achievement gap between Native American and non-Native students within the participating districts and schools. MindSong Math is the professional development program that serves as the project intervention. This program prepares teachers to effectively integrate culturally responsive mathematics, cognitively guided and differentiated instruction, hands-on-geometry, context-situated algebra, and technology. The MindSong Math Professional Development Program was developed by Dr. Judith Hanks, the CMAG primary investigator, Mindsong Math incorporates research-based programs such as Cognitively Guided Instruction, Maine's Impact Study of Technology in Mathematics, the Madison Metropolitan School District Learning Mathematics in the Intermediate Grades program, the CREDE Standards for Effective Teaching (culture-based), Math Recovery, and numeracy studies conducted by the Freudenthal Institute at Utrecht University in the Netherlands.

Eight objectives focus the CMAG project.:

1. to increase mathematics content knowledge of Native American students identified as LD and EBD;
2. to increase the mathematical problem solving skills of Native students identified as LD and EBD;
3. that Native American students identified as LD and EBD will report more positive attitudes toward learning mathematics;
4. that teachers of Native students identified as LD and EBD will develop greater knowledge of mathematics content;
5. that teachers of Native students identified as LD and EBD will develop greater knowledge of process standards and reform pedagogy;
6. that teachers of Native students identified as LD and EBD students will develop greater

knowledge of aligning instruction with assessment;

7. that teachers of Native students identified as LD and EBD will demonstrate knowledge of culturally responsive methods of teaching and teach content through culture-based thematic units; and

8. that school-based teams of teachers will provide district professional development.

INTERVENTION

The CMAG Project encompasses three characteristics found in many successful professional development projects: (1) groups of teachers from the same school participate together; (2) workshops and reflection sessions provide high quality contact lasting months; and (3) teachers learn new content and pedagogy in the context of teaching (Elmore, 2002; Loucks-Horsley, et. al., 2005). Table 2 outlines how these characteristics are integrated in the CMAG Project.

CMAG Intervention Activities

Need Identified	Activity to Address the Need
4 th , 8 th and 10 th grade WKCE math scores of Native students identified as LD and EBD need to be improved.	CMAG workshops will focus on deepening math content knowledge of teachers of special needs Native students and on the knowledge of how Native students learn such content.
The mathematical content knowledge of teachers working with LD and EBD Native students needs to increase.	CMAG workshops will focus on connected content, i.e., teacher knowledge of algebra, geometry, statistics/data analysis, etc will be developed in the context thematic units.
Teachers of LD and EBD Native students typically focus on skill development rather than the development of reasoning.	During CMAG workshops, teachers will be fully immersed in problem solving and will reflect on developing student reasoning through problem solving.
Teachers need to understand how students learn math content and how to assess for content knowledge.	During CMAG workshops, teachers will develop understanding of student mathematical thinking by participating in Cognitively Guided Instruction sessions levels I, II, and III
Typically math taught to middle and high school LD and EBD Native students is remedial and disconnected from real life.	During CMAG workshops, teachers will study connected content units (to develop their own content knowledge) and adapt these units for use with LD and EBD students.
Teachers need to become familiar with the latest web-based curriculum to understand its role in the math classroom.	Sessions will be devoted to learning technologies and accessing and exploring the web-based interactive curriculum found on the <i>MindSong Math</i> blog: http://mindsongmath.blogspot.com/
Teachers need to become acquainted with activities and commercial materials that allow one to teach via problem solving.	Workshop time will be provided for teachers to peruse and critique curricular materials from programs such as <i>The Mathematics Task Center Project</i> http://www.blackdouglas.com.au/taskcentre/index.htm , and the Maine Impact Maine Impact Study http://www2.edc.org/mistm/product/keysites.html
Many teachers of Native American students lack knowledge about Native culture and learning styles.	During CMAG workshops, teachers will become knowledgeable about culturally responsive teaching methods and how Native culture impacts on school performance.
Regular education teachers with inclusion classrooms need to understand how to adapt curriculum and instruction for LD and EBD Native students. Also, there is limited understanding regarding how elementary, middle, and high school curriculum dovetails and how this influences LD and EBD students' instruction.	CMAG faculty will co-present with CMAG treatment teacher teams (two regular education and two special education) and provide one or two day workshops/awareness sessions annually in participating districts.

Discourse between special education and regular education teachers is limited. Networking between teachers and among grades is needed. Also,	CMAG treatment teachers will participate in the CMAG Project for three consecutive years implementing content and methods in their own classrooms. These team members will also serve as math coaches.
--	--

ASSESSMENT

An analysis of variance (ANOVA) will be performed to test the null hypotheses of no relation between the independent variables introduced by the CMAG Project treatment (increased content knowledge of teachers, teacher knowledge of CGI, teacher knowledge of culturally responsive teaching methods, use of high interest lessons that focus on situated problem solving and connected content) and the dependent variables of student achievement and student attitude towards mathematics.

Major Objectives	Evaluation Method
Increase mathematics content knowledge of treatment Native American students identified as LD and EBD.	WKCE will be analyzed annually; MINDSONG MATH Assessment of treatment students annually, pre-assess (September) and post (May); MINDSONG MATH Assessment of Control students: pre-assess (September Year I) post (May Year III).
Improve the mathematical problem solving abilities of treatment Native students identified as LD and EBD.	(same as above)
Treatment Native American students identified as LD and EBD will report more positive attitudes toward learning mathematics	Attitude Assessment: treatment annually, pre-assess (September) post (May); Control: pre-assess (September Year I) post (May Year III).
Treatment teachers of Native students identified as LD and EBD will develop greater knowledge of mathematics content.	Content Knowledge Assessment treatment and control teachers: pre-assess (September Yr I) and post treatment (May Year III).
Treatment teachers of Native students identified as LD and EBD will develop greater knowledge of the NCTM Process Standards.	(same as above)
Treatment teachers of Native students identified as LD and EBD will develop greater knowledge of how to align instruction with assessment.	Teacher Knowledge and Beliefs assessment of treatment and control teachers: pre-assess (Year I) and post treatment (Year II); CMAG faculty will observe and interview treatment teachers each month. Control teachers will be observed by CMAG faculty September Year I and May Year III. Field observation protocols will document implementation.
Treatment teachers of Native students identified as LD and EBD will demonstrate knowledge of culturally responsive methods of teaching.	CREDE Rubric will be used to evaluate implementation.
Treatment teachers of Native students identified as LD and EBD will use web-based curriculum with their students.	Implementation Self Evaluation: treatment teachers will self-evaluate their use of web-based curriculum. They will also be observed and interviewed by CMAG faculty each month.
Treatment teachers of Native students identified as LD and EBD will teach content through content integrated thematic units .	(same as above)
Teams of project teachers (two special education teachers and two regular education teachers) will provide district workshops/awareness sessions and serve as mathematics coaches within their districts.	District-wide workshops will be documented and workshop participants will be surveyed following each workshop to evaluate participant benefits. Classroom teachers will be surveyed to determine amount of and effectiveness of coaching by CMAG treatment teachers.

PROJECT YEAR I IMPLEMENTATION

To achieve the eight objectives stated above, the following activities were completed during Project Year I:

- *August 2008 5-day workshop (40 participants) focus on CGI problem types and numeracy;
- *August 2008 teacher content knowledge pre-tested during 1st day of workshop;
- *September 2008 project students pre-tested (CGI Reasoning Assessment, Base 10 Assessment, Content Assessment (K-2 with MMSD assessment, 3rd grade and above with the Buckledown Assessment, Attitude Assessment);
- *October 2008 Project classrooms visited and WKCE prep materials distributed (Buckedown resources);
- *October-November 2008 Project classroom observations and teachers interviewed (tapes transcribed and analyzed);
- *January 2009 3-day reflection session (focus on teaching fractions);
- *February 2009 Conference with Winter SD administrator;
- *February and March 2009 fraction curriculum developed and distributed;
- *March 2009 conference with Wabeno SD administrators (Wabeno project teachers providing awareness sessions to entire elementary and middle school. This district is interested in adopting CGI approach schoolwide.);
- *March 2009 half-day workshop Crandon k-5 teachers (This district is interested in adopting CGI approach schoolwide);
- *March-April 2009 instructional DVDs produced and distributed (three DVDs: two on teaching fractions and one on Base 10);
- *February-May 2009 Project classroom observations and teachers interviewed (Tapes are currently being transcribed and analyzed. Three faculty members are interviewing to achieve inter-rater agreement on teacher implementation efforts);
- *February-April 2009 external evaluator visited five school districts;
- *May 2009 post-assessment of project students (each special education teacher tracking five students);
- *September 2008 and May 2009 Year I control classrooms pre-post assessments (During Project Year I, there were only two districts with project/control classrooms. More twill be included more in Year II);
- *Summer 2009 pre-post test analysis;
- *June 10-12, 2009 and May 18 & 19, 2009 2- day workshop (technology focus - Pam Buffington, director of the Maine Impact Study for Technology in Mathematics Intervention

*July 6-8, 2009 3-day make-up workshop (four teachers from the LaCourte Orielles (BIA), one teacher from the Bayfield SD, one teacher from the Bowler SD, and one teacher from the Wabeno SD joined the project during the Year I school year).

FINDINGS

The CMAG Project is currently in the spring semester of Project Year I (of a three-year project), and student participants were post-assessed in May. Test data is currently being assessed. Also, all project teachers have been observed and interviewed at least two times. At the time that this paper is being submitted, interview transcription and analysis continues. Partial analysis of interview transcriptions using the *Levels of Teacher Change Rubric* reveal, as would be expected, that teachers are at different levels of implementation. However, more than three fourths of the teachers have reported positive student achievement. The following teacher comments are typical.

- *I think they feel better about themselves b/c there is no right or wrong way*
- *They are coming up with a solution that makes sense to them and that makes them feel good.*
- * There is not somebody saying that is not right, do it differently. So they are coming up and feeling better about themselves.*
- *I see the kids enjoying more, so much more. They love it.*
- *It's not a matter of them seeing that they get F's on their paper, or they are getting marked wrong, they just explore and they have fun doing it.*
- *They like math more.*
- * The thing that I found is they enjoy story problems.*
- * They love story problems, and they love graphing.*
- * The kids love this.*

References

- Apthorp, H., Hankes, J., Livingston, R., Woempner, C., Barley, Z., Enriquez-Olmos, M., & Fast, G. (2005). Mathematics lesson interactions and contexts for American Indian students in Plains region schools: An exploratory study. Aurora, CO: Regional Education Laboratory.
http://www.mcrel.org/pdf/Diversity/5051RR_AmericanIndianMathInstruction.pdf
- Allexaht-Snider, M., & Hart, L. E. (2001). Mathematics for all: How do we get there? *Theory Into Practice*, 40(2).
- Ainsworth-Darnell, James W. and Douglas B. Downey. 1998. Assessing the oppositional culture explanation for racial/ethnic differences in school performance. *American Sociological Review* 63:536-553.
- Austin, Terri (1994). *Changing the view: Student-led parent conferences*. Portsmouth, NH: Heinemann.
- Ascher, M. (1990). *Ethnomathematics: a multicultural view of mathematical ideas*. Pacific Grove: Brooks/Cole Publishing.
- Baratz J.C., Ficklen M.S., King, B., & Rosenbaum, P. (1985). *Who is going to medical school?* Princeton: Educational Testing Service.
- Bear, G., Richards, H. & Lancaster, P. (1987). Attitudes toward computers: Validation of a computer attitudes scale. *Journal of Educational Computing Research*, 3 (2) 207-218.
- Bennett, A. (2003). Towards a cultural aesthetic for African-American designers in graphic design pedagogy. *Journal of Design Research*. 3 (2) 2003.
- Boyer, E.E. (2000) High school: a report on secondary education in America. NY: Harper and Row.
- Brown, A.L., and J.C. Campione. (1994) Guided discovery in a community of learners. In K. McGilly (Ed.). *Classroom Lessons: Integrating Cognitive Theory and Classroom Practice*, Cambridge, MA: MIT Press.
- Brooks, J. G., & Brooks, G.M. (1999). *In search of understanding: The case for the constructivist classroom*. Portsmouth, NH: Heinemann.
- Bradley, C., & Taylor, L. (2002). Exploring American Indian and Alaskan Native cultures and mathematics learning. In J. E. Hankes & G. R. Fast (Eds.), *Changing the faces of mathematics: Perspective on indigenous people of North America perspectives*. Reston, VA: National Council of Teachers of Mathematics.
- Cajete, G. (2000). *Native Science*. Santa Fe, NM: Clearlight Publishers.
- Carey, D. A., Fennema, E., Carpenter, T. P., & Franke, M. L. (1994). Cognitively guided instruction: Towards equitable classrooms. In W. Secada, E. Fennema, & L. Byrd (Eds.). *New directions in equity for mathematics education*. New York: Teachers College Press.
- Carpenter, T., Fennema, E., Franke, M., Levi, L. & Empson, S. (1998). *Children's mathematics*. Portsmouth, NH: Heinemann.
- Carpenter, T. P., Ansell, E., Franke, M., Fennema, E., & Weisbeck, L. (1993). Models of problem solving: A study of kindergarten children's problem-solving processes. *Journal for Research in Mathematics Education*, 24 (5).
- Chavers, D. (2000). Deconstructing the myths: A research agenda for American Indian Education. ERIC Document ED 447985.
- Cook, P.J. & Ludwig, J. (1998). The burden of 'acting white': do black adolescents disparage academic achievement? In C. Jencks and M. Phillips (Eds.). *The Black-White Test Score Gap*. Washington DC: Brookings Institution Press.

- Cordell, B. (1991). A study of learning styles and computer-assisted instruction. *Computers and Education*, 16(2), 175-183, 1991.
- Clark, J. (1999). Minorities in science and mathematics: A challenge for change. ERIC Review K-8 Science and Mathematics Education. 2(6). Washington, DC : U.S. Department of Education, Educational Resources Information Center.
- Clements, D.H., and Battista, M.T. (1992). *The development of a Logo-based elementary school geometry curriculum (Final Report)*. NSF Grant No.: MDR-8651668. Buffalo, NY/Kent, OH: State University of New York at Buffalo/Kent State University.
- Davison, D. (1994). Mathematics. In J. Reyhner (Ed.), *Teaching American Indian students: Mathematics*. Norman, OK: University of Oklahoma Press.
- Davison, D. (2002). Teaching mathematics to American Indian students: A cultural approach. In J. E. Hanks & G. R. Fast (Eds.), *Changing the faces of mathematics: Perspective on indigenous people of North America perspectives*. Reston, VA: National Council of Teachers of Mathematics.
- Dehyle, D., & Swisher, K. (1997). Research in American Indian and Alaska Native Education: From assimilation to self-determination. *Review of Research in Education*, 22.
- Demmert, W. G., & Towner, J. C. (2003). A review of the research literature on the influences of culturally based education on the academic performance of Native American students. Portland, OR: Northwest Regional Educational Laboratory: (<http://www.nwrel.org/indianed/cbe/>)
- Downey, G. L., & Lucena, J. (1997). Weeding out and hiring in: How engineers succeed." In G. L. Downey and J. Dumit (Eds.) *Cyborgs & citadels : anthropological interventions in emerging sciences and technologies*. Santa Fe, NM: School of American Research Press.
- Duran, E., & Duran, D. (1995). *Native American post colonial psychology*. Albany, NY: State University of New York Press.
- Eglash, R. (1997). When math worlds collide: intention and invention in ethnomathematics." *Science, Technology and Human Values*, 22 (1) Winter.
- Eglash, R. (1999). *African Fractals: modern computing and indigenous design*. New Brunswick: Rutgers University Press.
- Eglash, R. (2002). A Two-way bridge across the digital divide. *Chronicle of Higher Education*, B12 June.
- Eglash, R. (2002). Race, Sex and Nerds: from Black Geeks to Asian-American Hipsters. *Social Text*, 20:2, Summer.
- Eglash, R. (2003). Re-thinking symmetry in ethno-mathematics. *Symmetry: Culture and Science*. 12 (1).
- Eglash, R. (2005). L'algorithme ethnique. *Pour la Science*. April/June.
- Eglash, R. (2006) Ethnocomputing with Native American Design." In L. E. Dyson, M. Hendriks and S. Grant (Eds.). *Information Technology and Indigenous People*. Sydney: Idea Group.
- Elmore, Richard F. (2002) Bridging the gap between standards and achievement: The imperative for professional development in education. Eric Document ED475871.
- Fennema, E. & Sherman, J.A. (1976). Fenema-Sherman mathematics attitudes scale: Instruments designed to measure attitudes toward the learning of mathematics by males and females (Ms. No. 1225). *JSAS: Catalog of Selected Documents of Psychology* 6(1), 31.
- Fordham, S. (1991). Peer-proofing academic competition among black adolescents: 'acting white' black American style. In C. Sleeter (Ed.) *Multicultural Education and Empowerment*, Albany: SUNY Press.
- Fulton-Scott, M. (1983). Bilingual multicultural education vs. integrated and non-integrated ESL instruction." *NABE Journal*, 11 (3).
- Grande, S. (2004). *Red pedagogy: Native American social & political thought*. Toronto: Rowman & Littlefield Publishers, Inc.
- Green, R. S. (2001). Closing the achievement gap: Lessons learned and challenges ahead. *Teaching and Change*, 8(2).

- Geary, D.C. (1994). *Children's Mathematical Development: research and practical applications*. Washington DC: American Psychological Association.
- Gilmer, Gloria. (1999). Using technology to explore mathematical patterns in African American hairstyles. 77th annual meeting of the National Council of Teachers of Mathematics, San Francisco.
- Gravemeijer, Koeno P. "From a different perspective: building on students informal knowledge." In R. Lehrer and D. Chazan (Eds.). *Designing learning environments for developing understanding of geometry and space*. Mahwah, NJ: Lawrence Erlbaum.
- Gravemeijer, K. (1992). The empty numberline. Netherlands: Utrecht University. Draft Paper.
- Guiton, G., & Oakes, J. (1995). Opportunities to learn and educational equality. *Educational Evaluation and Policy Analysis*, 73(3)..
- Hankes, J. E. (1998). *Native American pedagogy and cognitive-based mathematics instruction*. New York, NY: Garland Press.
- Hankes, J. E. & Fast, R. G. (2002). *Using Native American Legends to Teach Mathematics*. Omro, WI: Honor Press.
- Hankes, J. E. & Fast, R. G. (2002). Investigating the correspondence between Native American pedagogy and constructivist-based instruction. In J. E. Hankes & G. R. Fast (Eds.), *Changing the faces of mathematics: Perspective on indigenous people of North America perspectives*. Reston, VA: National Council of Teachers of Mathematics.
- Hale-Benson, JE (1990). Visions for children: African-American early childhood education program. *Early Childhood Research Quarterly*, 5.
- Hall, E. R., & Post-Kammer, P. (1987). Black mathematics and science majors: why so few? *Career Development Quarterly*, 35.
- Haycock, K. (2001). Closing the achievement gap. *Educational Leadership*, 58(6).
- Hixson, J., & Tinzmann, M.B. (1990). *Who are the "at-risk" students of the 1990s?* Oak Brook, IL: North Central Regional Education Laboratory.
- Hoberman, J.M. (1997). *Darwin's Athletes: How Sport Has Damaged Black America and Preserved the Myth of Race*. New York: Houghton Mifflin.
- Hodgkinson, H. (2001). Educational demographics: What teachers should know. *Educational Leadership*, 58(4).
- Kawakami, Alice J. (1995) A study of risk factors among high school students in the Pacific Region. *Honolulu: Pacific Resources for Education and Learning*.
- Jackson, A. (1992). Multiculturalism in mathematics. In L.A. Stern (Ed.) *Heeding the Call for Change*, Mathematical Association of America.
- Jonassen, D. H. (1996). *Handbook of Research for Educational Communications and Technology*. New York: Simon and Schuster.
- Keenan, D. (2001). Trespassing Native ground: American Indian studies and problems of non-Native work. *Journal of Midwest Modern Language Association*. 34 (1).
- Klug, B.J., & Whitfield, P.T. (2003). *Widening the Circle*. New York: Routledge Falmer.
Left Brain Games, Inc: <http://leftbraingames.com>
- Lewis, M, Bishay, M., McArthur, D., Chou, J. Supporting discovery learning in mathematics: design and analysis of an exploration Environment and Inquiry Activities." Under review in Instructional Science. Available online at <http://www.rand.org/education/mcarthur/Papers/IS.html>.
- Lehrer, R., Strom, D., & Confrey, J. (2002). Grounding metaphors and inscriptional resonance: Children's emerging understanding of mathematical similarity. *Cognition and Instruction*, 20, 359-398.
- Lipka, J., Hogan, M., Webster, J., Yanez, E., Adams, B., Clark, S., & Lacy, D. (2005). Math in a cultural context: Two case studies of a successful culturally based math project. *Anthropology & Education Quarterly*, 36(4).

- Lipka, J. & Adams, B. (2004) Culturally based math education as a way to improve Alaskan Native students' math performance." ACCLAIM Working Papers #20, online at http://acclaim.coe.ohiou.edu/rc/rc_sub/pub/3_wp/LipkaAdams20.pdf.
- Lockwood, A. T. & Secada, W.G. (1999) Transforming education for Hispanic Youth: Exemplary practices, programs, and schools. *NCBE Resource Collection Series*, No. 12.
- Loucks-Horsley, S., Stiles, K., & Hewson, P. (2005). Principles of effective professional development for mathematics and science education: A synthesis of standards. *National Institute for Science Education (NISE) Brief*, 1(1).
- Math in a Cultural Context (<http://www.wested.org/cs/we/view/rs/738>)
- Martin, Danny. (200). *Mathematics success and failure among African-American youth: The roles of socio-historical context, community forces, school influence, and individual agency*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Means, B. (1997). *Critical Issue: Using Technology to Enhance Engaged Learning for At-Risk Students*. Oak Brook, IL: North Central Regional Education Laboratory,.
- Mickelson, R. A. (2003). When are racial disparities in education the result of racial discrimination? A social science perspective. *Teachers College Record*.105 (6).
- Moore, C. G. (1994). Research in Native American mathematics education." For the Learning of Mathematics, pp 9-14, 14-2 1994.
- NAS (National Academies of Science). (2001). *Building a Workforce for the Information Economy*. Washington D.C.: National Academy Press.
- National Council of Teachers of Mathematics. (2000). *Professional Standards for Teaching*. Reston, VA: National Council of Teachers of Mathematics.
- National Council of Teachers of Mathematics. (1992). *Professional Standards for Teaching Mathematics*. Reston, VA: National Council of Teachers of Mathematics.
- National Science Foundation, (1994). *Women, minorities, and persons with disabilities in science and engineering*. Washington, DC: National Science Foundation.
- National Science Education Standards* (1996). National Academy Press, Washington, DC.
- National Science Teachers Association Reports, (2002). *Teaching science in the 21st century: An evolutionary framework for instructional materials*. Arlington, VA: National Science Teachers Association.
- Native American Environment: <http://www.ncseonline.org/NAE/>.
- NCREL.(2000). Critical issue: Using technology to enhance engaged learning for at-risk students". <http://www.ncrel.org/sdrs/areas/issues/students/atrisk/at400.htm>
- Nunes, T., Dias, Schliemann, A., & William C., David (Eds.) *Street Mathematics and School Mathematics*. Cambridge: Cambridge University Press 1993.
- Ogbu, John. (1998). Voluntary and Involuntary Minorities: A Cultural-Ecological theory of School Performance. *Anthropology and Education Quarterly*, 29 (2).
- Payne, K. J. and Biddle, R. J. (1999). Poor school funding, child poverty, and mathematics achievement. Educational Researcher 28 6 4-13.
- Peery, A. (2004). *Deep change: Professional development from the inside out*. Lanham, MD: Scarecrow Press.
- Powell, L. (1990). Factors associated with the under-representation of African Americans in mathematics and science." *Journal of Negro Education*, 59 (3).
- Rauff, J. (1996). My brother does not have a pickup: Ethnomathematics and mathematics education. *Mathematics and Computer Education*, 30(1).
- Rites and Right Representations: <http://www.ritesandrightrep.com/>.
- Sacred Circle: (<http://www.tapestryweb.org/circle.html>)
- Sayler, B., & Apaza, J. (2006). *Using multiple measures to guide mathematics Reform*

- within a K-12 district.* Center for the Advancement of Mathematics and Science Education, Black Hills State University, Spearfish, SD.
- Science Atlas: (<http://www.project2061.org/publications/atlas/>).
- Smith, T. (2004). Curricular reform in mathematics and science since a nation at risk. *Peabody Journal of Education*, 79(1).
- Soldier, L. W. (2005). *Indian Education Today*, New York, NY: Oneida Nation.
- Starnes, Bobby. (2006). What we don't know can hurt them: White teachers, Indian children. *Phi Delta Kappan*. 87 (5).
- Swisher, K.G. (1996). Why Indian people should be the ones to write about Indian education. *American Indian Quarterly*. Winter Issue.
- Task Centre Kits for Aboriginal Students* (<http://www.blackdouglas.com.au/taskcentre/indigen.htm>)
- Teaching Integrated Math and Science (TIMS) Laboratory Method:
<http://www.kendallhunt.com/uploads/2/TTTimsMethod.pdf>
- Trumbull, E., Nelson-Barber, S., & Mitchell, J. (2002). Enhancing mathematics instruction for Indigenous American students. In J. E. Hanks and G. R. Fast (Eds.), *Changing the faces of mathematics: Perspective on indigenous people of North America perspectives*. Reston, VA: National Council of Teachers of Mathematics.
- Weiss, C. H. (1998). *Evaluation (2nd ed.)*. Upper Saddle River, NJ: Prentice-Hall. Wilson, A. & Yellow Bird, M. Eds. (2005). *For indigenous eyes only: Decolonization handbook*. Santa Fe, NM: School of American Research.
- Vygotsky, L.S. (1978). *Mind and society: The development of higher mental processes*. Cambridge, MA: Harvard University Press.
- Warschauer, Mark. (1999). *Electronic literacies : language, culture, and power in online education*. Mahwah, N.J: L. Erlbaum Associates, 1999.
- Yerushalmy, M. (1990). Using empirical information in geometry: students' and designers' expectations. *Journal of Computers in Mathematics and Science Teaching*, 9(3) Spring.

