

Playing with Numbers in Cultures: *Beginning to trouble essentialist views of mathematical knowledge re-production and use*

A. Chronaki and G. Mountzouri
University of Thessaly, Volos, GR
chronaki@uth.gr

Abstract

The present study is rooted in the belief that political, cultural and historical circumstances where we all live and experience notions of 'self' and 'other' simultaneously provide the context and motivation for our learning –including our learning of mathematics. At the same time, it espouses the view that oppressive experiences in mathematics learning are closely linked to hegemonic discourses that represent mathematics as essentialist body of knowledge of a linear, static and abstract form. Such hegemonic discourses construct mathematics as an inclusive 'language' with a universal code system and logic –ignoring the fact that contemporary mathematical symbols, algorithms and tools are social conventions whose historical development is the result of socio-political as well as practical constraints, affordances and struggles. Taking the above into consideration the aim of the present paper is to account for our attempts to design mathematical activity (organized as an outdoor creative workshop) where children and adults can play with numbers and begin to explore some complex and silenced stories concerning numerals and their symbols. The mathematical workshop was organized around three parts; a) a storytelling about numbers and their role in our lives, b) exploring and discussing the number-symbols used today in three cultures in a prepared Magic-Board where western and Arabic symbols and number-words were related, and c) introducing the game 'my name-my number'. In the context of the present paper, we discuss the above design experience in connection to issues linked; *first* to what might mean to engage with numbers in terms of functional or critical literacy, and *second* to how we –as educators- move towards acting out the 'playing with numbers' experience.

Jouer avec les Chiffres à travers des Cultures différentes: *Commencer à poser des questions sur les idées essentialistes pour la reproduction et l'utilisation du savoir mathématique*

L'étude présente est fondée sur l'idée que les circonstances politiques, culturelles et historiques dans lesquelles on vit et expérimente les notions de 'nous mêmes' et de l' 'autrui' nous fournissent le contexte et la motivation pour notre formation – y compris la formation des mathématiques. En même temps elle accepte l'opinion que les expériences oppressives dans l'apprentissage de mathématiques sont étroitement liées aux discours hégémoniques représentant les mathématiques comme un corpus des connaissances essentialiste d'une forme linéaire, statique et abstraite. De tels discours hégémoniques rendent les mathématiques un 'langage' inclusif ayant un système de code et une logique universels ignorant le fait que les symboles de mathématiques, les algorithmes et les outils contemporains forment des conventions sociales dont le développement historique est le résultat des contraintes, affordances et luttes à la fois socio-politiques et pratiques. En prenant en considération les discours ci-dessus, ce document vise à expliquer nos efforts pour la réalisation des activités des mathématiques (ayant la forme des travaux pratiques en plein air) où enfants et adultes peuvent jouer avec les chiffres et commencer à explorer des histoires complexes et silencieuses concernant les nombres et leurs symboles. Les travaux pratiques sur les mathématiques ont été organisés en trois parties: a) contes sur les chiffres et leur rôle dans notre vie, b) explorer et discuter les chiffres –

symboles qu'on utilise aujourd'hui dans trois différentes cultures par le moyen d'un Magic Board où des symboles occidentaux, des symboles arabes et des chiffres-mots étaient considérés et c) introduire le jeu 'My name – My number'. Dans cette étude on discute la conception présentée ci-dessus et les questions liées; *d'abord*, qu'est-ce que ça veut dire s'occuper des chiffres en tant que alphabétisation fonctionnelle, et *ensuite*, comment nous – en tant que enseignants –on avance vers l'expérience de "jouer avec les chiffres".

Mathematics Education and Agency

During the last three decades, enormous efforts have been placed over raising a sociopolitical agenda for mathematics education. Such efforts have started with early attempts to sensitize people on issues concerning ethnomathematics as epistemology and as curriculum, a broad spectrum of sociocultural perspectives on mathematical knowledge production, as well as issues of cultural diversity and social justice (Atweh et al., 2011). Although, over the years the re-organization of curricular practices in the form of policy or classroom practice have become the centre of attention, the actual re-contextualisation of a sociocultural or sociopolitical agenda concerning content (what to teach) and process (how to teach) is very scarce. Using Michael Apple's distinction amongst functional (i.e. developing competencies) and critical mathematical literacy (i.e. supporting sociocultural and political agency) it could be easy to claim that most national curricula for mathematics, from early childhood up to secondary and tertiary education, follow mainly the functional paradigm (Apple, 2004). The above is true not only for peripheral countries such as Greece, but also for metropolitan states in both Europe and US (see NCTM).

The present study is rooted in the belief that political, cultural and historical circumstances where we all live and construct notions of 'self' and 'other' simultaneously provide the context and the motivation for our learning. As such, agency (as voice) frames and reframes our will and potential to participate and challenge or even critique formal educational practices. At the same time, it becomes more and more clear that oppressive experiences in mathematics learning are closely linked to hegemonic discourses that construct mathematics as an essentialist body of knowledge that tends to capture human learning development in linear and static terms. Such hegemonic discourses construct mathematics as an inclusive 'language' with a universal code system and logic –ignoring the fact that contemporary mathematical symbols, algorithms and tools are social conventions whose historical development is the result of socio-political as well as practical constraints, affordances and struggles. However, an additional challenge remains and is closely connected to how we resist and trouble such an essentialist optic on mathematics education even for the early ages.

Taking the above into consideration the aim of the present paper is to account for our attempts towards designing mathematical activity as a pedagogical space where children (and adults) can play with numbers and begin to explore some complex and silenced stories concerning numerals and their symbolizations. The work we describe here was organized as an outdoor creative workshop and took place in the playground. It is experimental in nature and comes close to what some call 'performance ethnography' paradigm and others 'teaching experiment' methodology (see Hedegaard and Chaiklin, 2005, Chronaki, 2008, 2011). In the following section, *first* we explain what might mean to engage with numbers in terms of functional or critical literacy, and *second* we move towards a brief description of acting out the 'playing with numbers' experience.

Engaging with numbers: functional vs critical literacy

As explained before, the current mathematics curriculum in our country, and elsewhere, represents 'number' as a static form of knowledge. Children, in nursery schools and early year schooling centers, learn how to talk about number and how to write the numerals from 0 to 9. Early childhood educators place emphasis on developing children's 'sense of number'

with reference to developing the Piagetian notion of skills such as ‘quantity’ retention and ability to handle operations (addition and subtraction) with small operative (and tangible) units. From a functional literacy perspective, children have the opportunity to develop the necessary competences (i.e. handling number, problem solving, reasoning) needed to function appropriately within society and to serve the reproductive purposes and interests of dominant groups. They do so at most times in either clinical or ‘pseudo’ authentic contexts such as word-problems where ‘number’ sense tends to organize the specific entities of the situation. Within this perspective, there is no interest for emphasizing the cultural, historical and political nature of number development itself and as a result, there is scarce reference to number (as words, symbols, strategies) in non-western civilization. The mathematical knowledge situated in ‘other’ cultures has become silenced and marginalized as in parallel or in consequence, certain children’s agency (as voice) becomes silenced and marginalized, too. Children, at large, learn to naturalize ‘number’ as universal and static, and they learn to agree that the numerals of 0,1,2,3...9 are uniformly used everywhere all over the world –a view that tends to be projected as ‘common-sense’.

The notion ‘numbers are the same everywhere’ hides a number of issues; first that numbers as we currently know them in the West are based on the convention of using the so-called Arabic symbols; second that these Arabic symbols are not currently used universally (e.g. in a number of Arabic countries they are not formally used); and third the convention of using the Arabic symbols today is historically and semantically situated. Specifically, the ten digits (0, 1, 2, 3, 4, 5, 6, 7, 8, 9) are alternatively named as Arabic numerals or Hindu numerals or Hindu-Arabic numerals. One can read at the Wikipedia that ‘...[t]hey are descended from the [Hindu-Arabic numeral system](#) developed by [Indian mathematicians](#)’. However, the Indian numerals were adopted by the [Persian mathematicians](#) in India, passed on to the Arabs, and transmitted to [Europe](#) in the [Middle Ages](#). Soon, they spread around through European trade, books and colonisation. Today, although considered as the most common symbol representation, it is not the only one. For example, the Arabs still use the ‘Hindi’ or ‘[Eastern Arabic numerals](#)’ (.) in the [Middle East](#), and in [Indian languages](#) there exist many versions of numerals such as the [Devanagari](#) (०.१.२.३.४.५.६.७.८.९). However, the challenge of how one might be able to design a pedagogical space that supports the representation and performance of, at least partly, such a complex and multifaceted socio-political and historical background is huge. This is due not only to the fact that the very history of number symbolization development is complex by itself, but that aspects of it are either unexplored or open depending on whose history one attempts to narrate. Perhaps, the only solution is a modest adherence to representing fragments of historical moments aiming not towards to inform but mainly to sensitize children and adults towards making their own beginnings (see Chronaki, & Kanellopoulos, 2009). And, this is the path we chose to take in our design attempts.

My name-My number: organizing an outdoor maths workshop

In year 2009 our department organized a creative workshop in Volos -an urban city located in central Greece. It was an intercultural creative workshop under the theme ‘One-Volos-All-Color’. The word ‘color’ although used metaphorically to denote an anti-racist political agenda geared towards inclusion of ethnic minorities, at the same time, indicated the importance of this very basic feature (i.e. color) on which exclusion practices produce diversity (for more details concerning body-color epistemology see Chronaki, 2010). The aims of the workshop were; a) to co-create a temporary open ‘space’ for children and adults to interact and communicate by means of playing in varied organized ‘games’ and, perhaps, realize that diversity, at varied levels, is a creative part of our lives, and b) to engage student-teachers in designing such processes as part of their participation in specific courses, where they can problematize the complexities involved. During these workshops a variety of games were organized and they were related to literature, visual arts, puppet show, music, geography

etc. The age of children varied from 2 till 12 year olds and the age of the adults who accompanied them and participated varied from 20 to 80 year olds.

The mathematics workshop was introduced under the theme ‘number in cultures’ and our specific aim was to encourage children (and accompanying adults) explore that numerals and their symbols are not universal but culturally situated. Taking into account that the workshop took place outdoor, in a playground situation, and certain features such as the age, gender and ethnicity of participants are not known till the last minute, our design needed to focus on activities that children and adults could do in the course of small time scales, respecting the fact that engagement (and attention) in outdoor activity could not last for more than 10 minutes. As a result, our workshop was organized around three phases; a) narrating some parts of a story about the ‘king of numbers’ (see picture 1), b) introducing the Magic Board where Western and Arabic digit symbols are related (see picture 2), and c) playing the game: ‘my name-my number’ (see diagram 1 in Appendix A and pictures 3-4-5).



Picture 1-2: Narrating the ‘King of Numbers’/ Introducing the ‘Magic Board’

As can be seen in the pictures, children (and adults) were engaged enthusiastically to the varied parts of the workshop. Participating at the story-narrative, exploring the correspondence amongst digit symbolization and number words in the ‘Magic Board’, and consequently playing the game ‘My name-My number’ provided a context for opening up one’s own ideas towards a new terrain of experiencing number. For many, the idea that different number symbols are still in use in some countries was a surprise. It is interesting to emphasize that this ‘surprise’ element was instrumental towards shifting their attention from an essentialist view of number as universal and static signifier towards the idea of exploring number symbolization development and use across cultures. At the same time, children were engaged seriously into checking the correspondence amongst number words and symbols in three languages; Greek, Romani and Arabic.



Pictures 3-4-5: Children exploring number words and number symbols

As a way of summarizing this experience, we could argue that the workshop as a whole created a space for agency for the Greek and the Greek Gypsy children and the adults participants who immediately identified themselves with the process of exploring number words and number symbols in Arabic culture (see Chronaki, 2008). For example, a Gypsy girl

called Malevi counted the number of letters in her name and observed (i.e. by searching in the Magic Board provided) that the number word ‘esov’ that means 6 in Romani is much closer to the number word ‘sita’ that is used for 6 in Arabic than to the number word ‘exi’ that signifies 6 in Greek. For a detailed analysis concerning identity-work and mathematical learning see also Chronaki, 2008 and 2011.

References

- Apple, M. 2004. *Ideology and Curriculum*. New York. Routledge.
- Atweh, B., Graven, M., Secada, W., & P. Valero (Eds.), 2010. *Mapping equity and quality in mathematics education*. New York: Springer.
- Chronaki, A. 2008. An Entry to Dialogicality in the Maths Classroom: Encouraging Hybrid Learning Identities. In M. César, & K. Kumpulainen (Eds.), *Social Interactions in Multicultural Settings* (pp. 117-144). Rotterdam: Sense Publishers.
- Chronaki, A., & Kanelopoulos, P. 2009. Performing ‘beginnings’. In A. Chronaki (Ed.), *Mathematics, Technologies, Education: The gender perspective* (pp. 61-72). Volos: University of Thessaly Press
- Chronaki, A. 2010. Racism as Gazing Bodies: From ‘body-color’ epistemology to epistemic violence. A response to: Not-so-strange bedfellows: Racial projects and the mathematics education enterprise by Daniel Martin. In MES 6 Conference Proceedings. (<http://www.ewi-psy.fu-berlin.de/en/v/mes6/plenary/index.html>)
- Chronaki, A. (2011). Troubling Essentialist Identities: Performative Mathematics and the Politics of Possibility. In M. Kontopodis, C. Wulf and B.Fichtner (eds). *Children, Development and Education: Cultural, Historical and Anthropological Perspectives*. Dordrecht: Springer
- Gorgori , N., Planas, N., & Bishop, A.J. (2004). Dichotomies, complementarities and tensions. Researching mathematics teaching in its social and political context. In P. Valero, & R. Zevenbergen (Eds.), *Researching the Sociopolitical dimensions of mathematics classroom. Issues of power in Theory and Methodology* (pp. 107-123). Dordrecht: Kluwer Academic Publishers.
- Hedegaard, M. and Chaiklin, S. 2005. Radical-local teaching and learning: A cultural-historical approach. Aarhus: Aarhus University Press.
- Mountzouri, G. (in press). *The King of numbers*. Athens:Kedros Publishers.
- Van Oers, B. (1996). Learning Mathematics as a meaningful activity. In L. Steffe, Nesher, P. Cobb, G. Goldin, & B. Greer (Eds.), *Theories of Mathematical Learning* (pp. 91-113). Mahwah, NJ: Lawrence Erlbaum Associates.
- Vithal, R. & Skovsmose, O. (1997). The end of Innocence: a critique of “Ethnomathematics”. *Educational Studies in Mathematics*, 34(2), 131-158.