

## Ethnomathematics

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Ethnomathematics is the study of the relationship between mathematics and culture. It examines a diverse range of ideas including mathematical models, numeric practices, quantifiers, measurements, calculations, and patterns found in culture, as well as education policies and pedagogy regarding mathematics education. “The goal of ethnomathematics is to contribute both to the understanding of culture and the understanding of mathematics, but mainly to appreciating the connections between the two” (D’ambrosio, 1999, p. 146). Ethnomathematics is a new inclusive, pluralistic perspective of mathematics, in this case referring to a great range of numeric traditions and thought beyond that of those practiced in the Western or modern school systems and circulated by professional mathematicians and academics.

### Cultural Mathematics or Mathematical Cultures: Permissible Paradigms?

Mathematics as the culture-free or culture-neutral intellectual contribution of Western civilization was first challenged by the twentieth-century scholars attempting to conceive of mathematics within its cultural context and rewrite what had become a single dominant unilateral history of mathematics. Paulus Gerdes identifies the French psychologist who explored the social origins of mathematics, G. Luquet (1928), and the German mathematician, ethnologist, and pedagogue who had reflected extensively on early mathematical thinking, E. Fettweis, as the first forerunners of ethnomathematics (Gerdes, 1995, p. 19). In 1938 O’Raum is credited as the first scholar to challenge the colonial aims and legacy of mathematics education in Africa (particularly South Africa and current-day Tanzania), proposing a new model of arithmetic based on the students’ tribal context and knowledge base (see Raum, 1938). The scholars R. L. Wilder and Leslie A. White shared a concern with the anthropological explorations of mathematics, which Wilder presented at the International Congress of Mathematicians in Cambridge, Massachusetts, in 1950 and White in his 1947 publication “The Locus of Mathematical Reality.” The mathematician Morris Kline was also one of the initial scholars to establish the connection between mathematics and culture in his 1953 work *Mathematics in Western Culture*, soon followed by *Mathematics: A Cultural Approach* (1962) which also examined non-Western mathematical cultures and methods.

This new perspective on and exploration of mathematics as a cultural product derived from the anthropological ideas regarding culture that emerged in the twentieth century. In his conference presentation (1950), Wilder highlights that it is very uncommon to discuss mathematics in relation to man and his environment in a moment in which the inwardly directed studies of psychology and anthropology had just recently started to gain recognition in the academic world. The conflict (which can trace its origins as far back as the internalist/externalist divide between Aristotle and Plato) impinged on whether or not mathematics was a divine revelation existing outside of man and meant to be discovered or an intellectual exercise existing inside of man and meant to be invented. Whether invention or discovery, mathematics insights were believed to be either a product of one’s own

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understanding or of divine design, thus neglecting cultural influence. Leslie White, however, is the first to study both arguments of this debate in order to show that culture is ultimately the generator of all mathematical knowledge. Based on Durkheim's discussion of the relation between "collective consciousness" (i.e., culture) and the human mind, White demonstrates that since mathematics is both outside "man" (conceived as the individual organism) and inside "man" (conceived as the human species), it can be located in no other place but culture – culture being both a man-made construct as well as a mode of life informing all human action.

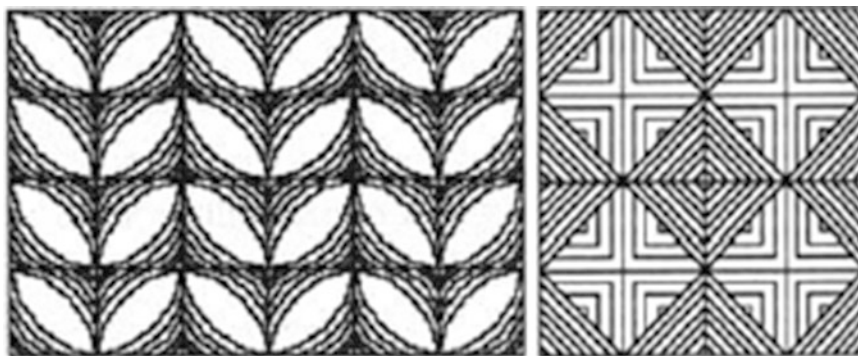
## The Beginnings of Ethnomathematics

These diverse cultural studies of mathematics were further promoted when they were formally considered part of a new social and intellectual ethnomathematical program as introduced by Ubiratan D'Ambrosio in 1977 during a presentation for the American Association for the Advancement of Science. D'Ambrosio is a mathematician and educator from Brazil who has strongly advocated for a more dynamic and multifaceted practice of mathematics. D'Ambrosio's thinking is strongly influenced by fellow Brazilian intellectual and educator Paulo Freire who promoted a *conscientização* that would allow for a more humanistic education stemming from students' personal experiences and appropriate to their own individual circumstances, making education as a matter of social justice and a means for students to have dialogue, develop consciousness, and politicize (*Pedagogia del Oprimido*). D'Ambrosio applied the principles of *conscientização* in order to appropriate the mathematics practices that have become repressed by Western history and its representation of mathematics. D'Ambrosio even goes as far to say that ethnomathematics serves as a step towards peace: "Mathematics is absolutely integrated with Western civilization, which conquered and dominated the entire world. 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. [Ethnomathematics, then, is] a step towards peace" (Greene, 2000).

## Trends in Ethnomathematics: Case Studies and Pedagogy

There are currently two trends within ethnomathematics research: a) the investigation of mathematics practices as cultural constructs of "other" societies (as opposed in some way to Western academic mathematics) and b) the political discussions of mathematics pedagogy, autonomy, and implementation in different cultural contexts. This numeric "otherness" has taken various forms, which Gerdes has extensively categorized as indigenous mathematics, sociomathematics, informal mathematics, mathematics in the (African) sociocultural environment, spontaneous mathematics, oral mathematics, oppressed mathematics, nonstandard mathematics, hidden or frozen mathematics, folk mathematics, and mathematics codified in know-hows (Gerdes, 1995, pp. 19–20). Scholars maintain that these particular expressions of mathematical thought have been systematically excluded from formal, academic mathematics but nonetheless abide by the same numerical principles that unite all forms of mathematical expression and merit investigation.

These studies tend to be anthropological or ethnographic in nature, relying on field study, artifacts, and description to determine how numbers are used and valued by cultural groups somehow designated as outside the Western world. Ethnomathematicians generally accept that the discipline is more creative in its methodological approach, going beyond the limits of history and integrating insights from the fields of anthropology, archeology, literature, linguistics, education, and others.



**Fig. 1** *Liteima* wall patterns (Lesotho). Geometrical shapes and symmetry are common topics of study in ethnomathematics (Image by Paulus Gerdes)

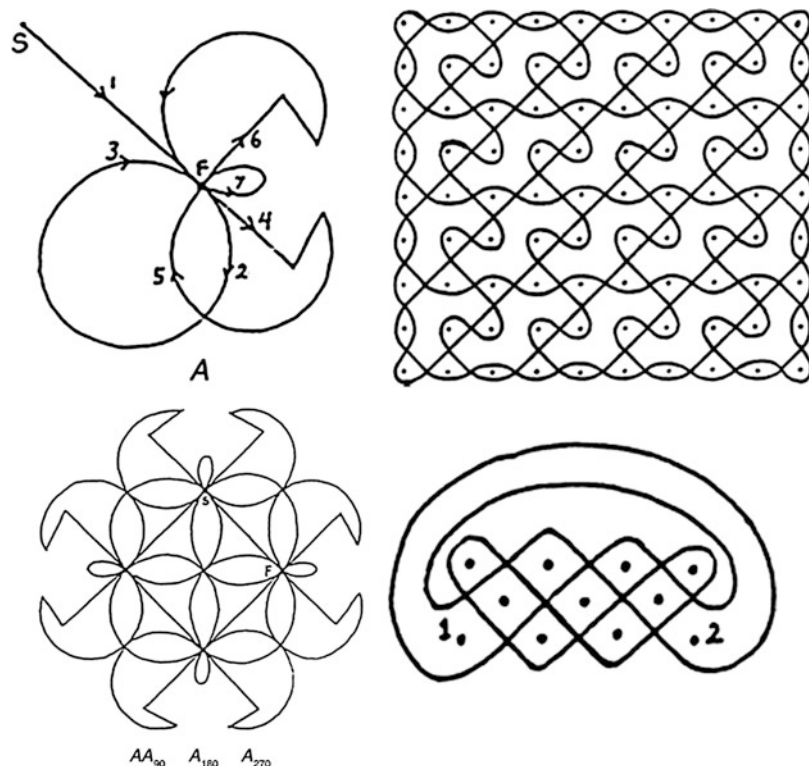
One of the first studies of another culture's mathematics through an anthropological lens is that of Claudia Zaslavsky. After travelling to Tanzania and encountering local mathematics practices, this teacher from New York decided to publish what she stated to be the first "analysis of African culture from the mathematical point of view": *Africa Counts: Number and Pattern in African Culture*. Since this initial study, the last forty years of scholarship has seen a blossoming of anthropological investigations regarding mathematics practices in diverse contexts. The ethnomathematician Marcia Ascher published many collections on diverse mathematical practices around the globe and her work entitled *Mathematics Elsewhere: An Exploration of Ideas across Cultures* exemplifies the main topics and geographic locations discussed in the field, including studies of divination, timekeeping, maps, relationship systems, and models in diverse locations such as the Pacific Islands, Nigeria, Madagascar, and India (Fig. 1).

The political and pedagogical trend of ethnomathematics stems from a conscious protest against the colonial structures that imposed and maintained Eurocentric values and number systems. This process involves a recovery of the third world practices denied credibility and space in the public realm. The pedagogical discussions of ethnomathematics operate under the premise that Western mathematics practices have not and are not always the easiest way for a group of people to learn and understand numbers. In addition, these same standardized practices may not address each student's daily needs or particular value systems in regard to counting and calculating. Because the way mathematics is presented to the youth of any culture dictates how mathematics will be used in societal relationships of that very same culture, many scholars are interested in finally scrutinizing the present state of mathematics education in light of its societal implications.

Alan J. Bishop's study *Mathematical Enculturation: A Cultural Perspective on Mathematics Education* (1988) was one of the most extensive projects examining the connection between culture and mathematics education. This publication is often cited as the source that proposes six universal numeric activities in which all cultures engage: counting, measuring, locating, explaining, designing, and playing. Bishop considers this project a social project and promotes "the kind of mathematical education which will enable that cultural force [of Western civilization as explored by Kline] to be recognized, absorbed, but also evaluated" (Bishop, 6) (Fig. 2).

## Future Collaborations and Resources

The International Study Group on Ethnomathematics (ISGEM) (<http://isgem.rpi.edu/>) was created in 1985 to actively discuss and promote ethnomathematics research. Eventually the North American



**Fig. 2** Malekula and Tshokwe sand tracings. Sand tracings are found in many cultures and are connected to ideas of graph theory, geometry, and topology (Image by Marcia Ascher)



**Fig. 3** Gran Bretaña School, Lima, Perú. 5th graders participating in an ethnomathematics seminar organized by author (Photo by author)

Study Group on Ethnomathematics (NASGEM) (<http://nasgem.rpi.edu/>) was created as an offshoot of the international group and founded the online *Journal of Mathematics and Culture* which explores the intersection of mathematics and culture while explicitly focusing on pedagogical concerns of ethnomathematics implementation in classroom settings. There are similar study groups based in South Africa, Brazil, and Latin America, including The Latin American Network (RELAET) (<http://www.etnomatematica.org/home/>) which brings together scholars from dozens

of countries and houses the indexed *Latin American Journal of Ethnomathematics* (<http://www.revista.etnomatematica.org/index.php/RLE>). The members and coordinators of these networks also actively participate in international conference series such as the International Conference on Ethnomathematics (ICEM), the Latin-American Reunion of Mathematics Education (RELME) (<http://www.clame.org.mx/relme.htm>), the Mathematics Education and Society conference (<http://www.mescommunity.info/>), and others. These forums and resources continually bring together the leading scholars of the field in the hopes of promoting the diverse mathematics methods and traditions that enrich our intellectual past and inform our future understandings of the world (Fig. 3).

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