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Kistemann Júnior, Marco Aurélio

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## **Book review: "From Ethnomathematics to art-design matrices and cyclic matrices" – Paulus Gerdes – Ed. UNESP, 2010**

Marco Aurélio Kistemann Júnior<sup>1</sup>

### **Abstract**

In this review, we present the ethnomathematics investigations undertaken in the last three decades by Paulus Gerdes, a Mozambique mathematics educator. The author presents a variety of discussions with several examples that explains the relationship of mathematics to human activities. We present, among other things, the cyclic matrices and its interrelationships with the African cultural contexts, undoing the erroneous impression that mathematics can be seen disconnected from the feature, which makes the individuals in their socio-cultural environments. Gerdes shows us that there's mathematics in different cultures and this helps us to realize the beauty of the symmetries and patterns, in addition to allowing depth between mathematics and human actions in the art.

**Keywords:** Art-design, Ethnomathematics, Cyclical Matrices.

Mathematics is still considered to many young a "rocket science" says Paulus Gerdes in the introduction of this work, reporting that this fact led him to present the themes of this book in the form of semi-autobiographical fragments.

In Chapter I, "*Ethnomathematics and teacher training*," Gerdes reminds us of the circumstances that arose in the Ethnomathematics proposal and project in Mozambique, after more than a decade of struggles to the liberation from Portuguese rule. According to the author, who attended the international team of teachers from the first training class of mathematics teachers in the country, the mathematics seemed a strange course to the students, imported from Europe and without roots in society and culture of Mozambique.

This fact makes Gerdes questioned, whether it is true that mathematics does not have roots in the cultures of Mozambique. For the author, this question serves as a provocation, since it is clear to Gerdes and that permeates his work, which mathematical ideas are not alien to African cultures, to emerging awareness that not all mathematics is sourced from European culture.

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<sup>1</sup> Doctorate student in Mathematics Education – UNESP – Rio Claro – SP. Email: [mathk@ig.com.br](mailto:mathk@ig.com.br)

The first chapter shows that the reflection and research about ethnomathematics in Mozambique was born in the context of training teachers of mathematics, and the major challenge of mathematics education, and educators in post-independence, is to contribute to a cultural renaissance and an appreciation of the positives aspects of traditional cultures.

"Mpaaángo: Both sides of mats decorated in Mozambique" is the second chapter of the book. Gerdes presents in this chapter the work of basket makers Tonga-speakers who use natural and colored strips in opposite directions to make their braids. He also reports that in the extreme northeastern Mozambique, another group of women speakers of Makwa invented a different reversal of colors of reversing camera to produce their mats bands sewn, whose strips are 45 angles at the edges of the band and generate patterns that change depending on the direction of the strip.

In Chapter III, "Sona, illustrated tales of Angola," the author reveals that contact with a book of drawings in the sand of the Cokwe people (northeast Angola) called 'sona', aroused his interest in a hitherto unknown geometry of the author. Contact with this book, according to Gerdes led him to an attempt to reconstruct and analyze mathematical elements of tradition 'sona' in mathematics education; he wanted to exploit the potential of this mathematical tradition of studying and traditions, which technically, have similarities with the tradition 'sona'

The following chapter presents geometric algorithms for which various algorithms 'sona', as the friendship, and chicken on the run and the lion stomach belong. Gerdes asserts that artists and geometers several times in human history have created curves that obey certain rules, constructed by applying certain geometric algorithms. Throughout this chapter, the author presents two examples as patterns made by Tamil women during the month of harvest in southern India. It also presents a design principle of a turn-of-regular mirror.

In Chapters V and VI, "Interlude: the discovery of a path" and "Curve-to-mirror generalized" respectively, the author criticizes the fact that the statements in mathematics rarely reveal the struggles and obstacles, before presenting a result that according to Gerdes, it can be said as the paved road from the deduction. In this context, it turns out

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route and results from his investigation that involves the drawings in the sand to the Cokwe people, the 'sona'. This chapter reveals the mathematical ability and creativity of the author, by using algebraic mathematical knowledge to analyze the patterns and symmetries in 'Sonas' and the curves of generalized mirror-generating patterns.

In the seventh chapter titled "Introducing Lunda-designs," Gerdes says that it can be shown that all the regular curves-of-the-mirror are generating the matrices of the light-dark similarities patterns, it invites the reader to find a demonstration. He revealed that the study of regular curves-of-the-mirror and the comparison with drawings of other cultures, it has done that the author studied the curves-of-generalized-mirror, which, in turn, it led to the invention of a new type of matrix and designs, Lunda-matrices and Lunda-designs.

The following chapter analyzes the common properties of Lunda-designs; it was invented by the author in the context of his investigations of curves of the mirror. The author elucidates the balance characteristics or local symmetries imply the balance properties and overall symmetry of Lunda-designs.

In chapters IX, X and XI Gerdes analyzes some particular types of Lunda-designs, it emphasizes the many connections between Lunda-designs and other areas of mathematics, and also deal with possible connections and entanglements with mathematical magic squares, the determinant theory, fractals and mosaics. For Gerdes, fractals have already been an interesting topic for exploration in the varied contexts of teaching-learning; it also enables the construction of fractals plans from Lunda-designs, the method of removal.

After exploring magic squares, determinants, fractals and mosaics, the author presents the following three chapters, a special type of Lunda-designs with attractive properties, according to the author, the Liki-designs. In these chapters, Gerdes introduces the cyclic structure and the powers of square Liki-designs; it shows results that the powers of Liki-designs of certain dimensions have cyclic structures. It is very interesting and worth noting the context in which the author has the idea about the Liki-designs and the reason of this name.

Chapters XV and XVI introduce the cyclic matrices (positive and negative) that results from the operation of Gerdes from the Liki-designs that generate many questions and speculations about the possibilities, properties and calculations performed with such

matrices, it wants to generalize the concept of matrix cyclical.

The following three chapters that precede the final chapter of the book, titled Extra, Gerdes deepened his investigation and analysis to demonstrate the properties of cyclic alternating matrices. It has also presented mathematical calculations that reveal, for example, that the product of two cyclic alternating matrices will always be positive and that positive results could be used in cyclic alternating positive matrices of other dimensions

In the final chapter, "Retrospect and Prospects," Gerdes calls into question the applicability of the concept of a cyclical matrix, in particular on the applicability of these matrices in extra-mathematical contexts. The author reports that there are already at least one application outside the realm of mathematics in which the cyclic matrices appear in studies of genetic codes using that uses the genetic matrices.

A wealth of investigations of Gerdes is the fact that him recognize the culture of the people, the culture of artists, artisans of the culture is constituted as an inexhaustible source of mathematical research and investigations on Ethnomathematics and Mathematics Education. The work of this mathematics educator in Mozambique shows that mathematicians can learn from the wisdom of individuals from other cultures, artisans, fishermen, farmers, and the mathematics teachers, in relationships marked by dialogue, experimentation and discovery, it can also learn from cultural diversity of their students.

We highlight an important speech of Gerdes Annex, it was written by the author and the afterword was written by Ubiratan D'Ambrosio. For the mathematics educator in Mozambique, a necessary precondition for the development of a mathematical-cultural awareness and social environment within future educators and mathematics teachers is to establish an educational environment in which, instead of the teacher educators are seen more as absolute authority, they become agents that enhance reflection.

We have also highlighted the care that Gerdes to submit questions and situations over and end of each chapter for allowing the reader to perform activities and demonstrations aimed at deepening the themes of this relevant book.