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Multicultural Mathematical Ideas: a New Course

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Multicultural Mathematical Ideas: A New Course

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All too often, even today, the average person fails to realize the universal humanistic foundation of mathematics. We've all heard the standard refrain "I was never any good at math" or encountered that silent pregnant pause when a person makes our acquaintance and finds out we are a mathematician. It seems that many people regard mathematics and mathematicians to be quite far-removed from the reality of human existence. But what makes this so?

I have had occasion to ponder this question over the last few years and have come to the conclusion that the average person's perception of mathematics is quite narrow. In addition, a person's perspective is colored by one's culture and experiences. As a teacher of mathematics, I strive to create experiences for my students that will increase their appreciation for, understanding of, and competence in using mathematics. Recently, I was able to create a new course for our newly developed Middle School Mathematics Minor Certification Program. This course, Multicultural Mathematical Ideas (MMI), developed under a grant from the Lilly Foundation, examines mathematics within various cultural settings, both past and present. Frequently, the things that we study are not called mathematics per se, but might be considered art, storytelling, astronomy, religion, commerce, or recreation. Although I have taught the course only two times, I can say that this course is changing how my students perceive mathematics and things mathematical. Frequently, they comment on how their perspective of mathematics is broadening. They are pleasantly amazed to find mathematics permeating just about every aspect of human endeavor. Ahh! One goal reached!

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This course had its genesis at a meeting I attended at the University of Wisconsin, Madison several years ago. At this meeting, scientists and mathematicians from the entire University of Wisconsin system came together to discuss the contemporary science-educational situation. The issue of the dominance of the male, Eurocentric perspective in science education pervaded the meeting. The meeting certainly gave me, a woman in mathematics, much food for thought. As presentations and discussions continued, I began to consider how I could merge my own ideas about teaching mathematics with the ideas that had come forth at the meeting. The course Multicultural Mathematical Ideas is the fruit of these reflections.

In this course, the traditional American Indian medicine wheel serves as a model in our opening class discussion as we begin to examine what is mathematics. We begin to explore the place of mathematics in Western and non-Western traditions, consider whether writing is necessary to mathematics, and try to see how our Western perspective comes into play in our approach to mathematics. The books *Ethnomathematics: A Multicultural View of Mathematical Ideas* by Marcia Ascher and *The Crest of the Peacock: Non-European Roots of Mathematics* by George Gheverghese Joseph provide sound resources for the heart of our course. Through numerous journal articles, we confront a variety of ethnic voices which supply many different perspectives to our mathematical dialogue. Comparisons and contrasts in mathematical philosophy and practice become very apparent as we consider articles such as "Sushi Science and Hamburger Science" by Japanese biologist Tatsuo Motokawa along with American Indian Vine DeLoria Jr.'s "Ethnoscience and Indian Realities," Sandy Greer's article "Science: It's Not Just a White Man's Thing," David Mtetwa's article "Mathematics & Ethnomathematics: Zimbabwean Students' View," and "Chicanos Have Math in Their Blood" by Luis Ortiz-Franco.

Meso-American peoples (the Incas, Aztecs, and the Maya), North American Indians and their ancestors, the cultures of ancient Egypt, the Middle East, China, and India provide a wealth of numerical, algebraic, and geometric topics: quipus with their knots help dispel the notion that writing is necessary for mathematics; bars, dots, and shells and number systems of base 2, 5, 8, and 20 provide systems that work efficiently and completely for arithmetic representation and computation; the sophistication of the calendrics of several ancient cultures makes our own calendar system pale.

The study of patterns is an integral part of mathematics and of the course. In our exploration of pattern, we examine the art—pottery, textile, graphics—of many ancient and contemporary cultures. As one part of this unit, we consider strip or border patterns and their classification using the system developed by crystallographers. Although our classification system is Western, the creation and execution of the patterns found in Navajo rugs, on Pueblo pottery, in Hmong paj ntaub (pon dow), and in woodland Indian beadwork and basketry is traditionally non-Western. The patterns that we find on these items are not traced out physically prior to execution but instead are conceived in the mind and then executed usually freehand or, in the case of textiles, with the use of cloth folding. Islamic art provides a great opportunity for students to explore the many sophisticated constructions and patterns using Islamic style and only a compass and a straightedge.

Recreation provides an extensive backdrop for mathematics. Fun and games is the watchword for part of a unit in which students explore a variety of mathematically-based games of chance and strategy. First, we learn about the culture and context of the game, then how to play it and finally, we analyze the mathematics at play in the game. In pairs or teams, students play several games such as Mancala, Nine Men's Morris, Picaria, Nim, or the American Indian Moccasin game. As a project, students analyze the mathematics behind one such game and present their findings in a paper or class presentation. The Tower of Brahma (Tower of Hanoi) provides the subject for a look at recursion. Students try to move up to seven disks according to the allowed procedures on individual wooden Towers of Hanoi. Later, as a group, we simulate this with student volunteers and then generalize to n disks. Pseudocoding the recursive process follows naturally. The Bridges of Königsburg problem, the sona of the Tshokwe, and Malekulan nitus provide an opportunity to look at several cultures that have been concerned with the same problem—that of tracing a figure continuously without any retracing. In our own contemporary mathematical culture, we too are interested in the related problem of networks. Although the contexts vary greatly, the underlying mathematical concept remains the same.

Archeoastronomy provides many opportunities to look at the mathematics, especially the geometry, that existed in many cultures around the globe. Our own country provides a wealth of evidence for the geometric acumen of earlier cultures such as the Hopewellian earthworks of the Ohio area, the Cahokia mounds east of St. Louis, the medicine wheels of the northern Great Plains and the Eastern slopes of the Rocky Mountains, and the sun dagger calendar at Fajada Butte in Chaco Canyon, New Mexico. These and many other sites give us reason to know that more than 2000 years ago our American predecessors were concerned with the movement of the heavens and built a variety of astronomical constructions that indicated their ability to bisect angles and to construct squares, rectangles, circles, octagons, and ellipses. Frequently, their constructions employed a standard unit of measure. That their geometry was not Euclidean does not diminish its importance.

By exploring a variety of human endeavors within their cultural context, the course Multicultural Mathematical Ideas succeeds in emphasizing the universality of mathematics, its intimate connection to the reality of human existence, and the wide spectrum of activities that exists for the expression of mathematics within a culture.

A variety of activities and techniques serve to make the MMI course challenging yet accessible for most students. Journals are an integral part of the course and students are encouraged to reflect daily on their experiences in the course. The journals provide a sensitive barometer of the pace and challenge of the classes. Because this course is so different from any other mathematics course most students have taken, their interest and enthusiasm are very high. This is evident in their journal entries. Small and large group discussions, laboratory experiments, data collection and analysis, projects, videos, guest speakers, readings, and student presentations provide rich classroom experiences. Numerical ratings and written evaluations of this course as well as personal reflections from journals show very favorable responses from students so far.

SUMMARY

Mathematics is an endeavor that has been undertaken by humankind across cultures and throughout history. By looking at the cultural context of many activities with mathematical basis, one can appreciate the importance of mathematics to that particular society. Different cultures express their mathematical ideas in a variety of ways. Looking at how humankind has expressed mathematical ideas gives us an understanding of what it means to be human. The course Multicultural Mathematical Ideas examines a wide spectrum of human endeavors that are the mathematical expression of a culture and that help to create the tapestry of what we call mathematics.

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X-ette

Lee Goldstein

X-ette, you wonder: you've finally acheived
Your friendless paradise, populated only by
These Pythagorean sonances, those Platonic ideas and unnamed symbols,
And surrounded so widely, too, by the crazed transmogrifications,
Whose nebulous trivia you have so deleted of your deftness,
Where to be does not require to be perceived,
These complements of sense, most of whom live daftly amid zeros,
Whilst the dimensionality, itself, rests singly on your shoulders;

adamantine x-ette,
No Hypatia art thee.