Multiculturalism in Mathematics: Historical Truth or Political Correctness?

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Introduction

Multiculturalism, cultural relativism, Eurocentrism, political correctness—these are fighting words in academia today. As conservatives clash with liberals over who controls the collegiate curriculum, the fight over multiculturalism is shaping much of educational debate today. With books like Dinesh d'Souza's *Illiberal Education* running up against a growing Afrocentrism movement in academia, the debate has been scorching. As one writer put it in an opinion column in the *Chronicle of Higher Education*, "Multiculturalism has emerged suddenly as a scholarly buzz word, and, with equal speed, has been converted into an epithet."

The term multiculturalism is used in many different ways to encompass many different aspects of teaching and scholarship. Generally, it refers to attempts to acknowledge and investigate the role of all cultures having an influence on a particular field. As it pertains to the collegiate curriculum, multiculturalism has perhaps become most closely identified with attempts to revise the literary canon of humanities courses to include authors from varied ethnic backgrounds. Charging "political correctness," conservative scholars have decried this trend, saying it stifles debate and dilutes the impact of education by including every conceivable viewpoint. Liberals shoot back, saying that traditional curricula have stifled debate for years by giving credence to only Western viewpoints and values.

What does all this have to do with mathematics? Plenty, though the connection might surprise some. Many academic mathematicians would probably have a reaction similar to that of one prominent mathematics professor at a well-known private university, when faced with the term "multiculturalism in mathematics:" "What?! If there's anything that's neutral and independent of culture, that has nothing to do with ethnicity or gender, it's mathematics!" Another mathematician laughed knowingly at the phrase: he had recently been asked by a gay activist group on campus for information on the work of homosexual mathematicians. In fact, it appears that the impact of multiculturalism on collegiate mathematics has for the most part been very small. But, judging from talks presented at conferences, articles appearing in journals, and books being written, it's clear that a multicultural outlook is gaining ground as a way of viewing mathematics.

Discerning the general opinion of this area is difficult, because many in the collegiate mathematical community don't know much about it. The enthusiasm of its proponents is clear, but equally clear is a strong undercurrent of suspicion that many are reluctant to voice. Some of those interviewed for this article who were the most negative about multiculturalism in mathematics would not go on record with their views. Some said that the entire area had not produced worthwhile results but were unwilling to criticize it publicly because they felt that the field was just beginning. Off the record, a few referred negatively to groups who were "just trying to show that everything started in Africa." One critic who also would not be quoted by name had this to say: "It's bad history and bad mathematics tied together with a hefty dose of racism."

Is Mathematics Culture-Free?

The various attempts to connect mathematics with culture have given rise to a wide range of ideas and approaches. Prominent among these is ethnomathematics, a scholarly endeavor, anthropological in spirit, which examines mathematical ideas as they arise in a particular historical, cultural, political, or social context. Often, ethnomathematics is tied to education and pedagogy in the belief that, in order to teach mathematics, one must understand the mathematical knowledge students bring with them from their own cultures. A related area is humanistic mathematics, which attempts to recognize and emphasize the role of intuition, discovery, emotions, and values in the development of mathematics. For the most part, humanistic mathematics has educational goals, but it also connects to ethnomathematics in its emphasis on the human aspect of mathematical ideas. Usually, multiculturalism is understood to refer to educational efforts to broaden the scope of mathematics teaching and learning to encompass mathematical ideas that arise in a range of cultures.

These ways of looking at mathematics immediately run into a big philosophical question: is mathematics culture-independent, or does it have "social fingerprints" from the environment in which it was developed? Most people would agree that the concept embodied by the statement $2+2=4$ has an inherent truth independent of any human uses to which the concept might be put. Unlike other areas of human endeavor, mathematical ideas possess a unique internal consistency. "It is interesting to talk about mathematics as if it were in the same category as art, or philosophy, or social science," points out Reuben Hersh, who is on the mathematics faculty at the University of New Mexico. "In those areas, it's very clear that different countries have different versions and they can even conflict. But mathematics does not conflict from one country to another... When there seems to be a conflict, and the people involved actually communicate, it's straightened out pretty soon. This doesn't happen in sociology and art and so on. So, I think as far as the content of mathematics is concerned... it's pretty objective, in the sense of being culture-independent. However, that isn't necessarily the case for style of presentation in writing and lecturing."

Hersh's colleague and co-author, Philip J. Davis, takes a somewhat different view. Davis, who is on the applied mathematics faculty at Brown University, wrote in the *Humanistic Mathematics Newsletter* that the commonly held Platonic view is that a statement like $2+2=4$ "is perfect in its precision and in its truth, is absolute in its objectivity, is universally interpretable, is eternally valid, and expresses something that must be true in this world and in all possible worlds." He then points out that extending this view beyond simple arithmetic truths is problematic: "the obvious fact [is] that we humans have invented or discovered mathematics, that we have installed mathematics in a variety of places both in the arrangements of our daily lives and in our attempts to understand the physical world... Opposed to the Platonic view is the view that a mathematical experience combines the external world with our interpretation of it, via the particular structure of our brains and senses, and through our interaction with one another as communicating, reasoning being organized into social groups."

The interplay between the facts of mathematics and social forces have clearly influenced the kinds of mathematical questions that get asked. Mathematical historian Judith Grabiner of Pitzer College maintains that the social influences on mathematics have been "immense." "There's been a great deal of interaction between social context and mathematics research," she notes. "That doesn't determine that $2+2=4$, but it does affect the directions of mathematics research." As an example, she points to Huygens' work on the theory of evolutes in curves. "The theory of evolutes comes from his interest in the pendulum clock, and his interest in the clock comes from his interest in the problem of longitudes of ships at sea," she explains. "If Holland had been a land-locked desert nation, I doubt that this problem would have interested him." Mathematics has even been shaped by religious practices. For example, followers of Islam must pray in the direction of Mecca. Not content with praying in a direction that was "vaguely east," the Muslims "took it more precisely, so you need some spherical trigonometry to find out the direction of Mecca... It's a nontrivial mathematical problem, in the context of the eighth and ninth century... There's an example of a religious need that gave rise to a direction of mathematical research."

As a more current example, some argue that research funding applies political pressure to the directions mathematical research takes. "It's not a coincidence that some fields are more heavily funded than others," says Claudia Henrion, a mathematician at Middlebury College who has an interest in women in mathematics and in social and political aspects of the field more generally. "There is a lot of resistance within mathematics to ask those kinds of questions. There's a really strong belief that you can separate the doing of mathematics from social and political issues." "To say that there are no social fingerprints in mathematics defines what are legitimate questions to ask about mathematics," she continues. "And it makes it okay to ask, 'Is Fermat's Last Theorem true?', but not okay to ask, 'Why were certain classes of people excluded from the world of mathematics?'"

Some go a step further and question the cultural neutrality of such underlying notions of Western mathematics as rationalism and abstraction. In "Western Mathematics: The Secret Weapon of Cultural Imperialism" (*Race and Class*, 32 (2) 1990), Alan J. Bishop of the Department of Education at Cambridge University "challenges the myth" that mathematics is "a culturally neutral phenomenon in the otherwise turbulent waters of education and imperialism." To support his argument, he looks at mathematics in trade, administration, and education in countries where the culture of a colonial power was imposed on the indigenous people. He concludes that "western mathematics presents a dehumanized, objectified, ideological world-view" that is at odds with many of the values and modes of thought of other cultures. Noting that Western mathematics is now taught in every country of the world, he remarks that "the cultural imperialism of western mathematics has yet to be fully realized and understood. Gradually, greater understanding of its impact is being acquired, but one must wonder whether its all-pervading influence is now out of control."

Broadening History

Whether mathematics is culture-independent is a question not likely to be definitively resolved. However, most would agree that the investigation and documentation of mathematical ideas arising in other cultures has been a neglected aspect in the history of the development of mathematics. Broadening the history of mathematics to include cultures outside of western Europe is a major goal of ethnomathematics. By most accounts, this term was coined by Ubiratan d'Ambrosio of the Universidade Estadual de Campinas in Brazil. According to d'Ambrosio, ethnomathematics provides a framework for examining the different ways people use mathematical thinking. "Classifying, measuring, estimating, counting, and so on, these are all techniques to understand and cope with reality, and they are found in all cultures that we have records for," he points out. "'Ethno' emphasizes that these ways of explaining and understanding are based on social and cultural roots." D'Ambrosio came to ethnomathematics through studying the history and philosophy of mathematics. But he found the prevailing views "so Eurocentric, as if the only value, the only way of thinking, comes from Europe. I wanted to see history in a broader way." His main concern, he says, "is to make ethnomathematics a scholarly, respected field with all the usual standards of scholarship." One form of recognition came recently when ethnomathematics was placed under the History and Biography section of the 1991 Mathematical Reviews Subject Classification.

Another sign of growth in the field is the formation in 1985 of the International Study Group on Ethnomathematics (ISGEm). ISGEm is mainly concerned with sharing information and fostering collaborations among its members, who are scattered all over the globe. The study group focuses on four main aspects of ethnomathematics: theoretical perspectives, research in culturally diverse environments, out-of-school applications, and curricular and classroom applications. Patrick Scott, a mathematics education professor at the University of New Mexico, is the editor of the ISGEm newsletter. The newsletter is mailed to about 200 people, but it actually has a wider circulation: because there is interest in the newsletter in dollar-poor countries, a number of representatives around the world photocopy the newsletter and send it to colleagues who would have difficulty paying for it. Among the topics covered in the newsletter are ways to use video games to illustrate mathematical topics, a report on ethnomathematical investigations of a wide variety of cultural activities in Mozambique, and an analysis of connections between ethnomathematics and the different "learning styles" of majority and minority students.

Heading ISGEm is Gloria Gilmer, President of Math-Tech, Inc., an educational research and development corporation in Milwaukee. Gilmer does ethnographic research on the mathematical activities of inner-city groups, with the goal of helping these groups make the connection to more abstract mathematical concepts. She sees ethnomathematics as a way of broadening the kinds of activities that are considered to be mathematical. "The question is, is it mathematics if it's not in the form that you ordinarily think of as mathematics?" she asks. "Or are we bent on calling certain things mathematics because of a certain form that we're imposing on the discipline?" The mathematics that most people are familiar with, she notes, is very formal and academic. "We think there is something beyond this, and we would like to call this ethnomathematics."

In contrast to Gilmer's work, some of the research in ethnomathematics is concerned with the mathematical ideas that arise in nonliterate cultures. *Ethnomathematics* (Brooks-Cole, 1991), by Marcia Ascher of the mathematics department at Ithaca College, is a good introduction to this aspect of the field. The book has been recognized for its careful scholarship and its wide range of subject matter. She writes that "Ethnomathematics, as it is being addressed here, has the goal of broadening the history of mathematics to one that has a multicultural, global perspective." To work toward this goal, Ascher focuses on several different instances in which mathematical ideas arise in the traditions of nonliterate cultures.

The mathematical constructs she discusses are remarkably sophisticated. For example, she investigates the sand tracing tradition among the Malekula of the New Hebrides. In the Malekulan mythology of death, these sand tracings play an important part in reaching the Land of the Dead, and it turns out that the tracings they do are Eulerian paths, the same graph-theoretic construction as found in the famous problem of the seven Königsberg bridges. Similar sand tracings can also be found among the Bushoong of Zaire and the Tshokwe of Central Africa. Another section of the book focuses on certain indigenous Australian groups in which kinship relations are organized using a dihedral group of order eight. Games of chance and strategy are analyzed, including what Philip Morrison, in a laudatory review of the book in *Scientific American*, calls a "kind of hyperbackgammon played with counters on an eight-pointed star."

Is Traditional History Eurocentric?

Some mathematical historians have worked on understanding the mathematics of other cultures but do not refer to their work as ethnomathematics. For example, David Pingree, a mathematical historian at Brown University, has built upon the work of Otto Neugebauer and others in ancient mathematical astronomy. Pingree agrees with the proponents of ethnomathematics that much of the traditional history has been "Eurocentric" in taking Greece as the starting point of all of mathematics. For example, he says that the development of trigonometry, commonly attributed to Western mathematics, actually has a circuitous history beginning with what's known as the "chord function," used by Ptolemy in the second century for problems in mathematical astronomy. The sine and cosine functions were developed from the chord function in India and were transmitted to the Babylonians, who in the ninth, tenth, and eleventh centuries developed ways of computing with the functions, thereby laying the foundation for Renaissance trigonometry. In fact, he says, transmission of Arabic mathematics through Muslim Spain was a major route by which mathematical ideas entered Europe.

In reading ancient mathematical texts in their original languages, such as Cuneiform and Sanskrit, Pingree says he finds many different ways of doing science and mathematics that developed in response to the needs of various cultures. "Material was transmitted over and over again from one culture to another and reworked into something new—it's a very complex history," he says. "What we're dealing with is not some kind of simple contrast between Babylonian and Greek mathematics... While [various cultures] influenced each other, the mathematical learning that each received from the other was reshaped to fit the needs of the society that received it." It is important to understand the mathematics in its cultural context, he says. "One should simply sit down and try to figure out what, say, Indian mathematicians were doing in terms of what they were trying to do and what they achieved," he says. "And this is remarkable enough, one doesn't have to compare it to Western mathematics."

However, Pingree says, some attempts to investigate the mathematics of other cultures have, paradoxically, held Western mathematics as the ultimate yardstick against which other contributions are measured. For example, he points out that the Indian mathematician Mādhava discovered the infinite series for the sine, cosine, and tangent functions around

1400, centuries before Gregory, the European mathematician generally credited with the discovery. Mādhava's demonstration was not completely rigorous by today's mathematical standards, but it was nonetheless quite correct. (In fact, Pingree says that some of his colleagues in the Brown mathematics department use Mādhava's demonstration in their classes because its geometric approach is more intuitive.) Pingree says that some Indian scholars have renamed the series as the Mādhava-Gregory series. "They're simply using the name, I don't begrudge them that," he says. "But in a sense this implies that Mādhava's understanding of the series was the same as Gregory's, which is not true. And there are other Indian scholars who will go whole hog and talk about how Mādhava discovered the calculus. This is simply false."

This kind of viewpoint, says Pingree, implies that scientific or mathematical developments have value and interest only if they can be related to something in Western culture. "This is one of the terrible things that I think is prevalent in many countries where the cultures have been overwhelmed by the impact of the West," he notes. "And some of the people who are affected by this respond by trying to claim their culture was within it the terms of Western science." In addition, he notes that such scholars often emphasize only those ideas that supported Western science, while ignoring later results that went in other directions.

As a result, Pingree is quite skeptical of attempts to multiculturalize mathematics history, which he believes are often motivated by political aims. For example, he serves on a committee of the Third World Academy of Sciences that gives a prize for an article on the history of science in the Third World. He says submissions by Third World writers have never received the prize because their work is generally written with a "nationalistic" viewpoint. These kinds of writings, he says, try "to prove the superiority of their culture by claiming that it pre-dates Western science. If that is their basis for their feeling good about their culture, that's a very sad comment on the total destruction of that culture."

Connections to Education

In the area of mathematics education, multiculturalism has had an influence primarily at the school level; the impact on collegiate-level teaching and curricula has generally been very small. For one thing, from calculus onward, the courses all concern mathematics as it developed in the West. However, some faculty are incorporating ideas of multiculturalism into certain courses, primarily those on the history of mathematics.

For example, Claudia Henrion of Middlebury College teaches a history of mathematics course with an emphasis on connections to social and cultural questions. The first part of the course looks at the history of "mathematical people"—who went into the field of mathematics and why, what their lives were like, and how their social environment influenced them. The second part of the course focuses on the relationship between mathematics and culture by looking at African, Egyptian, Babylonian, Greek, Chinese, Indian, and Muslim mathematics. Henrion says that looking at the mathematics that developed in different cultural contexts is "useful in seeing how mathematics is not the same in different cultures, and in trying to understand the relationship between the values of a society and the kinds of mathematics they choose to develop." The third part of the course brings together ideas developed in the first two parts to examine the history of geometry.

Out of this course grew an idea for a regional conference in New England, to be held in June 1993, on mathematics as a human activity. Henrion says that the purpose of the conference is to bring together mathematics professors to "talk about how to add the 'hidden' dimension of mathematics to their course in different ways and to understand the relationship between people and mathematics, and culture and mathematics." In addition, the conference will look at parallels between mathematics and the humanities and the implications these kinds of ideas hold for mathematical pedagogy.

At Ithaca College, Marcia Ascher has developed a course for upper freshmen to seniors in any major; she says she has had students who range from typical "math-avoiders" to seniors majoring in mathematics and physics. Her book *Ethnomathematics* contains many of the topics and ideas she covers in her course. For example, one topic is strip patterns, which are repeating decorative patterns that run over a two-dimensional strip of fixed width. The students first pick a basic repeating unit and generate their own strip patterns, and then they work on a project to find and analyze strip patterns in other cultures. Some interesting group theory comes into play here, because it turns out that all strip patterns can be analyzed using seven symmetry groups. Ascher says that the students gain an aesthetic appreciation in delving into both the beauty of the patterns and their internal logic. "We have a mathematical abstraction of symmetry groups from strip patterns," she notes. The project allows the students to see "these diverse expressions of mathematical abstraction in human settings."

One indication that these kinds of ideas are gaining ground in the mathematical community is the development of the Humanistic Mathematics Network, run by Alvin White of the mathematics department at Harvey Mudd College. The Network's main activities are organizing of sessions at national meetings and publication of a newsletter, which began in 1987 with a grant from Exxon Education Foundation. The Network has served as an umbrella for all kinds of discussions—from ethnomathematics, to the philosophy of mathematics, to ethical questions, to women in mathematics. Judging from the articles in the newsletter, there is a great deal of interest in the mathematical community in finding ways to emphasize the human aspects of mathematics as a means of connecting students to the mathematics they're learning. Some of the activity of the Network has centered on multiculturalism and ethnomathematics as a way to do this.

Although multiculturalism is often seen as a way to bring in students from groups traditionally under-represented in mathematics, it is interesting to note that many of the nationally-known programs to promote the achievement of minority students in mathematics have no explicit multicultural aspects. The Alliance to Involve Minorities in Mathematics at Mathematical Sciences Education Board of the National Research Council, headed by Beverly Anderson, professor of mathematics at the University of the District of Columbia; the Quality Education for Minorities Network, headed by Shirley McBay, a mathematician and former dean of student affairs at MIT; the Dana Center for Science and Mathematics Education, headed by Uri Treisman, professor of mathematics at the University of Texas at Austin; the TexPREP program, headed by Manuel Berriozábal, professor of mathematics at the University of Texas at San Antonio; the SUMMA program at the Mathematical Association of America, headed by William Hawkins, professor of mathematics at the University of the District of Columbia—all of these programs emphasize the importance of role models, support mechanisms, intellectual challenges, high-quality instruction, and hard work, but do not specifically embrace multiculturalism as a major aspect of what they do.

Berriozábal probably reflects the thinking of many of these programs when he says that mathematics is an intellectual challenge that "requires persistence, interest, and hard work." Because he teaches mostly Hispanic students, he says it is "fair, right, and appropriate" to bring in references to the achievements of such indigenous peoples as the Aztecs and the Mayans, "to give students an appreciation of the mathematics of other cultures." In European civilizations, technology did grow faster than in other places, he points out. But "today, in the civilizations we're living in, Hispanic and African-American youngsters are part of our civilization and there is no reason to think they can't be contributors." It's important to be inclusive of various groups, "but, as far as becoming a mathematician, there is nothing that substitutes for hard work and achievement."

An Integrated Approach

One of the few examples where culture, history, and heritage are woven into mathematics teaching at the collegiate level is found at Clark Atlanta University, a Historically Black Institution in Atlanta, Georgia. The driving force behind this effort is Abdulalim Shabazz, chair of the mathematics department at Clark Atlanta. "We live in a society that believes that heredity plays a part in who is going to be on the top and who is going to be on the bottom," Shabazz notes. "I say that's hogwash, that's nonsense." He says the common perception is that most students cannot excel in advanced levels of mathematics and that, in particular, "African-Americans, Hispanic-Americans, and Native-Americans are not expected to excel in mathematics. Now those perceptions, I let my students and my colleagues know, are false... Everyone who has the desire and who has the spirit of work, hard work, can reach high levels of achievement in the mathematical sciences."

Shabazz tries to create in the department an environment of cooperative learning, discussion, and debate. From what he describes, there seems to be a great deal of enthusiasm for mathematics among the students. He says that a visitor coming to the mathematics building would find that "we don't have the kinds of space, we don't have the materials that others have," he says. "But the students are studying, doing mathematics all around the hallways... We don't have lounges, so we have transformed the hallways into tutorials and places of discussion for mathematics and mathematical debate."

Telling students about the contributions their ancestors made to mathematics is an important component of Shabazz's approach. The objective is to "let them know that in their past, in their history, in their heritage, they have achieved greatness in the mathematical sciences," he declares. "In doing this, I simply tell them the truth. The origins of the mathematical sciences are to be found in Africa." He says he does not espouse an Afrocentric position, but rather a "truth-centric" position. "For example, in the Eurocentric teaching, they speak about mathematics beginning with the Greeks, which is not true," he says. "The Greeks were educated in Africa. And it was from Africa that Thales and Pythagoras and Oenipides and Democritus and Euxodus and Plato—all of these people came to get knowledge, and then of course it spread into the European continent. Euclid, who was an African, born in Africa, never left Africa, is always painted as a European... And Hypatia, an African woman [mathematician]... I've seen some pictures of her, and they have her looking like a European. In some cases, she looks like a Hollywood starlet! She was born in Africa, never left Africa."

Shabazz says this approach makes a big difference to his students, because the prevailing messages are that Black people played no part whatsoever in the development of mathematics. "It has to do with the question of self-esteem," he says. "In teaching students, you have to keep their self-esteem intact... I tell them, remember, your forefathers were the ones that built the pyramids, who put the Sphinx out there on the desert, in Egypt. Not only there, but you have pyramids in this hemisphere, the Americas... And then show them, by the existence of the huge African heads that have been found throughout various places in Central America, that Africans were traveling back and forth across the Atlantic long before Columbus ever dreamed of sailing the ocean blue."

This is Shabazz's second time teaching at Clark Atlanta University—he taught there from 1957 to 1963, returning in 1986 after nearly two decades as an Islamic preacher and four years as a mathematics professor at the University of Mecca. During his first period at Clark Atlanta, he produced impressive results—the department awarded 109 master's degrees in mathematics to Black students. Over a third of them went on to get doctorates in mathematics or mathematics education, and many of them in turn produced other Black Ph.D.s in mathematics. He reports that there have been estimates that approximately one-half of the estimated 200 Black mathematicians in the U.S. were either students of his or students of his students.

Why Multiculturalism?

Why introduce students to the mathematics of other cultures? Claudia Zaslavsky, a mathematics educator whose 1973 book *Africa Counts* has become a classic of ethnomathematics, provides a cogent summary of the various reasons in an article in the ISGEm newsletter: "[Students] learn that mathematical practices arose out of the real needs and desires of all societies. Mathematics comes alive when children study the measurement and numeration systems, the patterns in art and architecture, the games of skill and games of chance of various cultures. Students have the opportunity to learn about mathematical contributions of women and of Third World societies, a generally neglected area of mathematics. They can take pride in their own heritage, and at the same time become familiar with and learn to respect the cultures of other societies."

Most who work in ethnomathematics see these educational dimensions as important. In writing *Ethnomathematics*, Ascher says she was not motivated primarily by educational concerns, but she believes her work can function as an educational tool. "My concern really is to enlarge the vision of mathematics for mathematicians and for students they teach so that it does have a global perspective," she notes. "When you look in math history books... non-Western peoples, if they appear, usually appear in an aside or as basically trivial... There is no question that if the only place you see yourself in mathematics is in some quaint story about how Africans can't count to two or something, it's not a very friendly greeting."

"It's clear that some of the problems in schools are not a question of method or curriculum, but occur because of cultural distance between what we want to teach and the student," notes d'Ambrosio. "Ethnomathematics is trying to bridge this gap." He says that he has given talks in many different countries, and his message is well-received because many people are recognizing that the current mathematics educational practices are producing disappointing results. "The students are smart, but why do they react so badly to mathematics?" he asks. "It's because they find there is no cultural appeal to it. They find it remote from their own concerns and their cultural environment."

Understanding and connecting to this environment is an important aspect in teaching mathematics, says Gilmer, noting that teachers must provide a context for mathematics that engages students. "The context engages them, and when they are engaged, they think," she declares. "Some problems don't engage them, they're not interested... We have a lot of sterile problems, like 'add these monomials.' Well, [the students] get all kinds of weird answers on that because it doesn't mean anything to them." Because of the range and breadth of mathematics, one can always find problems that will engage students, she says. "To me, mathematics is extraordinarily flexible. The context of the problem can always be shifted. Mathematics interfaces with ordinary life in so many ways, we don't have to be stilted in formulating problems for students."

Often, introducing multicultural elements is intended to produce a "cultural reaffirmation" among the students. Patrick Scott of the University of New Mexico worked in Guatemala with Mayan children in a program intended to bring elements from the indigenous culture into teaching mathematics. "One purpose of using Mayan mathematics with Mayan children isn't so much the content of the mathematics as it is a cultural reaffirmation to make them feel good about themselves and their ability to learn mathematics and their own culture's contribution to mathematics," he explains. "Often, with the Eurocentric emphasis that there has been in mathematics, students get the impression that mathematics is something of the white man, that only the white man developed it and only the white man can use it... And then, I think that, for students from any culture, it can be both entertaining and edifying to see what mathematics has been developed in other cultures."

Judith Grabiner of Pitzer College agrees with this general viewpoint. For example, she says that she told a precalculus class that Medieval Islam made important contributions to the development of algebra and that the word algorithm comes from the name of a 9th-century Islamic mathematician, al-Khwarizmi. At the end of the course, one Black student signed his course evaluation and thanked Grabiner for refuting the myth that all mathematics was created by white Europeans. Such details "tell the students, this is yours too," she notes. "It's not that they can't learn mathematics in the traditional way. But you can make the classroom a friendlier place... It gives the students a sense of shared heritage."

However, Grabiner is quick to point out the importance of providing accurate information. "There is a danger in ethnomathematics of getting things wrong and saying that people have done things they haven't," she explains. For example, "it is important to know that the Babylonians knew of and used the fact that the sum of the squares of two legs of a right triangle is equal to the square of its hypotenuse." She says that some have claimed it's wrong to label this fact as the Pythagorean Theorem. But there is a good reason for the name, she declares: "The Pythagoreans proved it logically." "It's important to be accurate," she says. "The wonderful things people have created are already great, and it doesn't do anybody any good to exaggerate."

Some multiculturalization efforts have been criticized on exactly these grounds. For example, one document that has come under fire for inaccuracies is the "African-American Baseline Essays," compiled for the public schools in Portland, Oregon; these essays have also been used in other school systems, including Atlanta, Detroit, and Washington, DC. There are six essays on art, language arts, music, social science, science, and mathematics. The essays are intended to provide information about the history, culture, and contributions of Africans and African-Americans and are to be used by teachers and other educational staff as a reference and resource in developing curricula and classroom materials.

The science essay has been heavily criticized for inaccuracies and for containing a great deal of material that ordinarily wouldn't be considered science at all, such as descriptions of Egyptian religious beliefs. The essay claims that Egyptians used parapsychology as a scientific method and constructed gliders that they flew in for travel, expeditions, and recreation—the *Guinness Book of World Records* is cited to support the latter claim. In addition, the essay claims that Egyptian physicians treated "trans-material" aspects of illnesses by transferring "[energy] which they received from the Pharaoh, who in turn received his [energy] from the sun, to the patient." The mathematics essay does not contain these kinds of obvious problems and does not seem to have been the subject of criticism. However, it does contain some statements that many historians disagree with, such as that Euclid was born and lived his entire life in Africa and that there is "no logical reason" for the appellation "Pythagorean Theorem."

For all the efforts to connect mathematics to culture, a paradox remains: mathematics is often found to be the academic area in which students from non-Western cultures excel, precisely because it requires so little understanding of the culture in which it is taught. Donald Crowe, a mathematician at the University of Wisconsin at Madison, has done research applying the tools of crystallography to study symmetries in patterns arising in archeological and anthropological situations, so he has some understanding of the mathematics that arises in different cultures. In the 1960s he taught at a university in Nigeria where he says "we were basically imposing an English curriculum on this Nigerian situation." The students had trouble, for example, with botany, since the textbooks discussed English plant life. But in mathematics, he said, the students did just fine. "If you're going to read Jane Austen, you have to know about the culture," he remarks. "But if you're going to prove theorems in group theory, you don't have to know anything about the culture. You have to know the axioms of the proof, and any intelligent person can learn those. And there was no question that these students were intelligent."

Despite this example, Crowe says he believes that introducing elements of the mathematics of other cultures can be valuable in stimulating students' interest in mathematics. Others are more skeptical. For example, Diane Ravitch, who is now Assistant Secretary for the Office of Educational Research and Improvement in the U.S. Department of Education, has been a harsh critic of multiculturalism in all academic areas. In her article "Multiculturalism: E Pluribus Plures" (*Key Reporter*, Autumn 1990), she argues that injecting multiculturalism into mathematics education would be disastrous at a time when educators are struggling to revise the mathematics curriculum. "If, as seems likely, ancient mathematics is taught mainly to minority children, the gap between them and middle-class white children is apt to grow," she writes. "It is worth noting that children in Korea, who score highest in mathematics on international assessments, do not study ancient Korean mathematics... We might reflect, too, on how little social prestige has been accorded in this country to immigrants from Greece and Italy, even though the achievements of their ancestors were at the heart of the classical curriculum."

George E. Andrews, professor of mathematics at Pennsylvania State University, is also unconvinced by claims that multiculturalism will help students of diverse ethnic backgrounds excel in mathematics. He believes that the "replacement of human beings by political stereotypes" underlies much of multiculturalism. "There is very little humanity in it," he asserts. "There is a view that there are the 'ins' and the 'outs,' and the important thing to do is to make sure that the 'ins' pay for their past sins, and the 'outs' are 'empowered.'" He doesn't see much to be gained in showing mathematics students the contributions that their ethnic group made to mathematics. "[This] is basically saying to the kids, you're smart because somebody who has been long dead and who is related to you was smart," he says. For example, "the suggestion that I would believe that because Newton and I have the same sex organs, I am somehow ennobled, is one of the most ridiculous ideas that I can possibly imagine. And perpetrating nonsense like this on innocent children seems to me just pathetic." He says this approach also leads to a paradoxical situation: "If, unfortunately, in your ethnic group, we're not able to find anybody back there who did anything, then you're stuck."

Andrews is also suspicious of multiculturalists' aims of promoting self-esteem among students. He points to a report in *Time* magazine about an international comparison of mathematical ability, in which Korean 13-year-olds placed first and the United States last. On a "self-esteem" question, which asked the students to say "yes" or "no" to the statement, "I am good at mathematics," the American students placed first, with 68% saying "yes," while the Korean students placed last, with just 23% saying "yes." "What the proponents of multicultural education believe is that if you promote self-esteem, you somehow promote education," he declares. In this study, "the people who really are educated come in dead last on the self-esteem question, whereas we, who have been preaching self-esteem from kindergarten through grade twelve—and now hope to perpetrate it on the universities—have absolutely mountains of self-esteem but we don't know how to do mathematics."

The sharp differences in opinion about multiculturalism aren't softened by any hard evidence—it would be impossible to devise a conclusive test of whether students learn better when culture is taken into account. Still, the arguments put forth in support of multiculturalism are persuasive to many, and, in some cases, there seem to be indications that multiculturalism can be a way to interest more students in mathematics. And, amid national dissatisfaction with how little mathematics young people are learning, the goal of bringing mathematical understanding to a wider range of students has a good deal of political force to it.

Will multiculturalism eventually have an impact on collegiate mathematics? Before that happens, mathematics faculty would have to drastically change their thinking. "I personally find ethnomathematics interesting and potentially important. But I think most mathematicians find the whole thing uninteresting and annoying," says Reuben Hersh of the University of New Mexico. "They don't want to hear about it. The idea that they would have to know about mathematics in Africa before Euclid and explain it seems very alien and unimportant. But I suppose that if it is politically important, they'll have to do it—someone will tell them they must." Wouldn't that raise a controversy? "Well, there already is a controversy. The only thing is, the controversy... has not reached a level where people have to pay attention to it."

Appendix: Reading List

The following list of readings related to multiculturalism, ethnomathematics, and the contributions to mathematics of non-European cultures was prepared by Dr. Florence Fasanelli of the Mathematical Association of America.

Ascher, Marcia. *Ethnomathematics: A Multicultural View of Mathematical Ideas.* Pacific Grove, CA: Brooks/Cole, 1991.

An excellent detailed consideration of the mathematical ideas of people in traditional cultures. Each chapter in this 200-page volume contains notes with extensive annotated references.

Bedine, Silvio A. *The Life of Benjamin Banneker.* Rancho Cordova, CA: Landmark Enterprises, 1972.

The definitive biography of the first Black man of science in the USA.

Berggren, J.L. *Episodes in the Mathematics of Medieval Islam.* New York: Springer-Verlag, 1986.

Very readable survey of medieval Arabic mathematics.

Bos, H.J.M. and Mehrtens, H. "The interactions of mathematics and society in history: Some exploratory remarks." *Historia Mathematica*, 4 (1977) 7–30.

Arguments for studying the social history of mathematics.

Closs, Michael P. (Ed.). *Native American Mathematics.* Austin, TX: University of Texas Press, 1986.

Recent research on early mathematics in the Americas.

D'Ambrosio, Ubiritan. "Ethnomathematics and its place in the history and pedagogy of mathematics." *For The Learning of Mathematics*, 5 (1985) 44–48.

D'Ambrosio, Ubiritan. "Ethnomathematics: A research program in the history of ideas and of cognition." *ISGEm Newsletter*, 4 (1988) 5–8.

D'Amborsio, Ubiritan. *Socio-Cultural Bases for Mathematics Education.* Brazil: UNICAMP, 1985.

D'Ambrosio, the father of ethnomathematics, has written numerous articles and books on its different aspects, some of which are in English. Each of the references listed here contain bibliographies of some of his other writings.

Grabiner, Judith. "The centrality of mathematics in the history of Western thought." *Mathematics Magazine*, 61 (1988) 220–230.

An excellent presentation of the relationship between Western mathematics and Western thought.

Joseph, George. *Crest of the Peacock: The Non-European Roots of Mathematics.* New York: St. Martin's Press, 1991.

The best elementary study of Chinese, Islamic, and Indian mathematics available.

Lumpkin, Beatrice. *Senefer and Hatshepsut.* Chicago, IL: DuSable Museum Press, 1983.

A tale of how to teach young children by using ancient Egyptian unit fractions.

Morrison, Philip. "Book Reviews." *Scientific American*, 8 (1991) 108.

A review of Ascher's *Ethnomathematics* stating some of its principles with noteworthy clarity.

Swetz, Frank J. and Kao, T.I. *Was Pythagoras Chinese?* Philadelphia, PA: Pennsylvania University Press; and Washington, DC: National Council of Teachers of Mathematics, 1977.

Zaslavsky, Claudia. *Africa Counts: Number and Pattern in African Culture.* Boston, MA: Prindle, Weber, and Schmidt, 1973.

The hardcover edition is out of print but fortunately this classic is available in paperback through Lawrence Hill Books, Brooklyn, NY 11238.

NEWSLETTERS

The newsletters listed below regularly contain articles on multiculturalism as well as bibliographies, book reviews, articles, recent research, and announcements of national and international meetings.

Humanistic Mathematics Network Newsletter. (1987–) Alvin White (Ed.). Harvey Mudd College, Claremont, CA, 91711.

ISGEm Newsletter: International Study Group on Ethnomathematics. (1985–) Patrick Scott (Ed.). College of Education, University of New Mexico, Albuquerque, NM, 78131.

International Study Group on the Relations Between the History and Pedagogy of Mathematics Newsletter. (1973–) Victor Katz (Ed.). Department of Mathematics, University of the District of Columbia, 4200 Connecticut Avenue NW, Washington, DC 20008.

AMUCHMA Newsletter: The African Mathematical Union Commission on the History of African Mathematics. Paulus Gerdes (Ed.). Faculty of Mathematics, Higher Pedagogical Institute, C.P. 3276, Maputo, Mozambique.