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Analysis of a Culturally Based Sixth Grade Mathematics Module: Addressing Multicultural Education in School Mathematics

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ABSTRACT

Multicultural education should play an important role in the school mathematics curriculum. Culturally based school mathematics curricula are one vehicle to support implementation of multicultural education and school mathematics reform in classrooms. However, few examples of culturally based school mathematics curriculum have been analyzed to demonstrate how such curricula can incorporate key goals of multicultural education and address the recommendations of the National Council of Teachers of Mathematics (NCTM). This paper unpacks a sixth grade mathematics module that is both culturally based and standards based. The module is analyzed to show how it employs multiple themes that connect multicultural education to teaching and learning school mathematics. This analysis demonstrates how rigorous, standards based mathematics can also address key goals of multicultural education.

Introduction

> Teaching must start from students' life experiences, not the teachers' life experiences or the experiences necessary to fit into the dominant school culture (Gollnick & Chinn, 1998, pp. 306-307).

> … [A]ll children, including those who have been traditionally underserved, can learn mathematics when they have access to high-quality instructional programs that support their learning (NCTM, 2000, p. 14).

There is broad consensus within the mathematics education community that equity and addressing multiple facets of diversity in school mathematics (e.g., learning styles, culture, race, gender, language) is central to reform of school mathematics and to provide high quality mathematics curriculum and teaching and learning for all students (NCTM, 2000). Implementing multicultural education in mathematics classrooms is one way to address diversity and equity for K-12 students (Croom, 1997) and standards based mathematics curricula have sought to address multicultural education to varying degrees (Legaspi & Rickard, 2005). While growing evidence suggests that culturally-based mathematics lessons or activities can help all students learn mathematics, even if the students are not necessarily from the culture the lessons or activities are drawn from (e.g., McGlone, 2008; Zaslavsky, 1991), there has been relatively little inquiry into how culturally-based mathematics curricula are designed to address multicultural education in the context of teaching and learning mathematics (see Lipka, Sharp, N., Brenner, Yanez, & Sharp, F., 2005). Unpacking how effective, culturally-based mathematics curricula address multicultural education has the potential to inform teachers' use of such curricula, the development of culturally-based mathematics curricula, and to support teachers in integrating multicultural education into their practice of teaching mathematics, and potentially other subjects as well.

There are varying interpretations of what multicultural education means and how it can be addressed in school mathematics curriculum materials (e.g., see Legaspi & Rickard, 2005). One widely accepted definition of multicultural education is offered by Gollnick and Chinn (1998):

> Multicultural education is the educational strategy in which students' cultural backgrounds are used to develop effective classroom instruction and school environments. It is designed to support and extend the concepts of culture, differences, equality, and democracy in the formal school setting. (p. 3)

Within teaching and learning mathematics, the above understanding of what multicultural education is includes culturally based mathematics, which refers to peoples' experiences that arise within particular cultures to address mathematical problems that occur in their environments (McGlone, 2008). For example, learning about relationships between area and perimeter of rectangles and circles by studying circular dwellings of people throughout the world (e.g., teepees in North America, yurts in Asia), connects mathematics and cultures by drawing on cultural knowledge and traditions to build understanding of mathematical reasoning, concepts, and relationships (e.g., Zaslavsky, 1991). This example of multicultural education, using culturally-based mathematics, is consistent with multiple goals of school mathematics reform, including equity and teaching and learning powerful mathematics for all students (NCTM, 2000). Moreover, culturally-based mathematics is generally more meaningful, both mathematically and in terms of multicultural education, than typical, and often superficial, approaches commonly found in school mathematics curricula – e.g., sprinkling diverse names into traditional word problems in textbooks, using various national flags as examples of geometric shapes, providing pictures of diverse people and places (Legaspi & Rickard, 2005). Culturally based mathematics, therefore, is an approach that connects teaching and learning school mathematics with multicultural education to increase the accessibility, meaning, and application of mathematics for all students (McGlone, 2008; Rickard & Lipka, 2007).

Culturally Based Mathematics Curricula

A common view of traditional or standards based K-12 mathematics curricula (e.g., textbook series, commercially available supplementary materials and activities) is that they are largely devoid of culture and reflect the abstract and decontextualized nature of mathematics. However, critics argue that such curricula actually are culturally-based and, in particular, reflect Western European culture and advantage students from that culture over others (e.g., Malloy & Malloy, 1998). This perspective emphasizes the need to draw on students' backgrounds, knowledge, and communities (i.e., culture) to support teaching and learning mathematics (Rickard & Lipka, 2007). Providing all students with a variety of culturally-based experiences in mathematics arguably makes sense from the perspective of the discipline of mathematics itself – i.e., as a human endeavor, mathematics is the product of many individuals from many cultures, and this rich heritage should be part of what students learn about mathematics (Lipka et al., 2005; Swetz, 1997; Taylor, 1997).

Culturally based school mathematics curricula may take multiple forms (e.g., units, modules, lessons, activities), but typically share a common thread where mathematics is learned, conducted, or explored in some explicit and culturally authentic way or to understand a particular cultural activity. For example, as discussed earlier, students may apply and develop their understanding of perimeter and area to understand why many indigenous cultures build dwellings in a circular shape (e.g., Zaslavsky, 1991) or students might construct a model of a Yup'ik smokehouse to learn about the mathematics of prisms (e.g., Kagle, Barber, Lipka, Sharp, & Rickard, 2007). In both cases, mathematics and culture are entwined to provide an engaging experience for all students that address goals for reforming school mathematics (cf., Kagle et al., 2007; NCTM, 2000; Zaslavsky, 1991). In arguing for cultural knowledge and culturally based mathematics to be a part of the school mathematics curriculum, Malloy and Malloy (1998) note that:

> The curriculum that promotes all students participating in mathematics learning is problem-based. The problems are real and can be solved using multiple approaches and methodology. … Using the learning strengths of students' cultures in our pedagogy and our curriculum, educators can serve all students. (p. 254)

Such culturally based mathematics curricula address the above issues; including supporting broad reforms for school mathematics (see NCTM, 2000).

Math in a Cultural Context (MCC), a K-7 mathematics curriculum development project, has produced a series of modules for teaching and learning culturally based and standards based mathematics (Rickard & Lipka, 2007). Each module is based on one or more authentic cultural or subsistence activities of the Yup'ik people of southwestern

Alaska, one of the major groups of the indigenous people of Alaska. MCC modules are designed for teachers and students to explore and learn the mathematics that is embedded in authentic cultural and subsistence activities, thereby connecting mathematics to Yup'ik culture, developing and learning the mathematics in the cultural context, and then connecting to traditional Western mathematics. In this way, Alaska Native students, particularly Yup'ik students, have the opportunity to explore and learn mathematics on their own cultural terms, rather than solely having to adopt the (western) culture of the formal school setting. Consistent with research that has shown how students learn mathematics more effectively when they can navigate mathematical terrain from the more familiar ground of their own culture (e.g., Nasir, Hand, & Taylor, 2008); research on the impact of MCC modules on students' achievement has shown that all students, but particularly Alaska Native students, benefit from MCC modules. These benefits include outperforming peers who learn the same mathematics from traditional mathematics curricula and narrowing the persistent mathematics achievement gap with Caucasian students in urban Alaska (e.g., Lipka, Parker-Webster, & Yanez, 2005; Lipka & Rickard, 2007).

Building a Fish Rack

One of the modules in the MCC series is *Building a Fish Rack: Investigations into Proof, Properties, Perimeter, and Area* (Adams & Lipka, 2003). After providing background of the salmon fishery in the Bristol Bay region of southwestern Alaska, students learn in the module about how traditional Yup'ik fish racks are constructed and used to dry and prepare harvested salmon. In particular, fish racks have a rectangular frame, and constructing a fish rack includes determining where the four posts that form the "legs" need to be placed. Mathematically, this means placing the posts to make the vertices of a rectangle. The figure below shows the top of a typical Yup'ik fish rack; posts at the four corners are like the legs of a rectangular table (this type of fish rack is typically 4-5 feet high) and salmon that is prepared and cut is draped over the "slats" to dry:

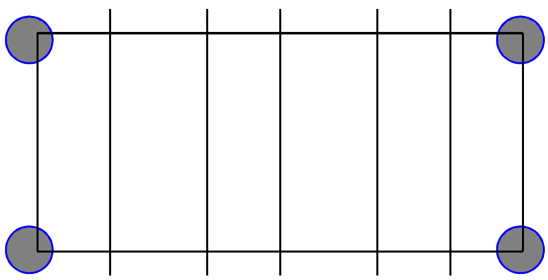

Figure 1. Top view of a Yup'ik fish rack with a rectangular frame.

Fish racks are generally made from wood, often obtained from nearby trees or recycled from other projects. Larger posts are used for the legs/corners of the fish rack and smaller poles (or branches) are used for the slats on which the salmon is draped. It is important to note that in different regions of Alaska, fish racks are made in different shapes and sizes, depending on local and cultural traditions, the material that is available, and the quantity of salmon that is (or is expected to be) harvested (Adams & Lipka, 2003).

After they learn about the form and function of Yup'ik fish racks, the *Building a Fish Rack* module engages students in several activities that provide an exploration of how a fish rack is made. Students learn how Yup'ik elders traditionally make fish racks, and then explore the mathematics embedded in the traditional construction process. For example, to correctly position the posts for the frame of the fish rack, it must be verified that the posts form the corners (vertices) of a rectangle; if the base of the fish rack is not rectangular, it may fall over and ruin the drying salmon. Students learn how Yup'ik elders determine the rectangular base by using ropes to measure diagonals, implicitly using the property of rectangles that the diagonals must be congruent (see Adams & Lipka, 2003). As the module progresses, students develop understanding of mathematical proof and reasoning (e.g., if the diagonals of a quadrilateral are not congruent, the shape cannot be a rectangle), as well as understanding about the relationships between perimeter and area of rectangles, and how to measure the perimeter and area of different shapes, including developing perimeter and area formulas for common figures (e.g., rectangles, triangles, parallelograms, trapezoids, and circles). All of the explorations are in the context of traditional Yup'ik culture and subsistence. For example, students explore the mathematical conjecture, "The perimeters of different rectangles are the same, so they will hold the same number of fish" (Adams & Lipka, 2003, p. 142). Mathematically, this conjecture is equivalent to asking that if the perimeters of different rectangles are the same, must they have the same area. Students explore this conjecture and determine that it is not true (e.g., a 1x6 and a 3x4 rectangle each have the same perimeter of 14 units, but have different areas of 7 square units and 12 square units, respectively), and then determine which rectangle, for a fixed perimeter, has the largest area (i.e., a square). These findings are then connected back to Yup'ik culture by finding, for a fixed amount of construction material, what shape a rectangular fish rack should be to hold the most fish (i.e., the fish rack should be made as close to the shape of a square as possible). At the end of the *Building a Fish Rack* module, students use toothpicks and gumdrops to make their own model fish rack and document their mathematical reasoning (Adams & Lipka, 2003).

A Case Study of Building a Fish Rack: Multicultural Education in School Mathematics

Sleeter (1997) argues that multicultural education and school mathematics overlap and connect in many ways. In particular, she shows that four themes emerge from the research literature that link multicultural education and school mathematics (Sleeter, 1997):

- Raising the mathematics achievement of girls and other student groups who underachieve in mathematics;
- Improving access to mathematics for students who have historically not studied mathematics at higher levels;
- Ethnomathematics, which urges teachers to employ culturally relevant pedagogy to engage students in mathematics;
- Connecting mathematics to the real-life concerns of students and the issues that impact them and their communities.

Analyzing the MCC *Building a Fish Rack* module through the lenses of these four themes can provide insight into how an example of culturally based school mathematics curricula may address multicultural education. Understanding how a culturally based mathematics curriculum module addresses multicultural education can, in turn, provide deeper understanding about the role such curricula may play in K-12 mathematics as vehicles for reform (e.g., implementing the equity principle of the NCTM Standards) and how they may help all students develop mathematical power (c.f., Legaspi & Rickard, 2005; Malloy & Malloy, 1998; McGlone, 2008; NCTM, 2000; Sleeter, 1997; Zaslavsky, 1991).

Raising Mathematics Achievement

Multiple studies have shown that students, who learned mathematics with MCC modules, including *Building a Fish Rack*, generally demonstrate higher mathematics achievement than their peers who learn the same mathematics from other mathematics curricula (Rickard & Lipka, 2007). For example, in a case study of how one sixth-grade teacher taught *Building a Fish Rack* in her classroom, comparing the results of pretests and posttests between the class and their peers in control classrooms (who learned the same mathematics on perimeter and area from other curriculum texts and materials) found that the *Building a Fish Rack* class (N=22) scored 42.91% on the pretest and 72.41% on the posttest, whereas the control students (N=47) scored 41.26% on the pretest and 42.04% on the posttest (Rickard, 2005). The *Building a Fish Rack* class and the control students were not only similar in their pretest scores, but were also comparable in terms of diversity and other factors (see Rickard, 2005). As well as quantitative measures, qualitative data collected in classrooms suggests that MCC modules, including *Building a Fish Rack*, also help students develop skill in communicating with mathematics and problem solving (Rickard, 2005; Lipka & Rickard, 2007). Moreover, while gains in academic achievement are generally similar for both boys and girls, MCC modules generally promote strong gains in mathematics achievement of Alaska Native students, narrowing the persistent mathematics achievement gap between Alaska Native and non-Native students (Lipka et al., 2005).

Access to High-Level Mathematics

As a standards based mathematics curriculum module, *Building a Fish Rack* develops rich mathematics content (e.g., perimeter and area of two-dimensional shapes and the relationships between these measures), as well as addressing process goals that are central to mathematics reform (e.g. problem solving, reasoning and proof, connections, communication, representation). For example, the NCTM representation process standard (see NCTM, 2000) is addressed in *Building a Fish Rack* because students, "…represent their solutions verbally, numerically, graphically, geometrically, and symbolically" (Adams & Lipka, 2003, p. 3). The NCTM content standards of measurement and geometry are the content standards most directly addressed by *Building a Fish Rack* (c.f., Adams & Lipka, 2003; NCTM, 2000).

Another way of establishing that *Building a Fish Rack* provides students and teachers with quality mathematics, and can prepare students for successful study of mathematics at higher levels, is to compare the module to other standards based curricula that addresses similar content and is known to be of high quality. One such example is the unit *Covering and Surrounding* that is part of the *Connected Mathematics Project* middle school mathematics curriculum (Lappan, Fey, Fitzgerald, Friel, & Phillips, 2002). Like *Building a Fish Rack, Covering and Surrounding* is standards based, is intended for sixth grade, centers on perimeter and area of two-dimensional figures (and the relationship between these measures), and addresses all five of the NCTM process standards (c.f., Adams & Lipka, 2003; Lappan et al., 2002; NCTM, 2000). Moreover, in its 1999 review of all twelve nationally available middle school mathematics curricula, the American Association for the Advancement of Science ranked the *Connected Mathematics Project* the highest; also in 1999, the U.S. Department of Education reviewed middle school curricula and the *Connected Mathematics Project* curriculum was the only one ranked "exemplary" by the Department's Mathematics and Science Education Expert Panel (Conklin, Grant, Ludema, Rickard, & Rivette, 2006). Supporting the claim that *Building a Fish Rack* is a standards based module that helps prepare students for high-level mathematics is its close alignment with *Covering and Surrounding*, as shown in the table below (*Covering and Surrounding* is comprised of seven Investigations and a final unit project, *Building a Fish Rack* is comprised of 18 activities with the last activity being a final project for the module):

Covering and Surrounding Investigations	**Corresponding Activities from Building a Fish Rack**
1. Measuring Perimeter and Area	9. Perimeter and Shape 10. Exploring Perimeter of Rectangles 11. Measuring Area
2. Measuring Odd Shapes	9. Perimeter and Shape (e.g., finding the perimeter of Seagull Island)
3. Constant Area, Changing Perimeter	15. Area Held Constant with Perimeter Changing
4. Constant Perimeter, Changing Area	12. Investigating the Relationship of Perimeter and Area of Rectangles
5. Measuring Parallelograms 6. Measuring Triangles 7. Going Around in Circles	13. Area of Different Shapes 14. Deriving Area Formulas
Project: Plan a Park (students create a rectangular layout or "blueprint" of a park with specific requirement, drawn to scale)	18. Project: Constructing a Fish Rack (students make models of fish racks using gumdrops and toothpicks)

Figure 2. Comparison of *covering and surrounding* and *Building a Fish Rack*.

As the above comparison shows, *Building a Fish Rack* addresses very similar mathematics content included in *Covering and Surrounding* (c.f., Adams & Lipka, 2003; Lappan et al., 2002). This analysis of the close content alignment between *Building a Fish Rack* and *Covering and Surrounding* underscores that *Building a Fish Rack* is standards based and can help prepare students for success with higher-level mathematics.

Ethnomathematics

> Ethnomathematics derives from the study of the form that mathematical ideas take in different sociocultural contexts. School mathematics is a very narrow subset of the range of mathematical thinking in which people have engaged, and it is usually limited further when it presents mathematics as a finished product to be memorized rather than as a challenging terrain for thought. (Sleeter, 1997, pp. 683-684)

Building a Fish Rack addresses the ethnomathematics theme of multicultural education in school mathematics by using the traditional approaches of Yup'ik elders for constructing a fish rack as the central mathematical motivation of the module, and building a model fish rack as the final unit project. Adams and Lipka (2003) summarize how *Building a Fish Rack* incorporates Yup'ik culture and the knowledge of elders with reform mathematics:

> The hands-on activities related to building a fish rack for the harvest of salmon form the basis upon which formal mathematics develops in this module. Students

> engage in activities that simulate the way Yup'ik elders might go about building a fish rack for drying salmon. In the process, they consider a number of factors: ease of access, durability, strength, and capacity to hold a large amount of fish. For example, students in one activity learn to maximize the area of a rectangular drying rack, given a fixed perimeter. This exercise applies directly to the real-life situation in which materials such as wood are often limited, and Yup'ik fisherman thus optimize the drying rack with the few resources they have. In many exercises students increase their understanding of both Yup'ik culture and Western mathematics by learning cultural constructs such as *sufficient* and *adequate* instead of *maximum* and *best.* (p. 3, emphasis in original)

As shown above, *Building a Fish Rack* addresses ethnomathematics, providing students with cultural approaches to connecting, engaging, and developing specific mathematical ideas. Another example of ethnomathematics as a vehicle for learning formal mathematics in *Building a Fish Rack* is Activity 5: Elder Demonstration. In this activity, students learn how several Yup'ik elders employ traditional approaches, using ropes and stakes, to mark out the foundation outline for a fish rack. One of the steps in the technique is to refine the rectangular outline by using the ropes to measure and adjust the diagonals of the rectangular outline until they are of equal length. Students use this authentic component of how the elders make the fish rack to learn formal mathematical concepts about rectangles and measurement, specifically that the diagonals of rectangles are congruent and that if the diagonals of a quadrilateral are not congruent, than it cannot be a rectangle; students actually do this in the module, typically using string and masking tape to make the outline for the base of the fish rack on the classroom or gym floor (see Adams & Lipka, 2003). More broadly, all students experiencing how mathematics is used in authentic ways in a specific culture benefit from having their perspectives widened about what mathematics is and how it is used (Masingila & King, 1997).

Connecting Mathematics to Real Life

Teaching and learning mathematics in ways that connect to students' real-life circumstances, concerns, or other issues that impact them and their communities, is another theme for addressing multicultural education in school mathematics. For Alaska Native students, particularly Yup'ik students in the rural Bristol Bay region of southwestern Alaska, *Building a Fish Rack* and other MCC modules connect to their lives because the modules were developed with extensive collaboration from the Yup'ik community, particularly elders (see Rickard & Lipka, 2007). Real-life connections for Alaska Native students are generally connections for non-Native students in Alaska as well because of integrated communities, the entwined nature of many issues in both rural and urban Alaska, and the fact that all residents of Alaska need to know about the multifaceted and multiethnic composition of their very large state to be effective Alaskans (e.g., see Goldsmith, Howe, & Leask, 2005). For example, many Alaska Native students have been to fish camp and *Building a Fish Rack* directly connects to traditional subsistence issues and supports their taking leadership roles in the classroom.

Moreover, Alaska Native and non-Native students who have not been to fish camp have generally heard about it and may have friends or relatives who have shared stories and their experiences. Finally, for students who live outside of Alaska, *Building a Fish Rack* may present a rich opportunity to learn about the state, about Alaska's first people and their culture, and about how both Alaska and its residents may be connected to their own lives (Rickard, 2005).

Conclusions and Discussion

> Using the learning strengths of students' cultures in our pedagogy and our curriculum, educators can serve all students. School can provide an academic environment that relies on students' cultural backgrounds as the foundation for teaching and learning and enlists the students to become responsible for their mathematics learning. (Malloy & Malloy, 1998, pp. 254-255)

Analysis of *Building a Fish Rack*, through the lenses of four themes connecting multicultural education and school mathematics, shows that the module addresses both multicultural education and school mathematics reforms. For example, *Building a Fish Rack* is a standards based module that addresses two of the NCTM content standards (i.e., measurement and geometry) and all of the NCTM process standards (c.f., Adams & Lipka, 2003; NCTM, 2000). Moreover, the module incorporates the multicultural education themes of increasing students' mathematics achievement (especially Alaska Native students), improving students' access to mathematics, ethnomathematics, and connecting mathematics to real-life issues for students. Murtadha-Watts (1997) argues for the need to develop K-6 mathematics curriculum that is culturally rich and can empower students, both as learners of mathematics and to help them make social decisions. *Building a Fish Rack* is an example of such mathematics curricula, as it is culturally based and helps students develop mathematical power. *Building a Fish Rack* serves as an example of integrated standards based mathematics and multicultural education, with strong results for students' achievement.

While *Building a Fish Rack* combines standards based mathematics and multicultural education, it is not part of a complete curriculum. The ten different modules in the MCC series for grades K-7, including *Building a Fish Rack*, comprise a supplementary curriculum which the authors believe is best used to augment a complete standards based mathematics curriculum (Rickard & Lipka, 2007). Therefore, while some researchers argue for the need for a complete mathematics curriculum where mathematics and multicultural education converge and empower students with socially transformative mathematics (e.g., Murtadha-Watts, 1997), *Building a Fish Rack*, and MCC modules in aggregate, do not accomplish this. However, as an example of what part of a complete curriculum that integrates mathematics and multicultural education could look like, *Building a Fish Rack* may serve as a vehicle for moving towards development of such a curriculum. Moreover, curricula like *Building a Fish Rack* may also help teachers develop and refine the skills, knowledge, and dispositions to teach culturally based mathematics and address multicultural education in the mathematics classroom. In particular, teaching *Building a Fish Rack*, or other MCC modules, may provide teachers with deeper knowledge of mathematics and a broader understanding of how to address multicultural education in their mathematics.

References

Adams, B.L., & Lipka, J. (2003). *Building a fish rack: Investigations into proof, properties, perimeter, and area*. Calgary, Alberta, Canada: Detselig Enterprises.

Conklin, M., Grant, Y., Ludema, H., Rickard, A., & Rivette, K. (2006). Connected *Mathematics Project: Research and evaluation summary* (2006 ed.). Upper Saddle River, NJ: Prentice Hall.

Croom, L. (n.d.). Mathematics for all students: Access, excellence, and equity. In J. Trentacosta and M.J. Kenney (Eds.). *Multicultural and gender equity in the mathematics classroom: The gift of diversity – 1997 yearbook of the National Council of Teachers of Mathematics* (pp. 1-9). Reston, VA: National Council of Teachers of Mathematics.

Goldsmith, S., Howe, L., & Leask. L. (2005). *Anchorage at 90: Changing fast, with more to come – Understanding Alaska research summary No. 4*. Anchorage, AK: Institute of Social and Economic Research, University of Alaska Anchorage.

Gollnick, D.M., & Chinn, P.C. (1998). Multicultural education in a pluralistic society (5^{th} ed.). Columbus, OH: Merrill.

Kagle, M., Barber, V., Lipka, J., Sharp, F., & Rickard, A. (2007). *Building a smokehouse: The geometry of prisms*. Calgary, Alberta, Canada: Detselig Enterprises, Ltd.

Lappan, G., Fey, J.T., Fitzgerald, W.M., Friel, S.N., & Phillips, E.D. (2002). Covering *and surrounding: Two-dimensional measurement*. Glenview, IL: Prentice Hall.

Legaspi, A., & Rickard, A. (2005). A case study of multicultural education and problem-centered mathematics curricula. *National Forum of Multicultural Issues Journal, 1E* (1), pp. 1-18. [On-line] Retrieved www.nationalforum.com.

Lipka, J., Sharp, N., Brenner, B., Yanez, E., & Sharp, F. (2005). The relevance of culturally based curriculum and instruction: The case of Nancy Sharp. *Journal of American Indian Education*, *44* (3), 31-54.

Lipka, J., Parker Webster, J., & Yanez, E. (2005). Introduction. *Journal of American Indian Education*, *44* (3), 1-8.

Malloy, C.E., & Malloy, W.W. (1998). Issues of culture in mathematics teaching and learning. *The Urban Review*, *30* (3), 245-257.

Masingila, J.O., & King, K.J. (1997). Using ethnomathematics as a classroom tool. In J. Trentacosta and M.J. Kenney (Eds.). *Multicultural and gender equity in the mathematics classroom: The gift of diversity – 1997 yearbook of the National Council of Teachers of Mathematics* (pp.115-120). Reston, VA: National Council of Teachers of Mathematics.

McGlone, C.W. (2008). *The role of culturally based mathematics in the general mathematics curriculum*. Paper presented at the International Conference on Mathematics Education, Monterrey, Mexico.

Murtadha-Watts, K. (1997). A convergence of transformative multicultural and mathematics instruction? Dilemmas of group deliberations for curriculum change. *Journal for Research in Mathematics Education*, *28* (6), 767-782.

Nasir, N., Hand, V., & Taylor, E. (2008). Culture and mathematics in school: Boundaries between "cultural" and "domain" knowledge in the mathematics classroom and beyond. *Review of Research in Education*, *32*, (1), 187-240.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics.* Reston, VA: Author.

Rickard, A. (2005). Constant perimeter, varying area: A case study of teaching and learning mathematics to design a fish rack. *Journal of American Indian Education*, *44* (3), 80-100.

Rickard, A., & Lipka, J. (2007). *A guide to effectively using math in a cultural context: Your instruction manual for MCC – Draft Edition*. Calgary, Alberta, Canada: Detselig Enterprises.

Swetz, F. (1997). The history of mathematics: A journey of diversity. In J. Trentacosta and M.J. Kenney (Eds.). *Multicultural and gender equity in the mathematics classroom: The gift of diversity – 1997 yearbook of the National Council of Teachers of Mathematics* (pp. 121-130). Reston, VA: National Council of Teachers of Mathematics.

Sleeter, C.E. (1997). Mathematics, multicultural education, and professional development. *Journal for Research in Mathematics Education*, *28* (6), 680-696.

Taylor, L. (1997). Integrating mathematics and American Indian cultures. In J. Trentacosta and M.J. Kenney (Eds.). *Multicultural and gender equity in the mathematics classroom: The gift of diversity – 1997 yearbook of the National Council of Teachers of Mathematics* (pp. 169-176). Reston, VA: National Council of Teachers of Mathematics.

Zaslavsky, C. (1991). Multicultural mathematics education for the middle grades. *Arithmetic Teacher*, *38* (6), 8-13.