Chapter 4
Techniques and Learning Processes of Craftswomen in Brazil

Maria Cecilia Fantinato and José Ricardo e Souza Mafra

Abstract This paper brings partial results on an Ethnomathematics research grounded on ethnographic roots, aimed at studying the techniques, processes and devices applied on curved surface registry called *cuias*, with a group of eight craftswomen, members of a craftswomen regional association, in Aritapera region, rural area of Santarém, Pará, Brazil. This paper intends to analyse informal learning processes developed during *cuias* crafting production and ornamenting activities. Fieldwork includes observation, free interviews, photographing and recording. Results indicate that the reflected iconography on these *cuias* shows multiple techniques and identified cognitive strategies, with wide-ranging metallic instruments and organic materials usage. The strategies are organised and multifaceted, related to each craftswoman's singular unity, and, simultaneously, to a collective unit capable of applying dynamism in constant relationships with nature. The dialogue between empirical evidence with the literature on informal learning processes allowed us to understand some important aspects of knowledge production/transmission of these craftswomen's community of practice, as well as their vicissitudes due to socio-economical and temporal factors. This paper aims at contributing to further studies on ethnographic researches in Ethnomathematics, as well as its unfolding in educational experiences.

Keywords Ethnomathematics · Ethnographic studies · Knowledge techniques · Informal learning processes · Craftswomen

M.C. Fantinato (✉)
Federal Fluminense University (UFF), Niterói, Brazil
e-mail: mcfantinato@gmail.com

J.R.S. Mafra
Universidade Federal do Oeste do Pará (UFOPA), Santarém, Brazil
e-mail: jose.mafra@ufopa.edu.br

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4.1 Introduction

This study, based on Ethnomathematics perspective and with sociological and anthropological theoretical contributions, is linked to a post-doctoral research carried out by the second author and supervised by the first author, during the year of 2015 (Mafra and Fantinato 2016). This research had as main objective the development of a study on techniques, processes and tools involved in the preparation of ornament patterns on the curved surfaces of vegetable gourds, called *cuias*, by a group of craftswomen who belong to a riverbank community dwellers of the north region of Brazil. The mathematical aspects involved in the techniques of ornamentation of the gourds, as well as the craftswomen learning processes, constituted our interest of research.

The western portion of Pará, one of the states located within the northern region of Brazil, is a diverse and singular area. Among its characteristics, it presents an important riverbank population, very particular in terms of cultural dynamics. There, handcrafting is the permanent and singular element in their lives and takes part in the local culture and in the natural dynamics of those who live there. Particularly, for a group of eight craftswomen who live throughout five neighbourhoods comprised within Aritapera[1] an area within the municipality of Santarém. These women express their daily lives, traditions, social relationships and the core of their existence in regional *cuias*[2] carving.

By means of a natural and singular representative knowledge and practice of their identities, they frequently get together to develop instrumental actions related to the productions of these *cuias*. They are organized as an association, *Santarem Riverside Craftswomen Association* (ASARISAN), started in 2003 and that joins dwellers of the area. Its main interest lies on the dissemination of natural handcrafting know-how as well as on the economic and cultural empowerment of *cuias* as a product of traditional knowledge. Through an anthropological, social and instrumental point of view, this research aims at learning more and deeper about these craftswomen's processes, motivations, techniques and tools used while developing carving registries on the surfaces of these regional *cuias*.

An additional purpose of this article lies on going back to empirical indications of this Ethnomathematics research, grounded on theoretical frameworks based on informal learning processes. We intend to do so by analysing existing processes and knowledge involved in the making of *cuias.* Conceptual tools from informal

[1]These areas are: Enseada do Aritapera, Aritapera Center, Carapanatuba, Cabeça d'Onça, and Surubim-Açu.

[2]This gourd (our *cuia*) is the fruit of a tree called *cuieira,* which is a traditional tree in the Amazon area. It blossoms different shapes, sizes, dimensions, such as roundish, ovallish or even slightly flattish. It is applied, specially, to drink *tacacá,* which is a typical Amazonian juice/soup, from indigenous origin. However, as time went by, many other artefacts have been produced applying the same raw material.

education studies were also considered, in dialogue with craftswomen's cultural practices, focusing on informal learning processes and knowledge transmission.

4.2 Ethomathematics and Ethnographic Studies

Throughout the last years, plenty of conducted researches and studies (D'Ambrosio 1993; Vergani 2009; Rosa et al. 2016) show the transdisciplinary nature related to the studies under Ethnomathematics perspective. The relationship between these studies and cultural anthropology, education, sociology and philosophy, indicate a meaningful broadness in a theoretical and methodological framework, capable of grounding researches and studies under the sociocultural bases.

A descriptive and thoughtful analysis of such opposing forces in a certain study context can deliver substantial meaningful convergence, validating discussions that involve indicators found at various knowledge areas, such as mathematics, history, anthropology and education. These indicators are unmistakably identified in Vergani's considerations, when she states that:

> Counting, localization, measurement, arrangement, play, description are activities which involve theoretical and practical perspectives besides critical expression. Ethnomathematics does not only fit anthropology, cognitive psychology, verbal language and aesthetics or playful expression. Its epistemological approach connects it to history, to general welfare and social justice. Its pedagogical approach gives room to common sense, social changes challenges and technological development (Vergani 2000, p. 37).[3]

Such considerations aim at the merging of a holistic conception of knowledge in the way D'Ambrosio (1985, 1993, 1997) suggests, that is, knowledge creation, its areas of acceptance, values and rules to be transmitted and spread widely. As such, they offer a connection and interaction with the natural environment, in such way that theoretical assumptions in Ethnomathematics perspective are present and alive from socially mentioned practices standpoints.

This knowledge can be linked to the development of symbolic codes and to the movement of such codes in their social lives according to the importance of its information and communication circle to the development of several activities. This improvement depends on the social environment stability and on its interrelationship with the surroundings, where such characteristics are produced and organized, consequently providing an "understanding/reading of the world from the same movement that (re)shapes such symbolic codes" (Vergani 2003, p. 134).

Related social cultural practices studies and investigations, as well as their connections with studies perspectives perceived by Ethnomathematics have been providing meaningful contributions in the last decades. At first, Ethnomathematics studies were closely related to ethnography and approached identified cultural

[3]This quote and the followings along this paper have all undergone free translation.

groups' know-how: "these groups could be based on their ethnicity, on their professional occupation, age, and even other aspects" (Palhares 2008, p. 14).

With the growth and improvement of this area of research, Ethnomathematics concept, developed by the leading Brazilian theoretician Ubiratan D'Ambrosio, was both re-evaluated and improved. D'Ambrosio's Ethnomathematics Programme (1993) replaced the idea of an ethnic mathematics, referring to the study of these different groups' know-how and their inherent cultural dynamics, by adding cognitive, philosophical, historical, sociological, political and, naturally, educational aspects. As a result, different sociocultural group studies under ethnographic framework emerged, prevailing for many years, even though this has been changing lately.

When analysing the graphs that classify presented studies in the four previous Brazilian Ethnomathematics congresses (Fantinato 2013), one can notice how representative the thematic axis *Mathematical education in different cultural contexts stood*, mainly in 2004 and 2008 congresses, matching *Ethnomathematics and pedagogical practices* axis, which concentrated more papers in 2000 and in 2012. Therefore, although these studies were once part of Ethnomathematics area, the ethnographic studies have been giving room to studies aimed at ethnomathematical ideas on pedagogical applications. From eight Ethnomathematics articles published by BOLEMA journal between 2006 and 2010, Costa (2012) found five of them on educational themes, and only one of them approached mathematical ideas present in different social groups' practices.

Even though we agree with Pais (2011), when he says that "a significant part of ethnomathematics research has educational aims" (Pais 2011, p. 210), we believe in the ethnographic studies liveliness in Ethnomathematics, especially when under transdisciplinary perspectives empirical data analysis (Vergani 2009). According to Clareto (2009), Ethnomathematics allows knowledge to be approached as an invention, as inventiveness and not as recognition of something that was already there. We propose, then, Ethnomathematics as "occidental mathematical re-identification" in other sociocultural settings, moving us towards originality, creating "possibilities to reach out for other senses, opening up other perspectives towards cognition and learning" (Clareto 2009, p. 130). Dasen (2004) says that:

> All societies, either from the North or the South, have their peculiar ways of transmitting their culture from generation to generation, away from formal education represented by schools […] good knowledge about informal education can help schools adapt these cultural contexts they are immersed into the environment realities they are placed in, in much better ways (Dasen 2004, p. 23).

In this study, concepts on informal education studies (Chamoux 1978; Dasen 2004; De Vargas 2009; Greenfield 1999; Lave and Wenger 1993) are brought into light in dialogue with an Ethnomathematics research on *cuias*' craftswomen cultural practices.

4.3 Contextualizing the Research

This investigation was developed in riverbank communities in Aritapera region along the Amazon River, in the state of Pará, in the north of Brazil, three hours away from Santarém by boat. Lowlands such as Aritapera go through lots of natural events due to severe geographic changes in times of flood/draught along the Amazon River, the first half of the year, the region undergoes the flooded season, while during the second half they strive through the dry season. Riverbank dwellers live their lives based on seasonal influence in order to maintain their livelihood; fishing, agriculture, cattle farming, household caring. These *cuias* crafting production is an antique traditional cultural practice developed by the women in this area, especially during the flooding season (Maduro 2013).

The *cuias* harvesting—collected from a tree called *cuieira Crescentia cujete*, as well as the following phases of their production, such as cutting, scraping, dying and crisscrossing—benefits from natural resources. By using natural resources at each stage of production (fish scales for sanding and an organic purple pigment for dyeing) this activity has no impact on the local ecological balance or on the forest's regeneration.

There is a variation on the devices and techniques applied on the carvings. Every craftswoman seems to dispose of a wide range of creative possibilities (D'Ambrosio 1997), regarding both the size and decoration of the *cuias*, depending on their different uses. There are basically two kinds of ornament patterns: the floral or the *tapajonic* (Fig. 4.1).

The floral ornaments, based on the mixing of indigenous techniques and European rococo, are very traditional, and were learned through informal processes with grandmothers and mothers. Symmetrical patterns inspired on indigenous culture of the region of Tapajós River, named *tapajonic*, which were first

Fig. 4.1 Handcrafted *cuias* with *tapajonic* (in the *front*) and floral (at the *back*) patterns. *Source* Photo by the authors, with ASARISAN's authorization

introduced by a group of anthropologists working in the community, however, slowly became part of craftswomen's repertoire of patterns. The different patterns drawn on the *cuias* demonstrate a rich modelling diversification, both at an individual and craftswomen's group level, passed on throughout the years by the influence of their cultural heritage.

The *cuia* assigned for a floral carving has to be totally smooth and the craftswoman performs her work by freehand on the roundish surface. As for the *cuias* with *tapajonic* patterns markings, characterized by geometric carvings of indigenous origins, the first step consists of carving two parallel circumferences on the widest part of the bases which has the half-scooped sphere shape. The drawing with geometric patterns is then started within the delimited half-scooped sphere space between the circumferences.

The *cuias* are applied to many different usages in riverside people daily routines, such as drinking, water or food storing, bathing, water removal from canoes etc. Although commercial activities involving such cultural artefacts have been happening since the 18th century (Costa 2013), they have deeply increased within urban contexts in the Amazon Region, when such *cuias*:

> (…) settled an acquired visibility as a mandatory vessel for the drinking of *tacacá,* regional cuisine dish which became widely known in the touristic circuits, as much as turning into a point of becoming an eloquent national representative identity symbol from Pará (Carvalho 2011a, p. 25).

In 2002, by means of *Cuias de Santarém* project, aiming at supporting the production and commercialization of such objects, fruits of this *cuieira* tree, such as bowls, cups, fruit bowls, *maracas*,[4] besides the *cuias* themselves—, the Folklore and Popular Culture National Centre (CNFCP/IPHAN) carried out researches, photographic and audiovisual documentation, courses and workshops, *cuias* sales and exposition, always with these craftswomen's intense participation in the decision making. Later, CNFPC became a partner of Santarém Riverbank Craftswomen Association (ASARISAN), founded in 2003, rather than a direct enforcer in the communities. Among the first changes that arose from such support was the printing of an almanac presenting ornament *cuias* standard patterns based on Brazilian museums' research.

Such work has been useful for encouraging these *cuias* decoration practices, promoting a process of memory rebuilding and diffusion of a rich iconographic gamut. At the time when *Cuias* de *Santarém* Project was implemented, severe carving ornament depreciation was into process as the market was truly interested in plain or poorly decorated *cuias*, which meant low sales prices (Carvalho 2011a, p. 14).

In 2003, in Aritapera community, the creation of ASARISAN brought a new work concept for these craftswomen, as part of the individual activity was replaced by group work, performed within the core of each community. Production increased

[4]Maraca is an indigenous musical instrument, consisting of two hollow containers filled with beans or small stones. They are shaken to provide rhythm.

and these *cuias*' ornament started getting more and more refined as usages have also diversified. ASARISAN has also brought both ornament patterns changes and pieces grading to attend national market and cultural exhibitions. The craftswomen, for example, started using measurement instruments to classify the *cuias* according to four sizes, as when they were to be commercialized in sets solely for ornamental purposes.

The establishment of such Association also had its consequences in the familiar subsistence tasks' distribution. After the creation of ASARISAN, men alone have been almost entirely responsible for many of the other activities such as fishing, agriculture and cattle farming. Women kept household responsibilities and their children's upbringing, alternating with the *cuia*s' production, which gets a lot more intense in flooding season. This circumstance has also contributed to strengthen female identity along these riverbank communities.

In this research, we followed a group of eight ASARISAN affiliated women. The study was developed through fieldwork and consists of a detailed description of the making of *cuias.* It involves a detailed description of labour group activities, applied resources, instrumental techniques and know-how intrinsic characteristics of this group. Its central focus lies on the process study, motivations, techniques and instruments applied on the curvy surfaces, named *cuia*s in the region.

The investigation lies on qualitative nature (Bogdan and Biklen 2003) with ethnographic fieldwork development, carried out between 2014 and 2015. Data collection methods used included field notes, recordings, open interviews, photographs and video recordings. This research intends to depict a "thick description" (Geertz 1973) of the cultural context in which this activity is practiced, to develop a clearer understanding of the cultural dynamics implied, as well as the search for the sense of understanding on peculiar cultural dynamics and its complexities. The investigation took ground on the immersion of the researcher in the environment where the studied object lies as the main theoretical principle (Bogdan and Biklen 2003), designating the observer-researcher as the main instrument able to both collect and analyse the data.

As part of this research program, we also carried out an analysis of informal learning processes (Dasen 2004) involved in the making of *cuias*. We attempted to use some conceptual tools drawn from informal educational studies with these craftswomen, focusing on informal learning processes and knowledge transmission, as related to the subjects' cultural practices.

4.4 Techniques and Processes at Handcrafting Know-How: Mathematical Aspects

The material and immaterial order mechanisms applied in Aritapera craftswomen's work activities show instrumental actions, both in obtaining the raw material and in crafting the final product, that is, the ready or *scratched cuias*. Their shaping and

their related products stages portray conceptual and concrete element knowledge from the visual perception of the one performing the action. Logic involved in the tasks performed moves towards a constructed and woven relationship with the physical environment in which they work. For instance, stylized flowers, fruits and animals are part of the ornamental repertoire.

The handling aspects involved in the act of shaping performed by these craftswomen, according to our observations, record procedures very much alike those performed in academic calculations, such as counting and application of proportionality principles. Some craftswomen perform calculations by estimate, that is, "mind calculations". Based on one of the craftswomen's speech: Avanilda: "we do it like that, we perform the calculation on our minds and get hands to work". Supposedly they have a very clear notion of the models and shapes to be performed as they have visualizing them on their minds for a long time.

Other cognitive activities which are mathematized[5] are related to the construction of bigger and or smaller pieces according to the dimensions of the storage bulk of the gourd. Such activities are performed according to proportional relations between the size of the biggest and smallest pieces to be made within an established set. Statements such as Lélia's, another craftswoman "we look at the model and reproduce it", or even according to Silvane, craftswoman: "depending on the size we want (…) we do it on our minds", to indicate the existence of a wide flexibility in terms of handcrafting activity cognitive variation.

Empiric knowledge, built throughout the years in the making of these *cuias*, offers us distinct elucidations to the detected episode. According to Silvane and Lélia: "to follow the same carving, we follow what we know, (…) we look at the catalogue or model and reproduce it".

During these *cuias* making processes, the existence of certain regularity in the dimensions of the produced pieces it may be noticed. The item's dimensions, as well the type of use it intended to, will serve as basis for these craftswomen when setting a suggested price. However, as it does not consist of a mandatory standardized procedure, pieces of similar size/characteristics may be found at different prices. According to the craftswomen, the prices are set during the moment of selling and are dependent on the mediation between them and the buyer or middleperson.

There is a variation on the devices and techniques applied on the carvings. As it seems, the craftswomen group imaginary and creative organization supply a wide range of possibilities (D'Ambrosio 1997) in the cravings and markings, related to different aims to the produced *cuias*. From the observed carvings, the talent towards different models, reflected in the imaginary artwork and patterns, shows rich modelling diversification and growth, identified in a personal unit (the craftswoman unique characteristics) and the collective unit (the craftswomen group),

[5]The use of the *mathematized* concept refers to the understanding, explaining, knowing, etc., referring to or daily needs. It suggests capabilities of classification, inference, problematization, and ability to relate things, among others, very similar to the characteristics observed throughout our empiric studies.

acknowledged by their gathered cultural heritage throughout the years, as Vergani (2003, 2009) states.

It seems there is an unavoidable absorption capability, offered by the interaction among distinct cultural dynamics, notorious in practice group communities living in the area. The endorsement made by Angeli, a craftswoman, who described one of the procedures applied in the reference markings: "Sometimes we calculate. Sometimes it doesn't work (Showing the way they perform the calculation). Half and half, naked eye". In other words, the imagination and creation/elaboration capability overlaps the predefined needs and aims, mainly screening related elements with attempt/error procedures as one of the core elements to the making of the final products (Lave and Wenger 1993).

While following up the work of the craftswomen, we identified along the production the development of many aspects, related to a kind of mathematical logic present in instrumental activities identified in the work with the *cuias*. Such aspects allowed us to make considerations about aspects of the manipulative act of modeling. In our observations, procedures not so distant from those used in calculations of the academy were identified, as described in the following.

4.4.1 The Use of the Compass in the Preparation of the Sections

Throughout our observations, we had the opportunity to observe one of the craftswomen perform the carvings on the *cuias* by means of a compass (cf Fig. 4.2). Lenil's handling of such instrument reveals unique skills in the records making and

Fig. 4.2 Craftswoman handling the compass. *Source* Photo by the authors, with ASARISAN's authorization

in the layout, as it seems she is the only one to handle such tool in her instrumental activities.

The craftswoman Lenil, while performing records with the use of the compass, follows a few simple steps of instrumental organization in the initial markings, which are described as follows:

(1) First of all, a starting point is defined, being such reference required for the following actions. The geometrical place assigned as starting point is the center of the curved surface.
(2) The preparation of lines and thin traces in the form of circles is performed using a kind of visual metric. The center of the compass provides—using the point located at the center of the curved surface—successive openings, thus distinct circles are obtained, all of concentric rays, as indicated in Fig. 4.3.
(3) After the initial circles markings, a set of smaller circles and circular auxiliary sectors is drawn, for more specific ornament settings, originating, thus, the floral patterns evidenced in the sections, as shown in Fig. 4.4.

The tracing developed during the process of incised records points to a successive division of circular sectors, such as those indicated in Fig. 4.5.

However, the distribution of such segments along the surface, as it seems, is determined on the basis of successive approximations between the lines initially

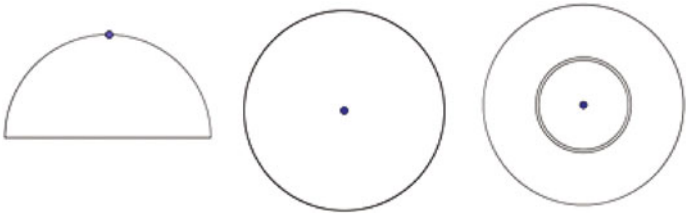

Fig. 4.3 Initial steps, with the use of the compass. *Source* Own authorship assisted by software

Fig. 4.4 Incisions made in a *cuia* using the compass. *Source* Photo by the authors, with ASARISAN's authorization

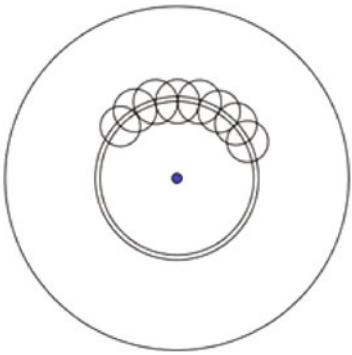

Fig. 4.5 Initial markings of floral patterns by using the compass. *Source* Own authorship assisted by software

drawn. Intersection of lines provides the creation of reference points, used for the preparation of the following sections.

Clearly there are evidences of a kind of qualitative mathematics, and also of the use of mental calculation for the composition of *eye* estimation, seeking to locate references of divisions and distributions of lines.

(4) It seems that, as the craftswoman uses the compass, employing a personal system of reference and qualitative measures the circle acts as the generator for the formats created to set a series of incised records.

The compass instrument itself is used to set the initial floral arrangement development. This first design is used as basis for the following steps—of scraping and scuffing, which will result on the final floral pattern. Considering such context, we infer that the craftswoman has gained experience through her connection with the instrumental activities developed in her working context. That is, by employing her compass handling skills, obtained from her instrumental activities know-how and from her personal life story, she transfers her values and essence to the pieces, bringing out a meaning which adds beliefs, emotions and feelings.

White (1988) states that the individual acquires a culture by means of inherited customs' learning. This is what is noticed when observing the craftswoman, as she learned to appreciate nature and reproduce/reflect herself, in a way it would portray knowledge and understanding produced through processes and controls developed in the making of *cuias*. When questioned about her procedures and techniques applied to the development of *cuias*' carvings, Lenil, the craftswoman, gives us evidences on how knowledge organization and transmission are performed when producing those *cuias*, making ornamental patterns with a compass.

> Lenil: each one of us here in our area has a particular type of (…) (referring to the *cuia* making). Lélia (another craftswoman) knows every little thing when she sees the mark (the scuff on the *cuia*) (…). When it's my turn to do it, it's different. She hasn`t seen me doing this type.
>
> Researchers: Are you an expert, Mrs?
>
> Lenil: Does it look the same (the other *cuia*)?

Researchers: No way!

Lenil: With my mother, in those days we already had card holders… (talking about other types of pieces) back then we had to use the compass to mark.

Researchers: When do you use the compass, Mrs? Or don't you use it anymore?

Lenil: I still use it, always. I still do. I'm going to make this one here (performing the layout with the compass).

Researchers: Do you always use the compass this much, Mrs?

Lenil: I always use. They always ask me to make a fern tree, or any other thing, I am always coming up with something new.

Researchers: But, do you decide on the layout to be applied on it yourself?

Lenil: *Yeah*. It can look really nice if we remove this little white here. Do you *wanna* see it looking different? When my husband buys big *cuias,* I get it and cover it with wide circles, and then I just do it.

Researchers: Do you choose to use the compass on those which are truly round?

Lenil: It draws and nothing gets lost (making lines with the compass) (04/08/2015).

The records made with the compass showed an iconography reflected in the *cuias*, which points out to motivations especially related to social representations evidenced in the community dynamics. Although the activity developed with the compass is considered a singular instrumental action, we identified how much social interactions exist in its environment, contributing to a flow of permanent and diverse knowledge exchange.

4.4.2 Two Possible Forms of Mathematical Distribution for the Tapajonic *Patterns in* Cuias

Many patterns are used as forms of records during the process of marking the *cuias*. The establishment of sequences is one of the most common mathematical ideas that can be found in different cultural contexts.

While following up the work with the group, we were able to identify some strategies of markings employed in the *tapajonic* patterns. Two possible aspects are highlighted in the work of craftswomen. Léia does it in one way (equally spaced markings, all at once), while Silvane performs the markings one by one (at the end she makes approximations for the last marks, in such a way that they remain at equivalent distance).

The spaced markings, developed by craftswoman Léia, are performed in a uniform manner, according to the following steps:

(1) The *tapajonic* patterns, for the most part, are produced on the lower surface of the *cuia*, delimited by two parallel traces and with no defined metric distance (see Fig. 4.6).

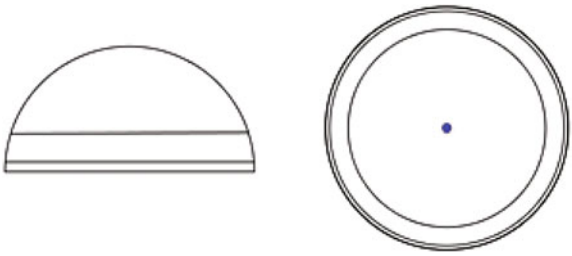

Fig. 4.6 Initial markings of *tapajonic* patterns making. *Source* Own authorship assisted by software

(2) The internal records are drawn within the lower and upper limits of the rectilinear line, in a multiplicity of possible patterns and formats. Among these formats, triangles, squares, lozenges or other polygons are used to compose the drawings.
(3) The spaced records have a uniform incision field, generated from the intervals between the markings, by choosing an initial segment, perpendicular to the two parallel tracings, on the edge of the *cuia*. There is a diversified repertoire, in relation to these standards. Some examples of patterns are presented in Fig. 4.7, drawn out from Carvalho (2011b, pp. 184–185).
(4) The marking of the lower and upper limits is done only once, by distributing the reference points throughout the field of recordings, so that these benchmarks might be used for the geometric construction of the illustrations. The craftswoman constructs the spaced segments visually, without the use of standardized metrics. It seems that her metric is conceived from the visual and global scaling of the *cuia* to be worked on, as illustrated in Fig. 4.8.

The other strategy, adopted by craftswoman Silvane, shows a style of marking according to a technique that we have chosen to denominate *marking by approximation*, as described in the following steps:

Silvane's steps 1 and 2 are identical of the strategy adopted by Léia.

(3) Silvane initially marks the interval spaces, in which the illustration will be recorded and works one segmented space at a time.
(4) In order to *close* the distribution of segments within the *cuia*, Silvane uses a sort of body metric (her thumb), drawing up estimates of approximation between the distances of the last markings, as to minimize any distortion in terms of the distance between the segments, as illustrated in Fig. 4.9.

The procedures applied in the making of the carvings show us a strong sensorial aspect, by means of our basic senses, mainly the sight, which shows estimate identification possibilities and measurements using the naked-eye (Shockey 2002). Additionally, it demonstrate intersected elements such as intuition, understanding and apprehension of available aspects within a certain context, elements which are meaningful to the construction of local knowledge, produced according to the needs and intrinsic limits of the natural environment.

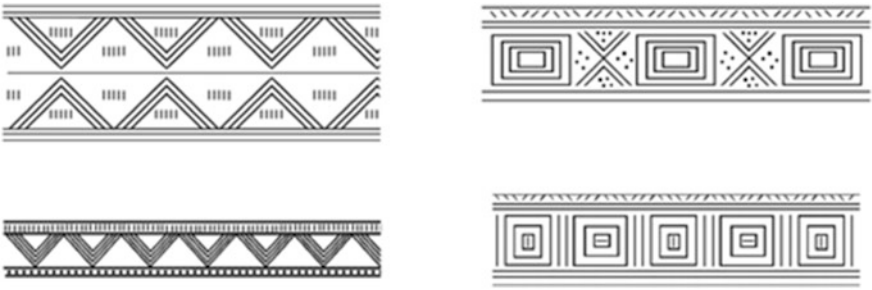

Fig. 4.7 Some *tapajonic* patterns used in the registry of sections in edges. *Source* Carvalho (2011b)

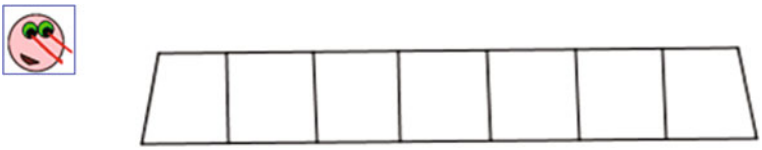

Fig. 4.8 Illustration of spaced segments, in the edge of *cuias*. *Source* Own authorship assisted by software, combined with image from https://gartic.com.br

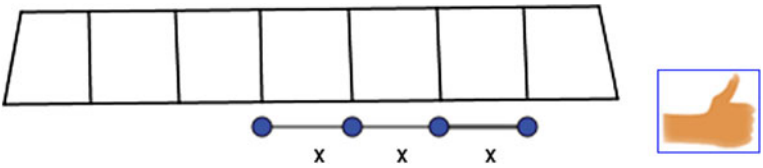

Fig. 4.9 Strategy adopted by Silvane in the final distribution of markings. *Source* Own authorship assisted by software, combined with image from http://bose-lady.net

The activities identified in the ornamental *cuias* making phases reflect multiplicative procedures, considering the essential elements in the pieces making process. On the other hand, the peculiar character perceived in each work is undeniable. The singular touch of personal elements, such as shapes and portrayed representations on curved surfaces, suggests elements related to *the skills* which each one of them owns in the development of their instrumental activities.

Such characteristics, we believe to be grounded on aspects such as the collective point of view, which coincides with the anthropologic concept of human being, capable of producing, and also with the knowledge disseminating perspective, considering day to day labour needs.

The records, revealed along the work performed with the compass, show an iconography reflected on the *cuias* which leads to motivations specially related to social representation highlighted in the community dynamics. Although the activity

performed with the compass is considered a singular unit in terms of instrumental action, we noticed how much this environment of existing and probable social interactions pervade a flow of permanent changes of diverse knowledge.

Diversified surface patterns are used during carving recording outlining process. Patterns setting is one of the most recurrent mathematical ideas in different cultural contexts. The usage of models and compasses establishes a strategy and labour production enhancement technique. Therefore, mathematical ideas present in the carving records conception on *tapajonic cuias* reflect work dynamics related to the structural organization of the social context it belongs to, considering local processes, organization and aesthetics.

The (holistic) harmony of such principles allows us to show the movement developed by the related knowledges with Ethnomathematics. The way the craftswoman displays the images reflected on the *cuias*' surface is strictly connected to these principles as emotions are still attached to the craftswoman throughout the carving records creative process, as perceived during the ethnographic research.

As such, we understand identified Ethnomathematics ideas reflect the manifestation of multiple emotions by the craftswoman. The emotion to afford a professional activity, to explain depictions when developing *cuias*' scribbling process, which makes us think about a rich array of possible outcomes, especially in terms of its application in educational environments.

Such line of thought demonstrates how much the cultural heritage printed in the dwellers' knowledge is exposed to diverse ponderings, among which we point out ideas and identified mathematical strategies in their relation with other knowledge mechanisms, interlocked, likely to be maximized for example, in educational environment placed around Aritapera communities.

4.5 Informal Learning Processes Among Aritapera Cuias' Craftswomen

Production phases involve a very diverse set of knowledge that could be analysed from an Ethnomathematics perspective. In this topic, the focus will be on informal learning processes and knowledge transmission among Aritapera's craftswomen.

These *cuias* production and ornament ownership process can be defined as Aritapera general technical knowledge, however private (Chamoux 1978) to the women's group. Although some men can eventually help in some phases, as in the fruit harvesting, it is understood as a typically female activity, passed from generation to generation: "it has been running through our forefathers, it is already historical. I learned with my mother, with my grandfather and there it goes" (Lélia, 03/8/15). Since young age, girls observe the daily activity of the women of the group in their process of *cuias* production.

We can define Aritapera craftswomen group as a community of practice (Wenger 1998), as they share the same knowledge and practices repertoire,

gathering in order to search for common objectives, and as their collective activity creates an identity feeling for the group. Another relevant concept applied in this study that provides an important tool to approach learning constituted as a social practice refers to *legitimated peripheral participation* (LPP) (Lave and Wenger 1993), which analyses "forms of adhesion and of identity construction, embodying place, acquired practice organization, development, reproduction and social transformation cycles in a community of practice" (Fantinato and De Vargas 2006, p. 3). By LPP we mean:

> (…) to draw attention to the point that learners inevitably participate in communities of practitioners and that the mastery of knowledge and skill requires newcomers to move toward full participation in the sociocultural practices of a community. 'Legitimate peripheral participation' provides a way to speak about the relations between newcomers and old-timers, and about activities, identities, artefacts, and communities of knowledge and practice (Lave and Wenger 1993, p. 29).

In the craftswomen's collective context, the knowledge transmission process related to these *cuias*' process happens by means of LPP. The apprentices, joining the craftswomen group, start performing carving and ornamental activities gradually, directed by the craftswomen through a well-defined progressive teaching/transmission process. The apprentices start off by learning the types of pattern which are considered the easiest.

In Carapanatuba community, Marinalva does not scratch. On the other hand, Silvane can only draw *tapajonic* carvings while Lélia is very good at drawing floral patterns. Therefore, knowledges related to this outlining can be considered as particular technical knowledge (Chamoux 1978), which depend on some specific skills. Angeli, from Enseada community, says that not all of them are skilful in graphics, and "she (Lenil) was the only one skilful with the compass" (05/8/2015). This lady chooses the c*uias* with round basis to apply this outlining tool.

The little girls and the apprentices learn through *impregnation*, process to which Chamoux (1978, p. 63) supposes two conditions:

> Firstly, it is based on a corporal training common to every single member of the village group: gestures, postures, material perception ways, language […] This training is connected to what is generally called group culture. Secondly, it implies in observation repetition of different techniques and gestures experimentation.

However, the same writer points out that in case one of these two conditions is not fulfilled, impregnation does not happen by itself. So, it requires a master to allow the conveyance of such know-how (Chamoux 1978). In the craftswomen's community practice context, this role is performed by the mother, the grandmother or even a more experienced person, such as a friend.

Throughout the fieldwork, we managed to observe an interaction situation between two craftswomen, Lélia and Marinalva, in which Lélia played the role of the master (cf Fig. 4.10). Marinalva was working with a large knife, building the support base for a fruit bowl, adjusting the piece gradually into a spherical shape. Then, Lélia took the piece Marinalva was producing and carried out a test placing a fruit bowl in the hollow semispheric shape on the piece Marinalva had been

Fig. 4.10 Two craftswomen interacting during *cuias* production. *Source* Photo by the authors, with ASARISAN's authorization

working on in order to check the balance of the piece. Lélia showed the set to Marinalva, who was attentively watching her friend and master, and pointed where the piece needed a few adjustments.

After the demonstration, Lélia handed Marinalva both pieces. Then, Marinalva applied the large knife in the areas in need of modifications, while looking at her friend/master. Right after verbal confirmation, she resumed to her scraping activity with the large knife. Minutes later, Lélia asked Marinalva to hand her the piece which had just been fixed and carried out the same balance test, saying:

> Lélia: Look Marinalva, look.
>
> Marinalva: Yes.
>
> Lélia: There is just this one more little thing here to fix, but reduce it from here, can you see?

Then Marinalva gets hold of the large knife to sharpen another knife which she was working with and remarks:

> Or we break it or we fix it (04/08/15).

And Marinalva carried on with her scraping work with the large knife.

The last step in the production of *cuias* consists of outlining, when the women make use of small knives to carve the black surfaces of these *cuias*, already dyed with *cumatê*[6] dye. The floral ornaments which represent a mixed traditional crafting, "based on the mixing of indigenous techniques and European rococo, were preserved and were transmitted in the craftswomen's collective memory" (Costa 2013, p. 41). Therefore, the floral pattern is learned through informal processes with grandmothers and mothers.

In contrast to the floral patterns, the *tapajonics* follow a different learning process as they were not used on the *cuias* ornament from Aritapera before the creation of ASARISAN and CNFCP/IPHAN enterprises. As previously mentioned, such

[6] *Cumatê* is a purple natural pigment produced out of an Amazon tree bark.

projects resulted in the printing of a catalogue of patterns from indigenous origin, as well as on the conduction of courses and workshops to encourage its spreading in the community. Raimunda, one of the craftswomen, confirmed these facts as she talked to the researchers:

> Raimunda: These ones here, these carvings here, we started working with them, when we got together, after getting everybody together. Then, there was this young man and then we managed to do it, thanks God. We managed to create the association, then we improved these carvings, more and more.
>
> Researchers: Did you use to make these *tapajonic* patterns carvings before the course?
>
> Raimunda: Only floral. We weren't taught all kinds of patterns at the course. There were few. Few graphisms. From that moment, we started creating, imagining, thinking how to do it. Sometimes, we picture a drawing on our minds and figure out how to do it (05/08/2015).

Raimunda and Lenil say this motivational work "awoke the creation of many kinds of pieces" and that it represented a cultural identity recovery. From *tapajonic* models learned in the workshop, the oldest craftswomen started creating plenty of different variations on such patterns. Little by little, they started sharing this knowledge with the youngest craftswomen. Angeli stated, pointing to two older ladies of her group "they both took part in a workshop, somebody came to present there. I did not take part in it, but I learned with her" (05/08/15).

Consequently, we found variations of *cuias*' decoration knowledge acquirement and transference in Aritapera craftswomen community. Raimunda said she picked *tapajonic* patterns in a course, therefore she learned in a formal situation. However, she transferred all that knowledge to a friend of hers, Angeli, informally.

We agree with Greenfield (1999) when she says that "as cultures change over time, the very processes of cultural learning and cultural transmission also change" (p. 57). However, the distinctions between formal and informal education, depending on the context they refer to, hold an array of shades, they are not dichotomous. De Vargas (2009) grounded on Greenfield and Lave (1979), mentions the existence of an informal/formal *continuum*:

> Greenfield and Lave stand their characterization grounds on the dichotomy which can be, in many cases, over generalized, in such way that it becomes more relevant to have a continuum as a reference, a grading among several levels and not merely an opposition (De Vargas 2009, p. 195).

This craftswomen's knowledge towards the outlining on these *cuias* is, therefore, dynamic. The *cuias* making art traditional knowledge and floral decorations started interacting with knowledge brought from the outside and learned by more formal learning means. In turn, this new knowledge related to these *tapajonic* carvings was incorporated by these women in the exercise of their practice, resulting in the generation of even newer knowledge, including that associated with this type of pattern.

We could deduce so when observing these women carve the *cuias,* as they create varied patterns without following any printed templates. Lélia even admitted she knew the catalogue with the *tapajonic* patterns, but she would rather follow, as she

says, the ones she had on her mind. Raimunda's words summarize this creative process: "we start doing it, start creating, it is imagination flow" (05/08/15).

This dynamic aspect can also be observed towards the characteristics of a specific technical knowledge (Chamoux 1978). This represents a good example of gender-specific knowledge, that is, in this case, knowledge transmitted strictly between women. However, Angeli told us one of her sons is learning to carve as well. As it is a prominently female activity, this fact called our attention. We suppose it is the direct result of a respect process of these craftswomen activity in the familiar context, as after the creation of the Association, they started making an outstanding difference in the family income.

4.6 Craftswomen's Techniques and Informal Learning Processes: Issues for Ethnomathematics

A wide range of aspects are still to be investigated. What is behind this knowledge? What is the meaning and importance of these instrumental activities developed in the *cuia* handcrafting for these communities in Aritapera? How social representations, reflected on the round surface carvings, become meaningful to the craftswomen group? These questions will find room when theoretical constructions in further investigations are viable and its focus rely on open questions inquiries.

Based on our observations, nearly the whole group runs or develops actions together or close to identical action, related to the established phases through the construction process of their activities. However, these arguments do not grant actual occurrence of a single reproducibility towards the pieces' decoration as we suppose each craftswoman acknowledges distinctive perceptive behaviour, established by their own peculiar nature.

It shows us, regardless the broadness of the context, that the cognitive construction elaboration is to be expected, diverging only on how they are performed, through constituent strategy of each specificity. Knowledge nature and work motivation established throughout *cuias*' preparation phases can set a dynamic aspect to it, from the universal point of view, so elements' organization which are available and accepted as necessary to the construction and to the mobility of this knowledge must be possible.

Material and immaterial access elements in our context, including biological factors, deep rooted costumes and rooted cultural speech, allow us to identify contexts' specificities, based on the activities construction and operational procedures from nature itself. Thus, we acknowledge a man not excluded from society, as his prime stimuli or *prime science* as an apprehension pivotal element, key to his cognitive knowledge development process.

Therefore, we have chosen to highlight the artefacts' making as an internal order factor, an internal stimulus and it also allows whoever is the raising kind of *cognitive mobility* perpetuity, important to transcend the present moment in search of a

model or a different representation of what had been previously perceived, and highly connected to the produced models, set and rooted on the craftswomen's mind. Thus, this perpetuity lies merely on the inexistence of atypical shapes in variability terms and never made by the craftswomen.

The craftswomen have been making these very much similar records on *cuias*' surfaces for a long time. When ASARISAN started, a new and more meaningful amplitude emerges and embraces even unimaginable possibilities. For example, the request for new shapes, demanding improved skills from them, such as the making of atypical layouts, and the elaboration of a catalogue with diversified dimensions, shapes and iconography.

The incorporation of new layouts and shapes demanded a new organization in terms of possible settings, however it is noteworthy how the craftswomen refused to neglect their heritage and traditional layouts and incorporated their own cultural background on their work. Permanent change perceptions, in terms of instrumental procedures, seem not to jeopardize their own set of practices. In our specific study, the craftswomen's group provides important data to exemplify what Almeida (2001) calls *science* of tradition, which may take into consideration sensitive, subjective relations and *un-rational* as meaningful importance in existing proceeding systems understanding in sociocultural context.

Several questions are yet to be investigated. What lies beneath this knowledge? When it comes to labour activities in pottery, what is the real meaning and importance of these communities in Aritapera? When and where do these beliefs become meaningful to the craftswomen's group? All these research questions are going to find significant answers if we establish a systematic mapping considering the meaning each of them hold to the life to which they belong. So they become viable by setting proper theoretical constructions in further investigations, concentrating on open ended questions.

When liaising with this group while in our study, we have noticed the existence of heterogeneity in terms of procedures and attitudes by their members. This is quite ordinary in any context where diverse and universe co-exist. In our study, we have tried to emphasize the study of applied procedures in the *cuias*' carvings record making, along with the broad understanding of the guiding and structural elements in theses labour activities.

These studies on non-formal learning processes help us understand production/transference knowledge aspects of practices communities, such as the craftswomen, producer of *cuias*, in Aritapera, as well as their own transformation. Over time, social and environmental factors, the cultural dynamics of the encounters, as well as worldwide economic globalization have influence on practices once considered as traditional. Greenfield (1999) stated that in traditional societies which are in changing processes, knowledge transfer, which was primarily performed by scaffold guidance shifts to being done through creation processes and trial-and-error experimentation.

As the craftswomen in Aritapera do not live isolated, interacting with people from big urban centres, they fit their productions to the needs of these centres, constantly re-elaborating their knowledge. We can discuss a formal/informal

continuum in the production knowledge transfer during these *cuias*' production and ornament. Knowledge related to *tapajonic* patterns outlining was introduced into the community by means of formal processes, but were transmitted from the craftswomen to the youngest ones informally.

We wonder if the ornament practice has not been learned through impregnation and by means of LPP, even though there had been a learning situation promoted by a more formal structure afterwards. This idea is corroborated by the fact that, the new aspects (the *tapajonic* patterns) were transmitted to the youngest craftswomen informally, as it used to be.

This matter raises questionings towards Ethnomathematics researches, mainly those attempting to articulate school and sociocultural knowledge for some groups. Most of the times these researches are mainly carried out in schooling contexts, unaware of the deep complexity existing in communities of practice (Wenger 1998) where they are taken from and very superficially adapted to the curricula by means of mathematical knowledge examples.

One cannot forget learning goals at schools are basically propaedeutic, very different from survival and transcendence goals which (D'Ambrosio 2006) summons knowledge production in domestic and professional lives contexts. Shall this *bridge* become more difficult at school due to the assumed artificiality of the context? Close attention to traditional knowledge learning and transfer processes in ethnographic studies in Ethnomathematics can truly contribute to deepen our debates.

It is important to avoid in Ethnomathematics researches an ethnocentric and legitimist look, which intends to notice merely manifestations of what can be understood as mathematics, and which ends up treating sociocultural group knowledge as exotic. The transdisciplinary and holistic view is central to perceive the quantitative and spatial multiple relations within social, cultural, economic, geographical and historical contexts. We also think the knowledge and cultural practices which these students share in their original groups, when incorporated in the school curriculum, can contribute to the permanence and renewal of these practices and traditional knowledge within their original contexts.

The range of artistic possibilities and technical, strategic and material investigation applied, lead our thoughts towards future pedagogical purposes related to Ethnomathematics truly, specially framed for teachers training courses. Learning environments placed around riverbank communities, close to Santarém, Pará, can take advantage of the identified principles in the making processes of these *cuia*s, in such way they can be brought inside the classroom.

This guidance aims at partnering with many other mathematical instrumentation mechanisms, in such way that knowledge gathered from these craftswomen's work may be turned into pedagogical action organizations, so as to improve skills and competences related to measurement, counting aspects and geometrical topology. The conceptual characteristics of such mechanisms can be settled in these environments, along with other subject areas, suggesting a possibility of interdisciplinary integration among knowledge areas capable of showing students a wide range of possibilities to handle daily circumstances.

4.7 Some Possible Methodological Developments Towards the Teaching of Mathematics

The topological notion of such sizing settings in curved spaces and surfaces makes us wonder about sizing, outlining and drawing referential construction's capacity on these types of shapes. Once again, we refer to the setting and making of a *qualitative* mathematical inference, in which agreed references on surfaces allow setting both guiding points alongside structural points applied in the making of such records.

These performed action expressions show elements connected to knowledge of distinct mathematical nature, in a highly-articulated manner, in which mathematical knowledge reflect transdisciplinary and holistic knowledge perceptions. Multiple relations are set due to the strategic action context applied to symbolic and spatial elements which blend with social and cultural contexts and these craftswomen's experience. These interactions allow some elements' prognoses and constructive action factors related to Ethnomathematics goals in terms of educational framework elements.

This investigation, under Ethnomathematics program principles, allows us to foreknow elements of influence over a series of aspects within mathematics teaching reality, mainly when considering the aspect related to life-like reality in which the student is in and mathematics knowledge acquisition. Such approximation can be discussed in terms of interlocution, discussion and understanding of distinct solving procedural methods of similar activity, either formal or informal. This analysis perspective lies on the assumption that it should be possible to understand the mathematics processes interconnected with meaning, with an existing reason which should clearly promote the ability of gradual abstraction and reasoning ability, creativity and cognitive process development.

We might mention, for future researches, the systematic study of patterns and metrics applied by the craftswomen and their similarities in terms of applied strategies in educational settings, by students. Mental calculation elements provided by these craftswomen, through the development of their activities suggest strong connections to cognitive activities like the ones we face under didactic teaching environment and therefore, we suggest further studies to be sensitive to such specificity.

Another possible example for this situation derives from geometry taught at school—the same that is strictly connected to Euclidian Geometry, that is, Geometry, which allows us to appoint answers when we propose them through constructions with rulers and compasses. When we witness, these works performed by these craftswomen and the perfection with which the carvings are done, by means of strategic constructions and cognitive elements, we understand it to be very close to geometric principles susceptible to regular school learning.

When analyzing the different activities developed by the craftswomen, outsiders, such as students, may understand that such strategies represent techniques and processes conceived in order to solve daily need situations. From the point of view

of school curricula, the endorsement of this knowledge as learning and categorical elements placed in educational environment becomes indispensable, in such way that balance between these dialogical areas is likely to be accomplished.

A proposal which can be made to contribute towards formulating a response to the questions placed previously consists of *immersing* parts of the educational community—students, teachers, parents, directors, legal representative etc.—directly into the context of these craftswomen's work, aiming at identifying, locating and understanding social cultural practices which include these women's and their own community life dynamics. However, pedagogical procedures compatible to local reality are necessary.

It is understood as sort of an intervention which can evolve to an action research, aiming at shifting the existing temporary scenario into a long term one. D'Ambrosio (2006) says that "An educator's intervention aims at refining practices and thoughts and instruments for criticism. This improvement does not happen as an imposition, but as an option" (p. 81).

Such actions, which are subjected to the recording of these singularities, have specific time and specific space yet to be figured out. Therefore, this knowledge allows technological organization (to the purest concept of the term) towards the purpose of providing these craftswomen's basic needs. From a knowledge philosophy standpoint, this could result in an improvement in school curricula, so as to establish a dialogue between the multiplicity of thinking and acting ways of this specific group and syllabuses taught in the classroom.

By that, we mean not only subjects such as Mathematics, but any others somehow connected to this process, as History, Geography, Arts or any other area seeking a work based on an experienced reality. Such curricula could contribute to students' intellectual and human growth.

These instrumental activities developed by these craftswomen show us a new perspective in the shape of distinct implicit and singular characteristic knowledge, reflected through codes and some representative patterns set in performed carvings and records. Through these signs and social representations shared by Aritapera dwellers and acknowledged as elements of value and meaning, there is a permanent transcendent and dynamic flow connecting these river bank residents.

Knowledge and culture promotion must be an educational permanent practice in the classroom. Our perspective somehow is close to the fifth approach, presented by Adam et al. (2003), when they classify ethnomathematical researches that establish relations with education. We quote Pinxten and François (2011), who believe that Ethnomathematics must move on from being the *car repair* department of mathematics education, to become its main avenue:

> (…) what goes wrong in the design and sales department of (mathematical) cars will be mended and repaired by the culturally sensitive zealots of Ethnomathematics, we say in an oversimplified and challenging way. We suppose that since we consider Ethnomathematics to be the generic category, its educational part would be the main avenue of mathematics education (Pinxten and François 2011, p. 267).

As seen throughout the craftswomen's work, mathematics ideas come along and provide support to the development of their final work. Therefore, getting students closer to such aspects could help the process of promoting an awareness increase towards the topics to be taught in the classrooms. Thus, knowledge and appreciation of the culture of socio-cultural groups, such as those of the Aritapera craftswomen, should be a constant in the educational practice in the classroom.

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