

Good-bye pythagoras?

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Abstract:

*In college classes in algebra, calculus, geometry, statistics, and the history of mathematics, among other subjects, and in degree programs for future elementary- and secondary-school teachers, professors are defining a new way of teaching math. They call it **ethnomathematics**--math from a cultural perspective.*

Full Text:

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[Headnote]

'Ethnomathematics' embraces non-European methods of math; critics fear a decline in rigor

Joanna O. Masingila of Syracuse U.: "We're trying to help the teachers make sense of the experiences students bring to school."

AT CALIFORNIA'S Orange Coast College, students in mathematics classes learn about the geometric designs in Navajo rugs when their professor, Eduardo Jesus Arismendi-Pardi, teaches the concept of slope.

Students at Rensselaer Polytechnic Institute use African fractals-patterns that repeat themselves at many different scales-in their computer-graphics simulations for Ron Eglash, an assistant professor of mathematics.

At the Newark campus of Rutgers University, students in teacher-education courses led by Arthur B. Powell work out river-crossing problems based on different cultures in their study of algebra.

And using a cultural analogy that's close to home, Jim Barta teaches his elementary-- education students at Utah State University a new way to think about the Cartesian coordinate system: street mapping in towns settled by Mormons is based on a system much like the one in which positive and negative numbers name intersections of lines.

In college classes in algebra, calculus, geometry, statistics, calculus, and the history of mathematics, among other subjects, and in degree programs for future elementary- and secondary-school teachers, professors are defining a new way of teaching math. They call it ethnomathematics-math from a cultural perspective.

"Every day, more and more pieces of the puzzle are coming together," says Mr. Barta, an assistant professor who is treasurer of the North American chapter of the International Study Group on Ethnomathematics, a support group for people in the field. "We're looking at multiple perspectives to help us better

understand human beings and relationships between being human and mathematics," he says.

Some professors strive to incorporate mathematical methods developed in non-European countries to calculate, measure, reason, and infer, among other things. Others take a broader view and include the practices of anyone--be it African or African-American, Filipino or female, one's neighbor or oneself--under the "ethno" banner.

POLITICALLY CORRECT MATH?

Good-bye Pythagoras? So long Euclid? That's what the critics fear. "I'm all for uncovering mathematical contributions from China or India or Africa or anywhere else, and I do some of that in my teaching," says David Klein, a professor of mathematics at California State University at Northridge. "But when it comes to actually teaching how to do mathematics itself, if the professors are so politically correct that they are reluctant to use Arabic numbers and European theorems and the powerful ideas of mathematics that were developed in the last few centuries in Europe, then it handicaps the students."

Mr. Klein's view is typical of the skeptics: He objects more to professors who take up students' time working out math problems with non-European methods-- even when they do problems the Greek way as well--than to instructors who incorporate the traditions of diverse cultures into their math-history lessons.

What worries critics the most is teacher education, where ethnomathematics is most prevalent. Some people feel that learning the mathematical methods of other cultures is not the best use of children's time, either. Kids must learn a lot in elementary and secondary school to do the higher-level math of college and beyond, they say, and math based on European thinking offers the most efficient, powerful tools. Courses that devote a lot of time to ethnomathematics, some critics believe, steer future teachers in the wrong direction, in essence dumbing down the school curriculum.

But even the most ardent professors of ethnomathematics say they are not trying to replace the great Greek and other European thinkers who have shaped modern mathematics. Instead, they say, they are blending European ideas with African, Asian, Native American, and other mathematical innovations, teaching both European and non-European practices.

And in most cases, they say, they are teaching the same concepts as other math professors, but also giving their students new reasoning skills--and a cultural education to help capture their interest and put the math in context. Call it mathematics with an anthropological bent.

Or, in some cases, math with a social agenda: By showing that math is not just the product of white-male thinking, a number of professors hope to make math more agreeable to nonwhite students and to women.

Or math meets politics: In the words of Ubiratan D'Ambrosio, a Brazilian mathematician who is a founder of ethnomathematics, the movement, which tries to increase respect for other cultures, is nothing less than "a step toward peace."

"Mathematics is absolutely integrated with Western civilization, which conquered and dominated the entire world," Mr. D'Ambrosio wrote in response to an email interview. "The only possibility of building up a planetary civilization depends on restoring the dignity of the losers and, together, winners and losers, moving into the new."

A GROWING MOVEMENT

Most people trace the beginnings of the ethnomathematics movement to a 1984 speech that Mr. D'Ambrosio, now an emeritus professor of mathematics at the State University of Campinas, gave at a conference of the International Congress on Mathematical Education in Australia. Sin after that meeting, a group of mostly American educators organized the international study group of which Mr. Barta is a member. The group's Web site, at <http://www.renselaer.edu/~eglash/isgem.htm>, describes the field and has many links to related resources.

At most institutions, ethnomathematics offerings are still fairly limited. One or two courses taught by one or two professors might include math from this perspective; few faculty members show up when a colleague organizes a talk on the subject. But in California, especially at community colleges, there is a lot of interest in multiplying those numbers.

What started as a talk at a diversity conference Last year has Quickly made Mr. Arismendi-Pardi, an associate professor of mathematics at Orange Coast College, a big name in California community-college circles. Since April 1999, he has given 31 talks on ethnomathematics at conferences and colleges. Last spring, he won a diversity award from the California Community Colleges system for "his innovative approach to teaching mathematical concepts in a cultural and historical context." And the statewide group representing the faculty of California's 147 community colleges passed a resolution applauding the role of ethnomathematics in making the discipline more accessible to a broader group of students.

"At the community-college Level, math is really a gatekeeper," says Mr. Arismendi-Pardi. "Students at the community college will take algebra or trigonometry, and they can't get out of it. They either don't pass it or are turned off by it," and then can't go on to more-advanced math and subjects that require it. "I'm trying to break down these barriers."

Empirical research still needs to be done to find out whether ethnomathematics draws students in, but professors like Mr. Arismendi-Pardi say they have anecdotal evidence that it works.

He moved to the United States from Venezuela in 1978, and has a missionary's zeal for helping other immigrants and people from minority groups succeed. By

describing the contributions of an array of people, including women, to the history of mathematics, he hopes to make the subject more appealing to nonwhites and whites alike. "They feel good about the fact that they see themselves in the subject," he says. "Their eyes light up."

MOVING BEYOND PROOFS

Proofs are not the only road to understanding mathematics, he tells his students. Six hundred years ago, the Incas used an accurate base-10 numeration system to collect important information on community needs. Greek geometry was derived from Egypt, he says; the Shoshone American Indians understood the concept of infinity; the Mayans calculated the orbit of Venus to be 584 days long, and modern astronomers peg it at 583.92 days. The list of achievements by non-Europeans goes on.

Robert N. Proctor, a professor of history at Pennsylvania State University at University Park, who teaches a history-of science course, tells his students that until the Gregorian reform calendar was adopted in 1582, the Mayans had the most accurate calendar in the world, deviating only 17.3 seconds from the calendar we use now.

He believes it is the professor's job to open the world of possibilities to students. "The main thing is to overcome ethnocentrism and the view that the West is the be all and end all in mathematical traditions," he says. "With different world-views, you can come up with different kinds of sciences and different observations."

But some professors, while aligned with ethnomathematics, worry that too much focus on civilizations of the past does little to help today's students identify with the subject. Like their colleagues who talk about the innovations of ancient civilizations, these instructors employ cultural references in their teaching. But they stick to references that have useful applications now, and stay away from stories of longago, faraway civilizations their students can't relate to.

"The folks who call themselves Afrocentric have been focusing on ancient Egypt and saying, 'Well, we've got to realize that ancient Egypt was black and that the pyramids were this crowning achievement of African glory,'" says Mr. Eglash of Rensselaer's department of scienceand-technology studies.

'A VERY SOPHISTICATED MATHEMATICS'

When Mr. Eglash discusses African geometric fractals with college students in his interdisciplinary courses, he shows how they were used long ago, and how they can be employed today.

"When I start presenting fractals in African-American culture, in particular in hairstyle patterns [based on old African designs], suddenly the whole classroom gets electrified," he says. "Here you have fractals, a very sophisticated mathematics that is used in computer-graphics simulations, suddenly being transformed into a bridge back across the middle passage." Rutgers University

Press published Mr. Eglash's book, *African Fractals: Modern Computing and Indigenous Design*, last year.

Ethnomathematics may be creeping into the college curriculum for technology, engineering, mathematics, and science students, but it is already changing the way in which prospective schoolteachers are taught to teach math.

Lawrence H. Shirley, an associate professor of mathematics at Towson University, in Baltimore, says that teacher educators are searching for ways to help their students make math easier to understand and more interesting, especially in the difficult middle-school years.

"If kids don't take the advanced-mathematics courses in high school, then they are going to be underprepared to take the mathematics courses in college," Mr. Shirley says.

He shows his students slides of African textiles and plays mancala games, involving counting and strategy, in his math-history course, which is required of all teacher-education students.

One of his students, Erin K. Grossnickle, says she learned that while other cultures have different ways of computing problems, at the core, the math they use is similar. She plans to utilize some of Mr. Shirley's examples when she is a teacher. "It gives me more opportunities to teach to my students and explain to them how math is all over, not just here-that everyone experiences it," says Ms. Grossnickle.

Some education professors are less interested in methods that expose children to other cultures than they are in helping kids identify mathematical practices from their own cultures.

"When teachers try to bring in multicultural mathematics, it's sort of like the black-history-month phenomenon: You pay attention to this for a certain time," says Joanna O. Masingila, an education professor at Syracuse University. She prefers to think of ethnomathematics as a way of making use of what people do regularly-"the mathematics that are used by people as they go about their daily lives."

Ms. Masingila, a member of the International Study Group on Ethnomathematics, teaches her students to incorporate their students' "out-of-school mathematics" into their lessons. "We're trying to help the teachers make sense of the experiences students bring to school," she says.

So, when her juniors and seniors do their student teaching, they hand out questionnaires to find out about their pupils' interests. One student found a boy in her class who built bicycles, so she was able to introduce ideas about ratio and proportion to her class using an example from his work.

AN EXCUSE TO AVOID MATH

Some people worry that ethnomathematics can provide too much cover for schoolteachers who don't really understand math. "It could undermine the goal of actually providing students a rigorous education in the mathematics itself by giving teachers who are afraid of mathematics an excuse to teach something



other than mathematics," says Alan D. Sokal, a professor of physics at [New York University](#) who does research on mathematical modes that describe situations in physics.

Mr. Sokal says ethnomathematics may be useful in certain circumstances, but it is "not a panacea." He worries that the approaches "don't really address the most serious problem, which is the lack of teachers who have a deep understanding of the mathematics that they're supposed to be teaching, and how to convey that understanding to the students."

Mr. Klein of California State at Northridge says the number of calculus sections on his campus has been cut in half in the last 10 years, because of declining interest and ability. And the students who enroll are weaker, he says, because they did not receive an adequate education in highschool algebra.

Mr. Klein became involved in a parents' education-reform group called Mathematically Correct after being disappointed by his daughter's elementary-school curriculum. In addition, "I wondered what was going on between elementary school and when I see them in calculus," he says.

"The proponents of the programs that cause me to tear my hair out advertise them as being math for all students," he says. "The word 'all,' as far as I can tell, is a code word for minority students and sometimes a code word for women and girls, and the result of this push is really watered-down, weak programs that don't have much arithmetic in them."

Even some advocates of ethnomathematics feel it is time to do serious empirical research to see if the methods really do teach students-at schools and colleges alike-what they need to know.

"We are going to have to step forward and start running the tests and doing the research on it to see if what we're doing is making a difference," says Mr. Barta of Utah State.

Naturally, critics agree. "Strategies that get people drawn in and interested that work and are reasonably efficient in time are fine," says Michael McKeown, a professor of medical science at [Brown University](#) and a cofounder of Mathematically -Correct. "We do need to ask to what extent those draw-in strategies allow us to cover the breadth of material we think students need to know."

Mr. Powell, an associate professor of education and academic foundations at Rutgers, and Marilyn Frankenstein, a professor of applied language and mathematics at the University of Massachusetts at Boston, argue that covering lots of material is not in and of itself a worthy goal.

"We're developing more than just mathematicians in the very strict sense of the word," says Mr. Powell, who edited a collection of essays called *Ethnomathematics: Challenging Eurocentrism in Mathematics Education* (State University of New York Press, 1997) with Ms. Frankenstein. "We are developing critical intellectuals who are scientists who are not only apt in their discipline, but also see the work that they are doing as connected to the society they're in, and see their society as connected to other societies on the planet." Ms. Frankenstein adds that mathematics is about more than equations: "It's about what that equation is going to do to the world."

* Join a debate on the issues raised in this article in the "Colloquy" section of The Chronicle's World Wide Web site at:

Eduardo Jesus Arismendi-Pardi of Orange Coast College: "At the community-college level, math is really a gatekeeper."

<http://chronicle.cam/colloquy>

[Sidebar]

A Sample Problem

Arthur B. Powell, an associate professor of mathematics and mathematics education at the Newark campus of Rutgers University, uses the following "river-crossing problem" to teach a topic within algebra: A man in North Africa must cross a river with a jackal (a predator), a goat (potential prey), and fig leaves (a potential snack for the goat). He has a boat that can hold him and two other items at one time. Neither the jackal and the goat nor the goat and the fig leaves can be left alone together on either shore. How can the man get the jackal, the goat, and the fig leaves across the river?

One solution:

Take the jackal and the goat, leave the jackal while returning with the goat, and then carry across the goat and the fig leaves.

An alternative:

Some say the preceding solution is not efficient. What would be a more efficient solution? The man might carry over the jackal and fig leaves and return for the goat. This may be considered more efficient since in the first solution the goat is carried in all trips; an efficient solution should be concerned not only with the number of trips, but also with the lightest load on each trip. Moreover, the fact that the jackal cannot be alone with the goat and the goat cannot be alone with the fig leaves does not imply that the jackal cannot be alone with the fig leaves.