TRADITIONAL SAND DRAWINGS: PROPOSAL FOR A DIDACTICAL SOFTWARE

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The story-tellers from the Tcwokwe people, Northeastern Angola, use to make sand drawings, called *sona*, to give a better description of their stories. Paulus Gerdes [2] greatly contributed to the reconstruction of the mathematical concepts involved in these *sona*, which can be classified in different classes, according to the rules given to draw them. Gerdes described some didactical uses of these drawings and is still developing the research on their mathematical properties.

In the poster we focus on a large class of *sona*, the plaited-mat designs, which are based on an algorithm deriving from mat weaving: the lines correspond to the strands of woven mats.

To draw a *lusona* the Tchokwe story-tellers first clean and smooth the ground and then use their fingertips to press in the sand a rectangular net of dots.

The topological aim of the drawing is to enclose all the dots in and by one or more closed polygonals, respecting the following rules:

- each polygonal is drawn in a continuos motion, in order to create a loop (any hesitation or stopping halfway is considered an imperfection or a lack of knowledge), and can intersect itself and/or other polygonals, just in one point;
- each segment of the polygonal(s) forms a 45° reflection angle with the sides of the imaginary rectangle enclosing the dots.

Looking at different sized drawings an interesting question arises: given the number of points in each row and in each column, say they are p and q, does it exist a relation between (p,q) and the number of closed polygonals needed to complete the *lusona*? The answer to the question is that the number of polygonals represent the ***greatest common divisor*** of p and q: ***GCD(p,q)***.

Our educational aim is to show how the mathematics, hidden in such a kind of traditional activities from a non-western country [1], can be actualized and become a tool to better vehiculate new concepts in maths classes, while valuing different cultures.

In view of that, using Java Programming Language, we have implemented a graphical program - *sona1* - which draws, in movement, the *lusona* and computes the GCD of two natural non-zero numbers. The program asks for input two natural non-zero numbers, p and q, and the ordinate, y0, of the point from which we decide to start drawing the sona; y0 must be an odd number because the grid of p x q points is inserted, to ease the procedure, in a rectangle of 2p x 2q points.

In the poster, the graphical output on the PC screen, for a 8 x 4 *lusona*, will be shown. The side window, with the inputs and the numerical output, represent the GCD of the chosen numbers.

The described software can be usefully introduced in the classroom to approach to and give a geometrical motivation of the concept of GCD, taking into account the often refered difficulties met by pupils in its appropriation. A possible didactic unit (which is currently piloted in a few schools) could start from teacher drawing on the blackboard a couple of full sona and soon after a partial one, with no explanations. Pupils, working in small groups, should then be asked to investigate the rules needed to make the sona and to draw (pencil-and-paper) a few of them. Soon after, the software can be used to have more examples in very short time. Pupils are also asked to count the lines L needed, to make a record of all the data (the input numbers P,Q and the output L) and to conjecture the possible relations among them. Each group leader will then present in a table and explain to the class the findings. The final step should be a discussion among the group leaders, which, probably thanks to the teacher's guidance, could allow the class to better appropriate the notion of Greatest Common Divisor.

Findings from piloting such a didactic unit in a few schools and their comparison with those from traditional introduction of the GCD are our present research interest.

References:

[1] D'Ambrosio, U. (1985), 'Ethnomathematics and its place in the history and pedagogy of mathematics', *For the learning of Mathematics*, 5, 1, pp. 44-48.

[2] Gerdes, P. (1999), *Geometry from Africa. Mathematical and Educational Explorations*, The mathematical Association of America, Washington, DC (USA).