9th ESHS Conference "Visual, Material and Sensory Cultures of Science" (Bologna, Italy, 31 August - 3 September 2020)

Proposal accepted by the Scientific Committee within the Scientific Programma on 28/02/20

1. **Title of the Symposium**: Ideas on children's mathematical education: words, images, and artifacts

2. **Organizers**:

Kristín Bjarnadóttir, Professor emerita, University of Iceland, address, krisbj@hi.is
Short biographical notice:
She completed her BA degree in physics and mathematics at the University of Iceland in 1968, her M.Sc.-degree at the University of Oregon in Eugene in 1983, and her Ph.D.-degree in mathematics education at Roskilde University in 2006. She taught mathematics and physics at compulsory- and uppersecondary-school levels until 2003 when she joined the University of Education, later School of Education at the University of Iceland, where she taught mathematics education. Her research interests concern mathematics teaching and textbooks for compulsory- and upper-secondary-school levels together with their history. She is the author of *Mathematical Education in Iceland in Historical Context. Socio-Economic Demands and Influences* (Lambert Academic Publishing, 2010). In 2009 she organized the seminal conference "On-going Research in the History of Mathematics Education", the first of the ICHME meetings on this subject, for which she has edited the proceedings series *Dig where you stand*, the last one in collaboration with Fulvia Furinghetti, Jenneke Krüger, Johan Prytz, Gert Schubring, Harm Jan Smid (Utrecht University, Drukkerij Baas, 2017)

Ana Millán Gasca*, Professor, Università Roma Tre, via del Castro Pretorio 20 – 00185 Rome, anamaria.millangasca@uniroma3.it,
Short biographical notice:
B.S. University of Zaragoza (Spain), 1986 (Mathematics) and Ph.D. University of Zaragoza (Spain), 1990 (Mathematics). In 2006 she joined the Roma Tre University (full professor since 2017) where she has taught graduate courses in history of mathematics, mathematics education, and mathematics for primary education, and postgraduate courses in history of science. She coordinates a research group on mathematics for primary education in the Department of Education of Roma Tre and the research seminar "Federico Enriques". She has published *Fabbriche, sistemi, organizzazioni. Storia dell'ingegneria industriale* (Springer Verlag, 2005, *Numeri e forme. Didattica della matematica con i bambini* (Zanichelli, 2016), *Technological concepts and mathematical models in the evolution of engineering systems. Controlling, Managing, Organizing* (Birkhaüser, 2003), edited with M. Lucertini and F. Nicolò, and with Giorgio Israel, *The world as a mathematical game. John von Neumann in 20th century science"* (Birkhäuser, 2009), *The Biology of Numbers* (Birkhäuser, 2003) and *Pensare in matematica* (Zanichelli 2012).

3. **Abstract**

Since the Early Modern times numeracy is the basis of a society scientific culture in a broad sense. The elementary mathematical education of people included in Europe cyphering and arithmetic, and basic ideas in geometry linked to measuring. Even if this practical learning tradition dates back to the Roman Empire, it was organized in a systematic way in Italian medieval *scuole d'abaco* (with the importation of the Indian numerical system of notation through the Islam areas). Printed books based on *maestri d'abaco* manuscripts where the origin of a tradition of books addressed both to autodidact adults, or to adult teachers, including those working with children of

various ages. Comenius (Komensky 1592-1670) included some mathematics in his instructions on the school of infancy or mother's school; but in the late 18th century and 19th century increasing attention was put on the specific needs and way of understanding of children as distinguished from adults of the popular classes. Scholars with different backgrounds (pedagogues and mathematicians), including women (from Edgeworth to Montessori and Comas) and in different countries – children's mathematical education is deeply rooted in national culture and language – took part in a cultural movement leaded by the inspiring figure of the Swiss educator Pestalozzi.

In past years historians of mathematics are devoting a growing attention to the evolution of ideas and material production on children's mathematical education of European tradition. Practical ideas included aspects such as the relevance of the body (visualization, hands on materials, rhythm and sound) and of orality (spoken words) in the child early education. Moreover, pedagogical thought in this area was linked to the idea of universal, free access to elementary school and to literacy, including numeracy and possible elements of geometrical drawing and intuitive geometry.

The Symposium presents some recent contribution in this area, and is intended to help trans-national comparisons and international collaboration between scholars. The focus is put on visual, sensory and material proposals and ideas in the 19th-20th centuries.

K. Bjarnadóttir 2014 “History of Teaching Arithmetic” in Alexander Karp and Gert Schubring (eds.), *Handbook of the history of mathematics education*, New York, Springer.
R. D'Enfert 2003 “Inventer une géométrie pour l'école primaire au XIXè siècle”, *Tréma*, 22. pp. 41-49.
A. Millán Gasca 2015 Mathematics and children's minds: The role of geometry in the European tradition from Pestalozzi to Laisant, *Archives Internationales d'Histoire des Sciences* 65(2)-175, 2015, 261-277.

4. **Keywords** (3) Mathematics, Elementary education, Artifacts

5. **Chairperson**
Session 1 K. Bjarnadóttir
Session 2 A. Millán Gasca

6. **Commentator**
Fulvia Furinghetti (retired Professor, University of Genoa, furinghetti@dima.unige.it)

Fulvia Furinghetti is Professor of Mathematics Education in the Department of Mathematics of the University of Genoa, Italy. Her research concerns: beliefs, images of mathematics in society, proof, problem solving, the use of history of mathematics in teaching, teacher professional development, and the history of mathematics education. She has organized the celebrations of the Centenary of the journal *L'Enseignement Mathématique* and of ICMI and was one of the editors of the proceedings. With Livia Giacardi, she has developed a website on the history of the first hundred years of ICMI. In 2000-2004, she chaired HPM (History and Pedagogy of Mathematics, the International Study Group affiliated with ICMI and focused on relations between the history and pedagogy of mathematics).

Paper 1

Title Learning arithmetic by poetry in 19th century Iceland: examples and a conjecture

Author Kristín Bjarnadóttir

Abstract
In the North-Atlantic the sun shines 21 hours a day at summer solstice, but only three hours a day at winter solstice. During winter-darkness, hearing sense is extremely important. Composing and chanting poetry was highly evaluated and pursued in dark homes in pre-industrialized Iceland.
Syllables are composed of vowels, usually accompanied by one or more consonants. *Metre*, the rhythmic element of a poem, is divided into *metrical feet*, composed of syllables. Each foot has a stressed syllable and one or more unstressed syllables.
Icelandic poetry has developed into a complicated art of rhythm, rhyming and *alliteration.* Alliteration means a conspicuous repetition of identical or related initial sounds in stressed syllables of the feet. The alliteration has a mathematical aspect in that it is arranged according to certain rules related to the relative distance between the feet.
A popular form of a verse, the *quatrain*, is a four-line stanza with end-rhymes and alliteration where only selected combinations of feet containing alliteration are allowed. A common form of the quatrain has four feet in the first line, where three out of six combinations of feet are allowed, whereas in a five feet line, five out of ten combinations are allowed.
Poetry, and quatrains in particular, have traditionally appealed to children. Many examples exist of verses composed by children at an early age, even before learning reading or arithmetic. It is a conjecture that composing and chanting poetry served as a support to or even substitute for arithmetic education in that it promoted number sense in the absence of light, paper, and in remote areas, primary schools.
References
Cochrane, R. (2003). *Studying poetry. The secret gems of poetry revealed*. Second edition. Bishops Lydeard: Studymates.
Gíslason, G. Th. (1990). *The Challenge of Being an Icelander*. Reykjavík: Almenna bókafélagið.

Keywords: winter-darkness, poetry, alliteration

Paper 2

Title Lunar Men, Practical Women. Strategies for the empirical teaching of mathematics and geometry in Maria Edgeworth and their circle

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Raffaella Leproni, PhD, is Adjunct Professor of English Language and Translation at Roma Tre University. Her didactic activity, held in different curricular and postgraduate courses, develops around authentic materials in socio-pedagogic and educational areas dealt with in CLIL perspective. Her research activity focuses on English for Specific Purposes in HR and Social Sciences, as well as on the analysis of the role of language in the participated construction of social identity as focal point of an intercultural perspective. She has long dealt with Edgeworth's work and its reception in Italy; among her publications, *"Still Blundering into Sense". Maria Edgeworth, her context, her legacy* (2019), *Tra il dire e il fare. L'innovazione educativo-pedagogica dell'opera di Maria Edgeworth* (2015). She also translated some of Edgeworth's works: "The Purple Jar" and "The Little Merchants", collected in *Due racconti* (2009), and *Harrington* (2012, 2015).

Abstract

The use of toys and materials especially conceived and built for the teaching of mathematics and geometry to children was one of the pivotal points in the Edgeworths' idea of practical education. Richard Lovell (1744-1817) and Maria (1768-1849) developed their conception of education as an experience-based science at the end of the long XVIII century; they based their method on the observation and analysis of real children, as well as on experimentation of different empirical strategies for the progressive acquisition of concepts and language at specific stages of the child's growth. The Edgeworth's family, their friends and their fellow-enlightened men and women of letters – the *Lunar Men* in particular – were involved all over Europe (some even in the United States) in a continuous exchange of ideas and data. Benjamin Donn's models, reviewed by Thomas Beddoes, paired the stories that Maria wrote for the education of children since their earliest age to adulthood, providing parents/educators with further potential learning opportunities and fostering children to empirical observation, experimentation and invention.

References

B. Donne (1796) *An Essay on Mechanical Geometry, chiefly explanatory of a set of Schemes and Models…*, Bristol

F. Fantaccini, R. Leproni (eds) (2019) *"Still Blundering into Sense". Maria Edgeworth, her context, her legacy*, Firenze University Press.

R.L. Edgeworth, M. Edgeworth (1796) *The Parent's Assistant*, London, Johnson.

R.L. Edgeworth, M. Edgeworth (1798) *Practical Education*, London, Johnson.

Eric Robinson M.A. (1963) Benjamin Donn (1729–1798), teacher of mathematics and navigation, *Annals of science*, 19:1, pp. 27-36.

E. Robinson (1956) Dr. Beddoes and Benjamin Donne, on the Teaching of Mathematics, *The Mathematical Gazette*, Vol. 40, No. 332 (May, 1956), pp. 133-135.

Keywords: Edgeworth, material teaching aids, Long XVIII century

Paper 3

Title Geometrical materials in Édouard Séguin's conception and design of education of "idiots"

Author Elena Gil Clemente (Universidad de Zaragoza, Spain, elenagil@unizar.es)

Elena Gil Clemente holds a PhD in Mathematics and teaches Mathematics and Math Education at the University of Zaragoza. Her research focuses on mathematics in special needs education (including the education of prospective mathematics teachers); historical research on geometry, drawing and mimesis in Séguin's thought has inspired her qualitative field work, combined with historical and epistemological insights on primordial mathematical concepts.

Research on mathematics with Trisomy 21 children has been presented in several meetings on mathematical education (including the Meeting of 2016 Montpellier Meeting on History and Pedagogy of Mathematics, as well as ICME13, CERME10, CIBEM2017, ICME14) and on intellectual disabilities (WDSC2015, 2018, IASSID2018, 2019).

Among recent publications: "The Effectiveness of Teaching Geometry to Enhance Mathematical Understanding in Children with Down Syndrome" (2019) with J. I. Cogolludo in *International Journal of Disability, Development and Education*, 66 (2) and "Séguin (1812-1880) and the arising of a formative approach of mathematics education for people with intellectual disabilities" (2018), with A. Millán Gasca in *Journal of Applied Research in Intellectual Disabilities*, 31.

Abstract:

Édouard Séguin (1812-1880), the pioneer of special needs education, puts the spotlight of the problem of idiocy precisely in the deep difficulties of some children for communicating with the world outside. Thus, his educational path focused on the awakening of awareness, developing a

physiological method. Séguin attributes to the enhancing of children´s geometrical intuition a central role in the awakening of consciousness and intelligence.

This conception drove him to the design of his now well-known educational materials, named by him *forceps of intelligence*. He begun by trying linear drawing and re-elaborating Itard's form-boards, and then introduced (1840´s) his first original wooden materials: congruent bricks or dominos and growing size rods. Eexercises of bricks layout and arrangement led to the understanding of the abstract primordial idea of plane and to the understanding of composing and decomposing relationships. The goal of exercises with rods was to work with geometrical comparison "greater than" or "less than" and ratios, determining physically them by matching the rods.

Activities of layout, arrangement and comparison with 3D-geometrical objects combine sight, hands on and motion with imagination, and makes it possible to link the *me* – my inner self – and the *not-me* – the outside world –. Current explanation of their efficacy considering them purely as "manipulative" conceal the fact that Séguin designed them as a powerful mean to "find patterns existing oly in the child's mind" and gave them a key-role in the development of action, intelligence and will.

References

Édouard Séguin, *Théorie et pratique de l'éducation des enfants arrierés et idiots (leçons aux jeunes idiots de l'hospice des incurables*, Paris, Baillière 1842.

"Origin of treatment and training of idiots," *The American Journal of Education* 2 (5) (1856): 145-152.

Yves Pélicier and Guy Thuillier, "Le fondateur de l'éducation des idiots: Édouard Séguin, 1812-1880," *Paedagogica historica* 20 (1980): 129-52.

Keywords: Special education, teaching materials, 19th century

Paper 4

Title From the construction yard to the classroom: the children oriented "natural geometry" by Jules Dalsème

Authors Paola Magrone (Phd, Assistant Professor of Mathematical Analysis, Department of Architecture, Roma Tre University, via della Madonna dei Monti 40, Rome, Italy, magrone@mat.uniroma3.it) and Ilaria Zannoni, independent scholar (Roma Tre University, Laboratorio di Matematica per la formazione primaria, via del Castro Pretorio 20, Rome, Italy, zannoniilaria@yahoo.com)

Paola Magrone, B.S. (1996) and PhD (2002) in Mathematics, University of Rome, Tor Vergata (Italy). Teaching (Roma Tre University): undergraduate calculus with elements of analytic geometry (School of Architecture); undergraduate course of Elements of Mathematics (Faculty of Education); graduate course of Didactics of Mathematics (master degree in mathematics). She is involved in the didactics of mathematics and in the popularization of the discipline. Her principal research interests are: drawing, geometric intuition and mathematical machines; history of teaching: Mary Everest Boole's contribution to aspects of intuition, perception and experience in elementary mathematics education and the formation of the scientific mind. Among her publications: an Italian edition of Mary Boole's *The preparation of the child for science* (1903) in collaboration with A. Millàn Gasca; L. Farroni, P. M. (2016), *A Multidisciplinary Approach to Teaching Mathematics and Architectural Representation: Historical Drawing Machines. Relations between Mathematics and Drawing*, in: Proc. of the 2016 ICME Satellite Meeting on the Relations Between the History and Pedagogy of Mathematics.

Ilaria Zannoni, Bachelor Degree in Science of Education (2014 Roma Tre University, Department of Education), Master Degree in Primary Education (Mathematics Education) (2018 Roma Tre

University, Department of Education), with the thesis "The natural geometry of Jules Dalsème: dissemination effort and contribution to primary mathematical education in France during the Third Republic", presented at the XVII Congress of the Italian Society for the History of Mathematics (Trieste 2018). She is a primary school teacher and member of the Roma Tre University Research and innovation Lab on Mathematics for primary education.

Abstract
In the lively panorama of 19th-century proposals for the mathematical education of children, we focus on the contribution of the French Jules Dalsème (1845-1904), professor of Mathematics at the École Normale de la Seine, trained at the École Polytechnique. His work *Éléments de Takymétrie (géométrie naturelle): a l'usage des instituteurs primaries, des écoles professionelles, des agents des travaux public, etc*. (1880) was inspired by a proposal for the training of workers and soldiers of the engineer Édouard Lagout (1820-1885). Dalsème preserved the main ideas of Lagout: a terminology typical of the construction yard, the use of material objects and the combination of flat and solid figures, whose measure is calculated according to similar rules. This project, close to everyday life and experience fits in the programs (1882) by Jules Ferry for a compulsory, free and laic school; the introduction of geometry could lead to a public school that formed free citizens and therefore to social progress. Tachymetry arises as an intuitive geometry: ready, immediate, exact. Dalsème was perhaps interested in Tachymetry as an engineer, and then trasfered it to children, being a teacher at the school of the Seine. Material objects are used to convey mathematical contents: for example, Dalsème recommends the use of the plumb for the explanation of the concept of perpendicularity, to "roll up a sheet of paper" for the construction of the cylinder.
References
Dalsème J. 1880 *Éléments de Takymétrie (géométrie naturelle): à l'usage des instituteurs primaries, des écoles professionelles, des agents des travaux public, etc.,* Libraire classique d'Eugène Belin, Paris.
Lagout É. 1874 *Tachymétrie. Géométrie concrète en trois leçon. Accessible-Inaccessible-Incalculable. Cahier d'un soldat du génie. Rèdaction des confèrences faites par ordres du ministre de la guerre à l'école régimentaire du gènie de Versailles*. Paul Dupont, Paris.

Keywords: general and vocational education, hands-on mathematics, 19th century

Paper 5

Title The formulation of a school geometry in the Brazilian primary school (XIX centrury)

Authors
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Maria Cristina Araújo de Oliveira, Degree and major in Mathematics at Pontifícia Universidade Católica de São Paulo and Universidade de São Paulo (Brazil), 1986, 1995; Ph.D. in Education at Pontifícia Universidade Católica de São Paulo (Brazil), 2004; Post-doctoral in History of Mathematics Education at Université Paris Sud XI, 2015. Researcher at GHEMAT - Mathematics Education History Research Group in Brazil since 2005. Associate Professor at Mathematics Department and Graduate Program in Mathematiccs Education at Universidade Federal de Juiz de Fora since 2009. Editor of RIDEMA – Journal of Research and Dissemination on Mathematics Education. Co-author in the chapter History of Mathematics and Culture: Moments and Movements in Brazilian Mathematics Education. In: Mathematics Education in Brazil. 1ed.: Springer International Publishing, 2018, v. 1, p. 103-127. Research in Mathematics Education, with emphasis on history of mathematics education, teacher education, and geometry teaching.

Abstract
The present study analyzes the circulation of foreign textbooks in Brazil and the different processes of appropriation of such references. The formulation of a school geometry in Brazil after its independence in 1822 is marked by the dialogue with European and American textbooks. The first national Portuguese-language productions are translations and adaptations of textbooks from France, such as the L.-B. Francœur drawing book (translated into Portuguese in 1829) and from the USA, such as N. A. Calkins's First Lessons of Things (translated in 1886). The articulation of the teaching of geometry with that of drawing is the most representative feature of the period, highlighting the opposition between drawing freehand geometric figures and with instruments. Faced with the circulation around the world of new reforms and methodologies for teaching geometry (Barbin, Menghini, 2014), the first textbooks produced by Bbrazilian authors – represented by A. C. Borges (1876) and O. Freire (1894) – despite being in contact with international production, ressemble the traditional Euclidean Geometry, which reveals resistance to the insertion of an "intuitive and experimental geometry" in the Brazilian elementary school.

References

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Calkins, N. A. (1950) Primeiras lições de coisas. *Obras completas de Rui Barbosa*. Vol. XIII, tomo I. Rio de janeiro: Ministério da Educação e Saúde.

Francœur, L. B. (1819) *Le dessin lineaire d'apres la methode de l'enseignement mutuel*. Paris: L. Colas, Imprimeur- Libraire de la Sociéte.

Freire, O. (1907) *Primeiras Noções de Geometria Prática.* Rio de janeiro: Francisco Alves & Cia.

Keywords: Textbooks, International circulation, Drawing.

Paper 6

Title Maria Montessori without artifacts: proportion for the absorbent mind in *Psicoaritmética* (Barcelona 1934) and the detachment from the longstanding abbacus arithmetical tradition.

Authors Ana Millán Gasca and Laura Parenti (independent scholar, Roma Tre University– Laboratorio di Matematica per la formazione primaria, via del Castro Pretorio 20, Rome, Italy, lau.parenti@hotmail.it)

Laura Parenti, Master Degree in Primary Education (Mathematics Education) (2017 Roma Tre University, Department of Education), with the thesis "Proportionality as an introduction to scientific thought in childhood". She is a primary school teacher and member of the Roma Tre

University Research and innovation Lab on Mathematics for primary education

Abstract
Maria Montessori developed her views on the mathematical education of the child (Montessori 1902; 1912) in two essays devoted to arithmetic and to geometry published in 1934 during a period that she spent in Spain. From the beginning, material teaching aids were presented in her overall proposals, starting with materials derived from her careful reading of Édouard Séguin, who included a description of measures and form without any drawing. *Psicoarimética* has a final chapter devoted to Ratio and proportion, included after the chapter on measure/the decimal metric system. Her treatment of proportions is not heavily supported by physical teaching aids, but shows quite well other crucial aspects of Montessori's didactical approach. First, the connection between number and geometry, and a systematic exploitation of the geometrical intuition, here trough the geometrical ratios subjacent to measuring of magnitudes as a material action (considered in the precedent chapter 10). Secondly, the role of imagination, that is startling in her presentation of the "rule of three", a pivotal aspect of traditional numeracy. Thus, even if the chapter appears as much more "traditional" and "severe" than the precedent eleven ones, the break with a long standing tradition rooted in medieval *scuole d'abaco* silhouettes here sharply, compared with her better known treatment of the number system, the four operations, and algebra.
References
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1912 *The Montessori method. Scientific pedagogy as applied to child education in "The Children's houses"*, New York, Frederick A. Stokes.
1934 *Psicogeometría*, Araluce, Barcelona (Italian edition, ed. B. Scoppola, Roma, Opera Nazionale Montessori 2011)
1934 *Psicoaritmética*, Casa editorial Araluce, Barcelona (Italian ed., ed. C. Grazzini, Roma, Garzanti 1971)
Millán Gasca Ana 2016 *Numeri e forme. Didattica della matematica con i bambini*, Roma, Zanichelli.

Keywords: Montessori, Ratio and proportion, 20th century

Paper 7

Title Representations of informal mathematics learning opportunities in Danish children and family magazines from 1925

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Troels Lange is professor of mathematics education. He completed his undergraduate degree and PhD in Denmark. He completed his PhD in 2009 at Aalborg University on children's perspectives on being in difficulties with mathematics. He began working in teacher education in the 1990s in Denmark and has since worked in teacher education in Australia, Sweden and Norway. He became professor at Western Norway University of Applied Science in 2016. He has published numerous articles on mathematics education, with a focus on how children experience mathematics.

Tamsin Meaney is professor of mathematics education. She completed in PhD in mathematics education at University of Auckland in 2000 on an ethnographic case study on mathematics curriculum development with an Indigenous community. Since then she has worked in teacher education in New Zealand, Australia, Sweden and Norway. She because professor in 2012. She has published books on early childhood mathematics education and on language challenges in teaching

mathematics in an Indigenous community. She has an interest in how historical discourses about mathematics education are adapted into current discussions, particularly in relationship to how these discourses affect social justice actions.

Abstract
School mathematics is only one way that children engage with mathematical ideas. Different forms of informal mathematics learning opportunities are made available to children through the common media available at a particular historical time. During the twentieth century, magazines were a common way to provide stories and suggest hands-on activities to children. In different parts of the magazines, there were often possibilities to engage with mathematical ideas (Joram, Resnick & Gabriele, 1995; Lange & Meaney, 2019). However, little research has been undertaken to systematically describe: the mathematics learning opportunities that these magazines provided; how they were represented; and whether these opportunities differed across magazine type. In this presentation, we examine four Danish children's magazines and four family magazines from January 1925. Using Kress and van Leeuwen (2001) multimodal discourse analysis, we describe potential mathematical learning opportunities. This analysis of written words and drawings provides insights into who was expected to engage in the mathematical learning opportunities and in what ways. For example, drawings of boys building radio sets accompanied by written description of the measurements of the different components indicates who was expected to use specific mathematical ideas and in what ways. Both types of magazines provided similar opportunities to engage with mathematical ideas. However, the children's magazines seemed to present a less gendered perspective on who should engage in mathematical learning opportunities.

References

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Kress, G. and Van Leeuwen, T. (2001) *Multimodal discourse – The modes and media of contemporary communication*. London: Arnold.

Lange, T. & Meaney, T. (2019 forthcoming). What the mathematics in the puzzles and handicrafts in 1920s Danish children's magazines tells about childhoods. *Contemporary Issues in Early Childhood*, *20*(4).

Keywords: Informal mathematics education; magazines; 20th century

Paper 8

Title: Numbers in color: A method of teaching arithmetic in primary schools

Author: Dirk De Bock (KU Leuven, Leuven, Belgium, dirk.debock@kuleuven.be)

Dirk De Bock is professor of mathematics at the Faculty of Economics and Business of the University of Leuven (Belgium). His major research interests are history of mathematics education, psychological aspects of teaching and learning mathematics, the role of mathematics in economics and finance, and financial literacy. His research in the field of history of mathematics education currently focuses on the role of Belgian mathematicians and mathematics teachers in the international modern mathematics reform movement of the 1960s.

Abstract
A main topic of debate and investigation in mathematics education during the 1950s was the use of concrete models and teaching aids. In this context, Georges Cuisenaire (1891–1976), a Belgian primary school teacher invented his famous rods: A set of colored blocks, symbolizing the natural numbers from 1 to 10. The rods were originally devised to explore and to gain insight into elementary mathematical concepts and skills, such as the four basic operations, finding divisors and

multiples, working with fractions, the decimal system, arithmetic sequences, and area and volume calculation.

Cuisenaire registered his rods in 1951 and from then, they were distributed among the community of Belgian primary school teachers. *Les nombres en couleurs* [Numbers in color], a booklet explaining to teachers the method and providing some suggestions for their use in the mathematics classroom appeared one year later (Cuisenaire, 1952). Cuisenaire's rods did not have to wait long for an international breakthrough. In 1953, Caleb Gattegno (University of London) visited Cuisenaire, was immediately enthusiastic and became a worldwide ambassador of the Cuisenaire rods.

In subsequent years several empirical studies on the effectiveness of the Cuisenaire-Gattegno approach were published, sometimes with ambiguous results, but the charismatic Gattegno always managed to find Cuisenaire enthusiasts in dozens of countries, including Australia, Canada, Germany, Spain, Switzerland, the UK and the US.

After the euphoria of the 1950s and 1960s, a period of disenchantment followed in the history of the Cuisenaire rods. Several attempts were made to use the material for the teaching of typical *New Math* contents to (very) young children, but the use of the rods in this context did not break through.

Reference

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Keywords: Belgium, teaching materials, 20th century