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## POLYSEMIC PROVOCATIONS OF BORDER NEGOTIATION<sup>1</sup>

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### PROVOCAÇÕES POLISSÊMICAS DA NEGOCIAÇÃO FRONTEIRIÇA

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### LAS PROVOCACIONES POLISÉMICAS DE LA NEGOCIACIÓN FRONTERIZA

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#### ABSTRACT

Considering Ethnomathematics “as path to a renovated education” we discuss it together with curricular ideas exploring mathematics knowledge in different contexts and the communication/translation among them. Permeable borders of mathematics education force translation that is rarely made visible to those involved: young learners move from school to home to various communities; teachers try to translate mathematical discourse into school cultures that can accommodate multiple student life languages of mathematics and learning. On the one hand we can say that curriculum is cultural translation (MOON, 2012). On the other hand, we can provoke translation as opportunity via the conception of Hannah Arendt that translation is a disruption that creates a moment of potential learning (APPELBAUM, 2013). To support our perspective we use examples coming from ethnomathematical research: ethnographic studies of the traditional practice of Xysta (Chios Island, Greece), and from young Roma learners of mathematics in Greece (STATHOPOOULOU, 2005). Through these examples we explore possibilities for making the power relations, authorities, and cultural clashes of life and school mathematics explicit for the children who are asked to carry out translations. We do this as a provocation to action: Instead of a school mathematics curriculum that tries to make processes of translation easier for the learners, we seek a curriculum that recognizes the funds of knowledge that children bring to the understanding of cultural translation. Translation is both disruption that make learning possible as border pedagogy, and the place of carnival in an uncanny valley that resonates with possibility.

**KEYWORDS:** Ethnomathematics. Translation. Uncanny Valley. Carnival. Border Pedagogy. Mathematics Education.

#### RESUMO

Considerando a Etnomatemática "como um caminho para uma educação renovada" e em conjunto com outras ideias curriculares, discutimos e exploramos o conhecimento matemático em diferentes contextos e a comunicação/tradução entre eles. Fronteiras permeáveis da educação matemática forçam a tradução que raramente é visível para os envolvidos: jovens alunos que passam da escola para casa e para várias comunidades; professores que tentam traduzir o discurso matemático em culturas escolares para que possam acomodar as múltiplas linguagens de vida e de aprendizagem. Por um lado, podemos dizer que o currículo é a tradução cultural (MOON, 2012). Por outro lado, podemos provocar a tradução como uma oportunidade por meio da concepção de Hannah Arendt de que a tradução é uma ruptura que cria um momento de aprendizagem potencial (APPELBAUM, 2013). Para apoiar a nossa perspectiva, utilizamos exemplos provenientes da pesquisa etnomatemática: estudos etnográficos da prática tradicional de Xysta (Ilha de Quiós, Grécia) e de jovens Roma, aprendizes de matemática, na Grécia (STATHOPOOULOU, 2005). Através destes exemplos, exploramos as possibilidades de tornar explícitas as relações de poder, de autoridade e de conflitos culturais da vida e da matemática escolar para as crianças que são convidadas a realizar as traduções. Fazemos

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isso como uma provocação para a ação: Em vez de um currículo de matemática escolar que tenta facilitar os processos de tradução para os alunos, buscamos um currículo que reconheça os fundos de conhecimento que as crianças trazem para a compreensão da tradução cultural. A tradução é tanto a ruptura que torna o aprendizado possível como uma pedagogia da fronteira e como o lugar do carnaval em um vale estranho que ressoa com possibilidade.

**PALAVRAS-CHAVE:** Etnomatemática. Tradução. Vale do Estranhamento. Carnaval. Pedagogia de Fronteira. Educação Matemática.

## RESUMEN

Considerando las Etnomatemáticas "como caminos para una educación renovada", las discutimos junto con ideas curriculares explorando el conocimiento de las matemáticas en diferentes contextos y la comunicación / traducción entre ellas. Fronteras permeables de la traducción de la fuerza de la educación matemática que rara vez se hace visible para los involucrados: los estudiantes jóvenes se mueven de la escuela a casa a varias comunidades; los profesores tratan de traducir el discurso matemático en culturas escolares que pueden acomodar múltiples idiomas de vida estudiantil de matemáticas y aprendizajes. Por un lado podemos decir que el currículo es la traducción cultural (MOON, 2012). Por otro lado, podemos provocar la traducción como una oportunidad a través de la concepción de Hannah Arendt de que la traducción es una interrupción que crea un momento de aprendizaje potencial (APPELBAUM, 2013). Para apoyar nuestra perspectiva, utilizamos ejemplos procedentes de la investigación etnomatemática: estudios etnográficos de la práctica tradicional de Xysta (isla de Chios, Grecia) y de los jóvenes romaníes que estudian matemáticas en Grecia (STATHOPOULOU, 2005). A través de estos ejemplos exploramos posibilidades para hacer explícitas las relaciones de poder, las autoridades y los choques culturales de la vida y las matemáticas escolares para los niños a quienes se les pide que realicen traducciones. Lo hacemos como una provocación a la acción: en lugar de un currículo de matemáticas escolar que trata de facilitar los procesos de traducción para los estudiantes, buscamos un currículo que reconozca los fondos de conocimiento que los niños aportan a la comprensión de la traducción cultural. La traducción es a la vez una ruptura que hace posible el aprendizaje como pedagogía fronteriza y el lugar del carnaval en un valle misterioso que resuena con la posibilidad.

**PALABRAS CLAVE:** Etnomatemática. Traducción. Valle de Extrañeza. Carnaval. Pedagogía Fronteriza. Educación Matemática.

## INTRODUCTION

Although the Ethnomathematics (EM) approach emerged originally as a response to issues of mathematics/mathematics education and inequalities in non-Western countries, we consider it as a dynamic field of knowledge and action built around the notion of culture and its connections to mathematics/mathematics education, as well as an approach that equally can inform mathematics education in Western areas. Since the notion of culture is crucial in our framework, we clarify that we conceive it as a complicated analytical category that is both "an historically transmitted pattern of meanings embodied in symbols, a system of inherited conceptions expressed in symbolic forms by means of which men communicate, perpetuate, and develop their knowledge about and their attitudes toward life" (GEERTZ, 1973, p. 89), and those "webs of significance" people themselves spin". Speaking about power/ power relations, we adopt the idea that a power relations network forms a dense tissue that crosses the mechanisms and institutions not located precisely on them (FOUCAULT, 1978, p. 120).

EM is by definition a fruitful and interdisciplinary field that has changed the way we conceive mathematics as well mathematics education. We should no longer be willing to think of mathematics and mathematics education as far removed from culture, politics, and controversy. Ubiratan D' Ambrosio, in his book, *Ethnomathematics: Link between Traditions and Modernity*, describes EM as “the mathematics practiced by cultural groups, such as urban and rural communities, groups of workers, professional classes, children in a given age group, indigenous societies, and so many other groups that are identified by the objectives and traditions common to these groups” (2006, p. 1). He presents Ethnomathematics as a program through the following dimensions: the Conceptual Dimension, the Historical Dimension, the Cognitive Dimension, the Challenges of Everyday Life, the Epistemological Dimension, the Political Dimension, and the Educational Dimension – pointing out in this way the holistic quality of EM.

In particular, D'Ambrosio (2006) stresses the political focus, and notices that EM is embedded in ethics, and specifically on the recovery of the cultural dignity of the human being because the:

(...) dignity of the individual is violated by social exclusion, which often occurs as a result of failing to pass the discriminatory barriers established by the dominant society, including, and principally, in the school system; but also by making costumes of the traditional garb of marginalized peoples; folklore of their myths and religions; crimes of their medical practices; and for making of their traditional practices and their mathematics, mere curiosity, when not the target of derision (p. 1).

Consistent with D'Ambrosio's conception of EM as a way to challenge the discontinuity of both students' everyday reality and mathematics classroom reality, he notices, with respect to the diversity, the need to reconsider curricula aiming to respond to diversity and to social inclusion issues. In our contribution to this dossier, we take this initiative one step further, and propose that translation within liminality at once disrupts smoothness of border crossings from one social reality to another, and awakens possibility within this disturbance and disruption.

Whereas researchers have approached ethnomathematics in recent decades through a variety of points of view: as a research activity (GERDES, 1994); as a subject of study (D' AMBROSIO, 1985); as a way of behavior (ZASLAVSKY, 1994); as a form of expression (BORBA, 1990); and as a language of communication (BORBA, 1990) – a problematic notion of culture permeates each of these approaches. Early phrasing of ethnomathematics, consistent with the anthropological understanding of culture as defining difference, was not yet influenced by the discourses of cultural critique, nor by post-colonial

concepts of creolized inter-cultures, and consequently re-established indigenous mathematical and pedagogical traditions (those not included in the standardized, normative, Colonialist curriculum) as inferior and less sophisticated than those set by developed nations as *universal*.

In this paper we are trying on the one hand to present a panoramic approach to mathematics knowledge, putting the light on different aspects of EM in order to communicate different perspectives of EM: the role of EM in valuing knowledge that is developed and used in several out of school contexts, the way of integrating these experiences and ideas in developing alternative curricula, the role of EM in using students funds of knowledge in order to facilitate their inclusion mostly when we speak about students out of main stream. On the other hand, learning from the field of robotics and its notion of the uncanny valley, and using the metaphor of carnival in the style of Bakhtin (1984) – based in his work, Rabelais and His World – we attempt to explore an even broader aspect of EM: Through this connection we explore alternatives that make it possible to critique EM yet also use its methods and ostensible purposes to challenge the established order in mathematics classroom.

How we go ahead: we explore the landscape of mathematics education through the metaphor of the uncanny valley (Appelbaum 2011), to raise the complexity of the ethnomathematics-mathematics and ethnomathematics-mathematics education boundaries and border crossings. We, then, present the experience of an ethnomathematics research in the spot studying a traditional practice and the educational implications of this. Next we present the experience of our work with Roma students and their community of origin and the connection with Roma students' (mathematics) education. We finally introduce the notion of translation as unlearning-learning, as a way to pull these various polysemic regions together across the terrain of ethnomathematics.

In referencing our prior work connected to EM, we emphasize two foci: craftsmen's practices of *xysta* in their cultural context on an island in Greece, and their exploitation in mathematics teaching and learning (we discuss the different environment that are created in mathematics classroom); and our work understanding the experiences of Roma youth in Greek schools. The notion of translation as a method of dwelling in the uncanny valley allows us to remain in the carnival of border pedagogies rather than trying to tie together two or more distinct realms or cross boundaries of polysemic territories as we form a practice of ethnomathematics.

## MATHEMATICS LEARNING IN THE UNCANNY VALLEY

The concept of the uncanny valley has its origins in the field of robotics. Japanese engineer Masahiro Mori hypothesized in the 1970s that robots and other representations of real living things are attractive to people as they become more and more real, but that there is a range of closeness to the real that is not real enough, and in this range people are repulsed. He graphed human reactions to robots that he had designed, and in this graph one finds a deep valley of negative response when the representations are lifelike, but not lifelike enough. The hypothesis was used to explain audience negativity in response to the film *Polar Express*, and has been useful in videogame design, film animation, recent robotics work, and theme park design.

We offer the notion that this concept can be extended metaphorically to any design science. In this way, we think of educational programs as designed. They represent a sort of engineered reality to us. When they appear very much like our expected reality, we are attracted to them. But when they are too much like our expected reality, yet not exactly close enough, we find ourselves in that uncanny valley, and are repulsed. The question is what it takes to push us past the range of the valley into the pleasurable, positive reactions that Mori hypothesized for robotics. If we can figure this out, then we become highly successful as educationists, consulting for videogame companies, themeparks, robotics firms, and any other design scientists. We might also find a new, deep sense of satisfaction in our educational work.

Most specifically, we can say that ethnomathematics and school mathematics share an uncanny yet disturbing resemblance – similar enough to create a feeling of the uncanny, yet not similar enough to create the *jouissance* of intermingled delight. This is a way to set up an understanding of the funds of knowledge that learners bring from culturally embedded practices into school –teachers and curriculum developers see the funds of knowledge within the uncanny valley of repulsion rather than as resonating in the joys and visceral thrills of identification. Likewise, the school mathematics is experienced by learners as similar to –yet not similar enough to –the mathematics of those culturally embedded life experiences that they live through in their everyday lives. We might say that there is a compulsively strong urge to focus on the other even as one recoils, in the same uncanny way that we might experience a mannequin in a clothing store window, or our own reflection in the mirror.

Though originally intended to provide an insight into human psychological reaction to robotic design, Bryant (2006) claims that the concept expressed by the uncanny valley is

applicable to interactions with nearly any nonhuman entity. The idea is to imagine a plot of emotional response against similarity to human appearance and movement; the curve is not a sure, steady upward trend. Instead, there is a peak shortly before one reaches a completely human *look* (...) but then the curve plunges into a deep chasm below neutrality into a strongly negative response, before rebounding to a second peak where resemblance to humanity is complete.

This chasm — the uncanny valley of Doctor Mori’s thesis — represents the point at which a person observing the creature or object in question sees something that is nearly human, but just enough off-kilter to seem eerie or disquieting. In our case, the school mathematics may or may not look more or less like everyday mathematics; or vice versa; or, ethnomathematics-influenced curricula may or may not look more or less like the reality of traditional school mathematics; or vice versa. The first peak is where an individual would see something that is human enough to arouse some empathy, yet at the same time is clearly not enough human to avoid the sense of wrongness. The slope leading up to this first peak is a realm of relative emotional detachment — affection, perhaps, but rarely more than that.

Figure 1 (Bryant, 2006) describes curves of emotional response, plotting it (from top to bottom) first against how closely an entity’s motion resembles human movement, then against physical resemblance to human appearance, and last against a synthesis of the two.

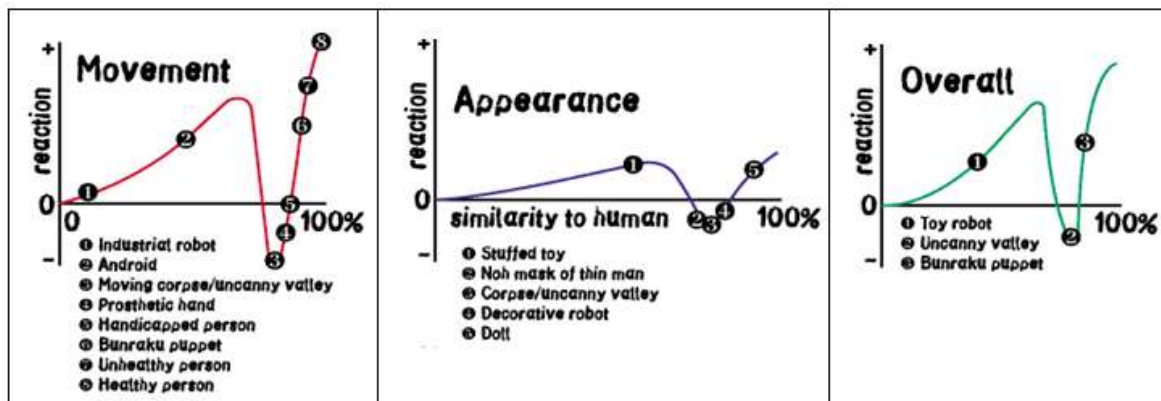


FIGURE 1 – Emotional response

Source: <http://www.terraforming.com/auti02.htm>

It is significant to note, judging from the relative depth of the curves, that Dr. Mori apparently considered motion more important than simple appearance, though he stressed that both are affected at least as much by subtle nuances as by more striking factors. We can extend the metaphor back to mathematics and/or mathematics education to consider motion as flow and change in ideational positions or status, hierarchy, or dimension.

Mori recommended that designers should not try too hard to duplicate human appearance, since some minor flaw would likely drop the unfortunate android or cyborg into the uncanny valley. He favored prosthetics and robots remaining visibly artificial, but smart and stylish in appearance, placing them near the top of the first peak in the graphs. We could translate the recommendation metaphorically to educational programs, where those that look initially a lot like traditional human schooling are appealing until the *flaws* of difference are revealed as uncanny, dropping them into the creepy valley of revulsion. Thus the fate of innovation would be to make programs that employ ideas of critical pedagogy and border pedagogy clearly unlike those that would be understood as *normal*. Yet they would seem to need to be stylish, according to Mori, appealing to educational fashion. An alternative would be to make the programs so real that they are no longer repulsive but are instead embraced, being placed to the extreme right on our graphs.

But we can see in this setup of the uncanny valley that one is quickly tempted to imagine two worlds of experience and a border between them. The question is, can we cross over the border through verisimilitude? The fantasy is one of perfect translation so that the languages of each are mapped isomorphically, in order to create a perfect, harmonious match. Hence we take learners of mathematics in everyday life and in school as needing to create a perfect translation from one realm to the other, and vice versa. However, such a fantasy may not be ideal for our purposes. We suggest that the translations are most powerful and helpful when they do not match. When there is a disruption with translation, we have the opening to understand our ignorances, and to fashion new border knowledges and practices that live in both worlds and in their own world of liminality at the same time.

### *Stories of continuities and discontinuities of mathematics knowledge*

In this section we attempt to make connections with the above ideas through an example from our own ethnographic research.

#### *a. The story of Xysta: (re)bridging two different realms*

This research concerned a traditional practice (Xysta<sup>4</sup>) and its educational implications: Using mathematical ideas and techniques coming from this practice we created a liminal space in mathematics class aiming to a fruitful dialogue between these ideas and mathematics (formal curriculum) that challenged the everyday reality of a geometry class. We use the term liminality in the way it was adopted by the anthropologist

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<sup>4</sup>For more information regarding Xysta, please see: Stathopoulou (2006, 2007).

Victor Turner (1969) and was introduced earlier by the Ethnographic Van Gennep [1909] to describe a point between two situations; in our case: mathematics classroom context, everyday context.

The objective of the original research on the spot was twofold: on the one hand to explore the connection of this practice with the culture and the community, and on the other hand to explore mathematical ideas incorporated within this practice either by observing the patterns already constructed or by observing traditional craftsmen *in situ*. Xysta are a kind of graffiti that appears at the village of Pyrgi, one of the medieval villages of Chios (a Greek island). Xysta for this village constitutes an important tradition strongly connected to their identity<sup>5</sup> (figure 2).



**FIGURE 2** - 'Xysta' on houses façades  
Source: Authors' personal file

Looking at the above figures we can recognize lot of mathematical ideas that are, also, included in mathematics curricula at school, like: Geometrical constructions (geometrical shapes such as rectilinear or circular figures), several kinds of transformation (translation, rotation, and reflection), patterns, the golden section.

The research on the spot was not only focused on the study of the already constructed Xysta that decorate houses facades, but also to the procedure of their construction. In situ observation and interviewing of two traditional craftsmen working on the construction completed the pragmatological material. Through this observation two important notices seem to be remarkable. The first concerns the fact that all these patterns are constructed only by the use of just two tools: a compass and a lath (straightedge without markings) (figure 3).

<sup>5</sup>Why do you like to have xysta at your house? "Because I'm a Pyrgouis (= habitant of Pyrgi). Jesus Christ was born in the manger and the manger is what he remembers". This came by the discussion of an 80-years old man. Other people also expressed similar aspects regarding Xysta.





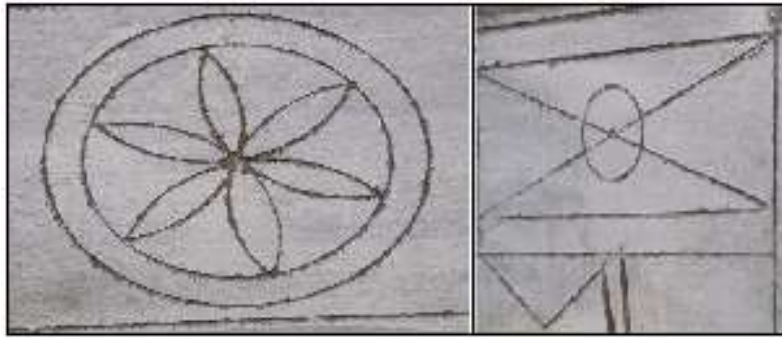
**FIGURE 3** - Tools: a lath and a divider

Source: Authors' personal file

Thus these constructions recall the only constructions that were acceptable in the ancient Greek mathematics. The second concerns the realization that the craftsmen used important mathematical ideas — despite they were not aware of it—without care about both the corresponding theory and why some mathematical ideas were applied. For example, they constructed 'parallel lines, rectangles, rhombi, squares; they determined the center of a rectangle, they divided circles into 6 equal parts, etc., in mathematically accurate ways. In the question addressed to the one craftsman about how did he know (using the compass) that the circle was separated in 6 equal parts, he replied: “It will, me as a craftsman have learnt this”.

The above briefly presented experience of Xysta informed the design and implementation of an interdisciplinary project that was carried out in a group of 10<sup>th</sup> grade students in the 2<sup>nd</sup> high school of Ilion in Greece (STATHOPOULOU, KOTARINOU; APPELBAUM, 2015). Mathematical ideas and technics of Xysta came to dialogue with mathematics teaching in the classroom together with the use of WebQuest and Drama in Education techniques in order to support the experiential dimension of the project.

For the project's purposes we provided to students, among other materials, pictures of Xysta on houses façades as well as pictures of craftsmen constructing geometrical patterns (figure 4).



**FIGURE 4 - Xysta under construction**  
Source: Authors' personal file

In Geometry's class we tried to develop a dialogue between the mathematics that are hidden in the pattern of Xysta and the formal mathematics that is taught according to the curriculum. We explored questions like:

- Could students (re)think and reflect about the mathematical ideas hidden in Xysta's construction?
- How does the discourse of an informal (mathematics) practice introduced into the mathematics classroom interact with the emerging mathematics classroom discourse?
- Which is the additional value of inserting in mathematics classroom ideas of informal mathematics?
- Does the discussion on ethnomathematical ideas provide a suitable framework for renegotiating the dichotomy of formal-informal knowledge?

In this context, as Rosa and Orey (2006) note that:

(...) ethnomathematics emphasizes the communal and tends to connect mathematics with its contexts. If these two components are to be brought together then Ethnomathematics may be conceived as an overarching aspect of the curriculum because mathematics may be humanized, that is, Ethnomathematics may be viewed as a philosophical, contextual, affective, and attitudinal approach to the curriculum (p. 64).

In our case, the students were able to think through ethnomathematical methods about the material craftsmen used for the construction of *xysta* in the context of time and historical conjunctures. Along with the mathematics they learned about the roots of this tradition and in general the potential connections of mathematical ideas with their local history and culture. Xysta of Pyrgi, in this case, were understood in the context of the architecture of the buildings, the social relationships among the people of the island (part of which happens outside houses), and a building's architecture. This all happened in a

classroom and social space different from the typical one of everyday teaching, and in a set of experiences that honored and required individuals' critical thinking.

A discussion was held about geometrical tools and the way they are recontextualized by the craftsmen during the construction process; they could be transformed for responding to a specific situational process to a situational affordance. Students noted and discussed the curious fact that craftsmen used the tools that are accepted for strict mathematical constructions; however the constructions were made approximately because of tools' nature and the context. Developing a dialogue between in and out of classroom mathematics discourse, students had the opportunity to reconsider their ideas about mathematical knowledge and the dichotomy of it in formal and informal.

Introducing ethnomathematical ideas in the mathematics classroom, through an out-of-school practice, a liminal space was created with new Discourse — a blend of the Discourse of the informal practice and of the formal one of the mathematics classroom, dictating new forms of participation legitimized by this space of learning in the context of the mathematics classroom through a rich repertoire of resources and tools.

Some students' quotes depict the kind of the space that was created in the mathematics classroom, and the way this space affected students in terms of both mathematics and cultural issues, in addition to challenging the dichotomy of formal-informal knowledge.

- *'During the whole process, the connection of Geometry with everyday life and art was merged'.*
- *'Many times [mathematics] there is a simple knowledge that is useful in our everyday life. There is no need to be a scientist to use mathematics, it isn't so difficult'.*
- *'I could not think that people like craftsmen do mathematics (...) although we use symmetry in our lives, we have learned symmetry only as a procedure'.*
- *We saw Geometry in a different way. It's something new to us, because here (in every day class) we do Geometry simply for solving, for estimating angles, finding parallels and thing like these'.*
- *School does not give children the opportunity to understand that mathematics are useful in something'.*
- *'I was surprised of the way they made the figures, using the traditional tools that are connected with the geometrical constructions in ancient Greek'.*

Through this project based on ethnomathematical ideas we inserted a dialogue about knowledge, culture and context; we inserted a bridge to integrate mathematical ideas. The negotiations that take place contribute not only for a smoother transition between students' life worlds and the science [mathematics in our case] classroom, but more importantly, it also challenges the tight boundaries of school science funds and discourse to be more fluid and porous to nontraditional student resources (BASU; CALABRESE; BARTON, 2007). The validation of diverse funds of knowledge — basic for an ethnomathematical approach — and discourse, as legitimate mathematics classroom resources, positions informal knowledge students as rightful experts of certain knowledges directly related and applicable to school in several subjects.

A context like this “sheds light on science [mathematics] learning because it offers a way of understanding how learning science [mathematics] involves learning to negotiate the multiple texts, discourses, and knowledges available within a community as it is about learning particular content and processes” (BARTON; TAN, 2009, p. 52). It also redefines “the role of the learner as a contributor, collaborator, and leader in the learning culture” (NOVEMBER, 2012, p. 6). The learner is not crossing boundaries but finding ways to remain in both sides of any boundary while tolerating those who refuse to participate in this liminality enough to share in their more limited discourse at the same time as reveling in the carnival of the uncanny valley.

#### *b. Roma students stories: improving Roma students participation*

The Greek educational system, like most educational systems in European countries, doesn't effectively respond to a school reality characterized by linguistic and cultural diversity. The applied pedagogies formulate a field of unequal distribution of opportunities for recognizing and exploiting the learning resources included in the linguistic and cultural capital of a diverse student. Since Greek schools' practices guided by an assimilationist ideology seem to ignore or understate fundamental characteristics of children's cultural identities and as a consequence Roma children have erratic school attendance and in the class stay in silence feeling their world marginalized and underestimated (NOULA, COWAN; GOVARIS, 2014). Furthermore, top-down educational policies addressed to the mainstream students, combined with the ways that teachers interpret and materialize those policies in contexts including Roma students, appear to significantly account for diminished school attendance of Roma children.

Aiming to respond to this situation, through a recent Project regarding Roma kindergarten students' education we tried to develop a bottom up curriculum for language

and mathematics teaching. Through ethnographical work in the classroom, in schoolyard and in the community of students' origin we selected pragmatological material that were put in dialogue with school curriculum; we attempting a dialogical approach (ROSA; OREY, 2015), bridging emic and etic approaches for better understanding of mathematics.

Here we provide a short story, part of this bottom up curriculum. It is an activity based on ideas coming from students' everyday experience. It had to do with the use of (playing) cards, an endeavor familiar for both adults and children, as we had observed being with them in the community and as well as in schoolyard. We are not going to discuss here the mathematical objectives of the activity (it is out of our aim) but we will stress the fact of participation: Roma students, due to their familiarity were willingly involved, gained *voice* in classroom, (could count up to 10 using the cards for particular familiar games). Actually, during the negotiation of this activity Roma students presented a significant difference in both; involvement in learning process and in classroom interaction (with teacher and peers). Indeed, in some cases Roma students helped the non-Roma since they were more familiarized with this practice; something that could be seen as subversion of everyday situation in the classroom.

It seemed that the association of extracurricular activities, compatible with an ethnomathematical perspective, in conjunction with the strategic support of every communicative resource they hold (eg. mixing of languages and other types of semiotic resources as the design, music etc.) created a borderline learning space that supports student's involvement in the learning process. It facilitated a dialogue with the different kind of knowledge; with different discourses. Accepting and validating what students considered as their 'own' improved their self-image and supported the renegotiation of their identity as equal participants in classroom interaction. The overall practice constituted a small step to the development of a framework where cultural backgrounds are a tool for change.

## **MATHEMATICS LEARNING IN LIMINAL TERRITORY**

In the language of multiculturalism and diversity education, and ethnomathematics, others are the vehicle of the gaze that sets up the uncanny, and, in the process, chasms of difference. That is, *others* are constructed by the assumptions of most forms of multiculturalism in its misleadingly optimistic, liberal perspective; these others become mirrors through which we see ourselves, and thus, through the mirroring process, establish

the uncanny. Border pedagogy events<sup>6</sup>, in contrast, enable all participants to celebrate the exchange of identity made possible by the presence of *carnival*, in the sense of Bakhtin, which it is explain below. In this way, border pedagogies avoid the uncanny gaze of the mirror of others. Elizabeth Garza's description of the U.S./Mexican border and its constant cultural indeterminacy, for example, sounds very much like the distance between mathematics in school and mathematics in everyday life:

(...) the same barrier dividing the people who live on each side of it also creates a unique set of life experiences that they share in common (...) in a counterintuitive paradox the border itself becomes a unifying factor illuminating surprising similarities among borderlands inhabitants living on both sides (GARZA, 2007, p. 2).

Yet far from describing the uncanny, creepy, haunted house of educational theory, she shares how meetings of teachers from both sides of borders brought hope and ideas to her work, as well as their own. Why the difference? Bernardo Estrada (2006) suggests that a paradoxical sense of unity grows out of a focus on the seeming split of a border, as participants in border pedagogy events are challenged to seek changes in unjust barriers to quality education for all students in these *border regions*<sup>7</sup>.

The strategies that we discover and develop together create a vibrant energy within each of us, an excitement to go back and try these in our classrooms. Through understanding that there are no recipes or formulas, no checklists or advice that describe the one best way to educate all children, Border Pedagogy participants are discovering new ways of relating and engaging students, caminos that allow students to become critical thinkers and creative problems solvers (ESTRADA, 2006, p. 36).

Within the context of ethnomathematics, border pedagogies enable all participants to claim membership in 'the borderlands' and in this respect no one is superior or dominant as the authority on borderland experience. Instead of the all too common uncanny, haunting gaze of 'the other', a spontaneous regrouping often takes place, based on a sense of a shared identity and experience as borderland inhabitants. Participants are positioned to explore educational topics from that common ground. For example, when discussing the issues of cultural and linguistic diversity in education, Garza's (2007) students, future teachers, drew on their experience as inhabitants of the border region to build deeper understanding. They found many common threads, all of which took on new importance for

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<sup>6</sup> We use the word "event" for any pedagogical or educational encounter, formal or informal, such as a classroom lesson, teacher group meeting, etc.

<sup>7</sup>The examples cited here reference the U.S./Mexico border; however, the notion of border region can be extended to many geographic borders, such as South Africa/Zimbabwe, Pakistan/Kashmir/India/China, the Basque regions of Spain/France, etc.

these students because they saw each thread as woven into preparation for teaching in the border region.

We employ Bakhtin's (1965) idea of *carnival* to describe the rich border pedagogy experiences. For Bakhtin, *carnival* is associated with collectivities. Those attending a carnival do not merely constitute a crowd; participants see themselves as a whole, organized in a way that defies socioeconomic and political organization. According to Bakhtin, "all were considered equal during carnival. Here, in the town square, a special form of free and familiar contact reigned among people who were usually divided by the barriers of caste, property, profession, and age" (p. 10).

The carnival atmosphere challenges dichotomies by holding the lower strata of life most important, as opposed to higher functions (thought, speech, soul) usually privileged in the signifying order. At carnival time, a unique sense of time and space causes individuals to feel they are a part of the collectivity, at which point they cease to be themselves. It is at this point that an individual exchanges bodies through costume and mask and is renewed. At the same time there arises a heightened awareness of one's sensual, material, bodily unity and community. Differences are transformed through exchange in *carnival*, rather than analyzed or avoided; that is, rather than juxtaposed<sup>8</sup>.

We commonly look to the juxtaposition of differences as a source of learning and growth. We might claim hope for multicultural encounters because participants are confronted by the experiences of the other. But we can see from the perspective of the uncanny that these mirror experiences that return our gaze are likely to cause revulsion rather than a pleasure of learning about ourselves and others. They create gaps or ruptures instead of bridges or conduits of exchange. Educational theorists like rupture, they themselves are not easily trapped in the uncanny valley of this educational landscape, or at least do not feel so trapped. Yao (2005) has described the appeal to rupture as a potential site of learning - such as between what we know and do not know, or between what we know and cannot know, or between what we know and do not want to know - as the *unheimlich maneuver*.

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<sup>8</sup>Our use of carnival is in the *longue durée* sense of Bakhtin (1965), Le Roy La Durie (1979), and Davis (1975). More recently there has been scholarship on carnival as experienced in unequal ways that seem to suggest class, race, and other categorical differences, so that carnival can be one more social institution of social reproduction; see Scheper-Hughes (1992) and Malewski (2009). Our claim is that border pedagogies more closely resemble the former rather than the latter.

What we find in such experiences is accusatory *others*, an uncanny gaze back at us that shows us - ourselves - to ourselves as different from whom we thought we were. The legacy is the ghostly trace of those encounters that haunt us – uncannily – for the rest of our lives. In many multicultural education contexts, the uncanny experience strengthens resistance to learning rather than encouraging such learning. The gaps between people are crystallized rather than permeated. Thus, the *unheimlich* reinscribes Eurocentric Enlightenment ideology within the post-colonial project, reifying categories and differences rather than reinventing them.

Thus multicultural meetings with difference, while as erotically alluring as the mannequin character that led Freud to write about the uncanny in the first place, tend to be surprisingly disappointing as learning opportunities. This is because they fall into the uncanny valley. The *unheimlich* is a frantic Freudian dependency on estrangement and alienation for a claimed personal or social transformation. Yao urges an alternative to *gaps between*, which he paints for us through the notion of a gradient – a conception of difference that operates not through absolute, fixed distinctions, but rather by means of relative, phased dimensions.

Instead of a radical discontinuity, this model of difference works with spectra or series of continua of variance. Gradients make it possible not only to undertake comparisons along any number of conceptual or material axes, but also to recognize gradations within and among those dimensions of difference. This shifts the domain of comparison into a multidimensional space of potential relations instead of focusing on discontinuities. The gradient reconfigures the very conditions and possibilities for comparison.

The gradient may be what is happening in those border pedagogy events that Garza and Estrada so glowingly report. For when we think of borders as ‘borderlands’ – either geographically or literally, or figuratively in a conceptual landscape, we place ourselves within a creolized *intercultural* and liminal territory (CLIFFORD, 1988). Borders are concrete lines of differences, whereas borderlands are permeable, ill-defined areas with no specific borders. We are no longer looking in from a critical standpoint outside, as might be the case with epistemologies of ignorance and their three fixed dimensions that situate knowledge along parallel, independent paths. Instead, we are *in* the borderlands, wherever and whatever they might be, with whatever shifting sense of difference and continuity they imply. Jaime Romo (2005) writes, “In contrast to popular negative views, border pedagogy affirms, interrogates, and negotiates sociocultural differences” (p. 194).



We offer this way of being as *liberated* in the uncanny valley, because it slides along gradients of culture and concepts, rather than jumping into crevasses. The intercultural wrestles with difficult experiences of power and authority while celebrating in this difficult work the joys of the uncanny. Parallel cultures, either geographically or in the realms of knowledge and ignorance, eliminate in some ways the critical issues of power and the interrelationship of subordinate and dominant groups.

Border pedagogues seize the very tools of the uncanny – the haunting of what we know, do not know, and cannot know - and make them the tools of practice; the uncanny becomes the point of their work, and power and authority are new materials of theory and practice. In this way, these theorists look for new mirrors because they promise new gazes, rather than anticipating what they might reveal. They enjoy the uncanny expectation as a defining feature of what is special about the intellectual challenges of their work in the borderlands, living the embrace of critical multiculturalism (APPELBAUM, 2002; CHICAGO CULTURAL STUDIES GROUP, 1992; KANPOL; MCLAREN, 1995).

Braiddoti (2005) describes a new European version of this carnival in terms of the dominant centers deconstructing their powers and letting them be, while the marginal become the motors of change; her point is to bypass the gaps of a dialectic between center and margin, so that we can celebrate the abilities that accompany not knowing, in order to creatively *be with* the not knowing. Schwart (1995) quotes Audre Lorde in her explication of critical multiculturalism: “It is a waste of time hating a mirror or its reflection instead of stopping the hand that makes glass with distortions” (LORDE, 1992, p. 85). And, we need to take this to heart. There is no point in getting mad at educational theory for its uncanniness that haunts our everyday lives and futures.

What is this something that comes *very close*? That is *disquieting only to the extent that it is close*? As we struggle to break away from hegemonic discourses, the traces of signs, signals and signatures appear in uncanny ways to haunt the work. The ghosts [are] *at work* in the curriculum (BRUCE et al., 2003).

There is no point in being afraid of ignorance. It comes with the territory. It is part of the pleasure. *Bukimi* has a strange and uncomfortable origin in a haunted history we wish we could forget; but it is lived by people who carry that legacy into new borderlands, making use of its pleasures as well as its horrors. It is in the pleasures that we find the carnival.

## MATHEMATICS LEARNING AS A TRANSLATION

The philosopher Hannah Arendt preferred to write not in her mother tongue of German, but in her less comfortable languages, English and French. She found that writing in the second and third language disrupted her thinking enough to *unlearn* assumptions and commonsense forms of thinking, and to help her clarify precisely what it was that she did want to say. We can take from her this clever form of critical pedagogy back into the carnival of the uncanny valley: as people move in and out of subcultural and political contexts, everyday practices in and out of school and home, political protest and workplace practices, one might say they need to render the mathematics of a non-mother-math, clarify precisely what it is that they are mathematically speaking and hearing, reading and writing, and in essence, using mathematical translation to unlearn assumptions and commonsense forms of thinking.

### *Creating a liminal space in mathematics classroom: a dialogue between everyday and school knowledge*

In this section we challenge the classroom reality attempting translations and exploring ways in which can work: only as resource, only as an obstacle, as both, as disruption that creates a moment of potential learning. Research has shown that dichotomy between formal and informal knowledge is a source of difficulties in learning mathematics in school and in knowledge's exploitation in both ways (from school → everyday, everyday → school) or better knowledge's exploitation in multiple chassis and levels. Here we discuss the attempt to exploit everyday knowledge Roma students acquire in their cultural context, as it was arose through fieldwork in Roma students' community of origin, in mathematics teaching in the classroom.

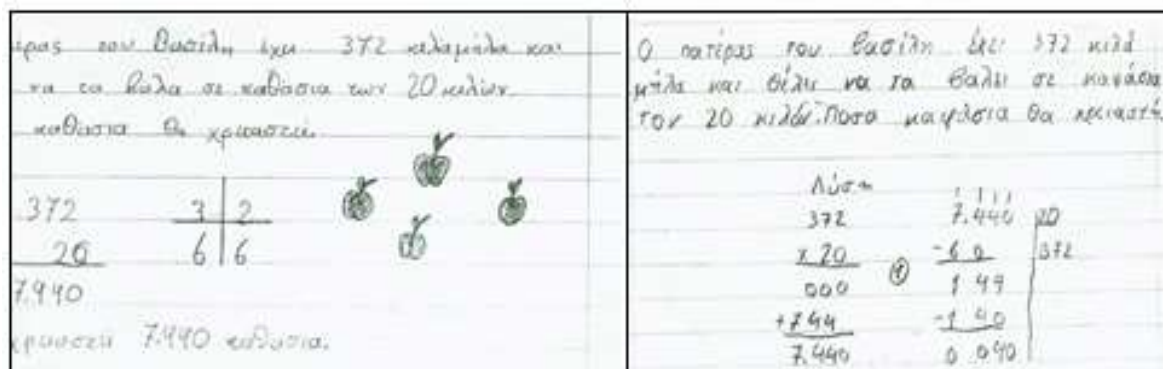
Inserting two examples that potentially constitute translations from the one realm to the other we have the chance, among others, to explore if they match or not and if they provide learning experience in both cases. Also issues of knowledge's complicated nature are emerged helping us to understand that the use of students' knowledge and students' mathematics learning it is not a just linear relationship and a reconsideration of mathematics education in a broaden way is needed. The first example concerns a typical division problem that was posed to Roma students in a first grade Roma class. The group of students that involved in this activity was of 10-12 years old — despite students of first grade — and they had attended the class for about one month. So students had no idea about the fact of division and much more of its algorithm.

The problem: *Vasilis' father has to distribute 372 kilograms of apples into 20 kilogram crates. How many crates are needed?* was effectively solved by all Roma students through effective strategies, different than typical division algorithm. Actually two main strategies were selected. The one was a continuous subtraction: Christos, subtracted 20 from 372 and using repeated subtraction reached the correct result. He did all the calculations mentally without the need of writing anything. The other Roma children corresponding the one crate to 20 kilos performed continuous additions and were also effective. For example, Apostolis for each crate draw one line, while for testing the result came back put a sign to each one line. In the following picture is Apostoli's version.



**FIGURE 5 – Roma student's solution**  
Source: Authors' personal file

What was important of this experience and deserves discussion, but perhaps, partly, exceed the objectives of this work, is the way non-Roma students of other classes dealt with this problem. In the following two figures, the solutions of two non-Roma students of 4<sup>th</sup> and 5<sup>th</sup> grade (same age with Roma) are provided (figure 6).



**FIGURE 6 – Non-Roma students' solution**  
Source: Authors' personal file

In the first case Roma students were asked to solve the problem by the researcher (the one author) while they have established relationships of trust, of respect, since the

researcher were each day also to the community sharing everyday experiences and reflecting on them as well as contributed to several performances in the communities as for a example celebrations of cycle life. Furthermore, students in the classroom were encouraged to collaborate, to select and apply their own strategies and also to use their language if they felt that it was needed. In the cases of non-Roma students we gave the test to all the class and students worked personally, as it was the norm in both classes.

Instead of attempt any kind of interpretations we would like to put questions regarding: effective and non-effective solutions, the dichotomy of formal-informal knowledge, the role of norms and practices that constitute the classroom culture. Could we see in these cases the uncanny valley? Could we make the *Unheimlich* familiar?

The second episode we provide here it is about a conflictive situation—culturally and cognitive — that took place in the Roma classes and concerned the whole class of Roma aged 7-12. The confusion here was enormous. The students worked in two different groups according to their age: one group was the students of seven to ten years old, (3-4) and the other, the students of ten to twelve years old, (4- 5). The first time the discussion exceeded one teaching hour. The same question came back 2-3 days later.

We quote here a part of the discussion.

Anna: “I don’t know it, Mrs.”

Kostas: “10 drachmas coin”.

Anna: “10 drachmas coin”.

Researcher: “You say what Kostas says without thinking?”

Anna: “5”.

The discussion carries on when they realize that one of the two items cost more than a 10-drachma coin.

Anna: “1 hundred”.

Kostas: “20 drachma coin”.

Researcher: “But you had this amount before you have bought the things!”.

(Anna is laughing at him).

Researcher: “Anna, which one is of bigger value? 20 drachmas or 50 drachmas?”.

Anna: “50 drachmas”.

Researcher: “Could we get more change than we give?”

Anna: “No”.

The discussion with the group of the older student carried in a similar manner. Firstly, they answered 10 drachmas coin and at the moment they understood that it was impossible they tried some other answers.

During the break, Kostas (10 year old) came by himself, saying:

“Miss, we don’t get anything”

“Why? How much do the two things cost?”

“19”

“And we give 20”

“Yes, they cost 19; we give 20 we don’t have any change”.

The pragmatological information that is needed here and that would clarify the landscape is that at this period of time the drachma coin had so limited value so that when the changes were in less than 5 drachmas you were not taking back anything. In this case a familiar context was transformed to an uncanny valley, which is a space that caused embarrassment to students and makes them to rethink their ideas.

This way of *translating* in order, not to cross over into a different register or discourse, but instead to remain in the carnival of the uncanny valley, where we are both fascinated by the similarities and recoil from the too-close verisimilitude, enables the unlearning and the relearning to be placed in a broader context of an ethnomathematical worldview. This worldview shares with border pedagogies the coexistence of border worlds with the line drawn in the sand, so to speak: there are those not using ethnomathematics who cannot enjoy the pleasures of the carnival, and are forever doomed to the plight of rigid boundaries and the constant struggles of translation that are unproductive and disturbing, uncanny and confusing. Those people suffer. And then there are the ethnomathematicians, who revel in the carnival of the polysemic, dwell in the uncanny valley rather than fleeing it, and foster the unlearning and relearning of translation as enlarging perspective.

## FINAL CONSIDERATIONS

We discussed the role of Ethnomathematics through the metaphor of Carnival, as the term is used by Bakhtin in order to describe overthrow, collectivity, deliberation from the dogmatism of formal mathematics, the absence of fear that cause cultural and cognitive conflicts in typical a mathematics class, to form a borderline learning area which integrates different practices, challenging both the prevailing truth and established order, to remove hierarchical discrimination, privileges, norms and prohibitions. In such a context the space

and time is restored the coherence and students do not perceive static situations and their image.

Border pedagogues appropriate the very tools of the uncanny making them tools of practice in a way that power and authority are reconsidered: shifting sense of difference and continuity they imply. As D'Ambrosio (2006) notices:

Ethnomathematics fits into this reflection about de-colonization and the search for real possibilities of access for the subordinated, the marginalized, and the outcast, or excluded. The most promising strategy for education in societies that are in transition from subordination to autonomy is to restore dignity to their individuals, recognizing and respecting their roots. Recognizing and respecting an individual's roots does not signify rejecting the roots of the other, but rather in a process of synthesis, reinforcing their own roots. This is, according to my thinking, the most important aspect of ethnomathematics (p. 30).

Thus, ethnomathematics could be considered as a posture, as a way to celebrate the diversity of people, of practices, of integrating local and global, of reconsider the uncanny valley of approaching the *unheimlich*.

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