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ABSTRACTS**

Nicolas GAUVRIT. *Genes and mathematics: Educational studies in mathematics and the genetics of mathematical difficulties.* 9-26

Abstract. We review a series of recent genetic accounts of mathematical difficulties or disabilities, and briefly discuss possible theoretical interests of these experimental findings for future research in the field of mathematical education.

Eric MOUNIER. *Models for oral Indo-European numbering with an educational purpose, application to spoken numeration in France.* 27-58

Abstract. Young pupils often perceive the notion of number when using oral numeration. It allows solving various problems such as counting a collection of objects. Learning and considering increasing size of numbers generate an evolution of the methods in use. The syntax of particular numbering provides specific resources. There are similarities between Indo-European oral numerations but also differences in the perception of the logic of their syntax. It is possible to find arithmetic or ordinal principles. By offering a priori models, this article aims to provide an analytical framework to take into account certain characteristics of the constitution of the signs that make up an oral Indo-European numbering. We indicate the place of analysis in earlier finding, explain the link to learning, present the methodology and finally present obtained results: proposals of theoretical models for the mathematical principles of an Indo-European numbering and then their use in interpreting the numeration in France. Its purpose is to provide elements for educational studies on both learning and teaching numbers.

David BLOCK, Kostas NIKOLANTONAKIS & Laurent VIVIER. *Registers and numerical praxis at the end of first grade in three countries.* 59-86

Abstract. Through numerical problems given to pupils of three different countries, we show the importance of representation registers and types of tasks for the mathematical activity. Besides some differences, sometimes marked, between the three nations, we identify combined influences of the register of the statement and the type of tasks. We distinguish two cases according to the link of the type of tasks with the institution.

Patrick GIBEL ET Mhammed ENNASSEF. *Analysing within theory of didactical situations a school sequence about the comprehension of decimal number system.* 87-116

Abstract. The purpose of this article is to analyse, within the framework of the theory of didactical situations in mathematics, a sequence aiming to evaluate and to develop children's ability to use their knowledge about the comprehension of decimal number system in a first grade class (students aged 6-7 years) in a primary school. The sequence, mainly based on a communication's game, consists in carrying out conversions of numbers from the symbolic representation to the collection of the corresponding quantity of objects and vice versa. The game allows the children to test validity and suitability of their procedure. Moreover this sequence allows the teacher to evaluate, in situation, the degree of acquisition of the different representations of number in the decimal number system.

José Carlos CORTES ZAVALA & María de Lourdes GUERRERO MAGAÑA.

Interactive software to create technological environments for mathematics learning. 117-136

Abstract. This article deals with a research work related to the use of technology for Mathematics teaching and learning. In this one, some current educative aspects and

tendencies converge, such as: the use of software, the use of several internet platforms, educative software design and development, and the use of calculators and computers. We study the mentioned tendencies from the point of view of teachers (with educational perspectives) and also from the point of view of the learning of mathematics (cognitive issues), through the creation and use of Interactive Technological Environments for the Learning of Mathematics (ATIAM). Also, we include research results linked with design and construction of software for the learning of mathematics in ATIAM's environments.

Armando CUEVAS, Magally MARTINEZ & François PLUVINAGE. *Promoting functional thinking in teaching calculus: An experiment with the use of digital technology and its results.* 137-168

Abstract. This article presents a teaching experience in a first calculus course at college level, founded on the idea of promoting functional thinking to understand the basic concepts of calculus. The experiment was conducted with freshmen, given the serious deficiencies in algebraic and functional concepts. We apply a methodological approach using digital technologies in two types of activities, which are reproducible: Introducing concepts through interactive educational scenarios (IES), which simulate real situations proposed to students, and using the tutorial system CalcVisual. In this experiment, unlike remedial courses, functional thinking is not seen as a prerequisite but as a proper object of the course. Analyzing the results, we note in particular a significant reduction in initial prerequisite deficiencies and progress in functional thinking.

Athanassios RAFTOPOULOS & Demetris PORTIDES. *The Concept of Function and its Spatial Grounding.* 169-194

Abstract. It has been argued that understanding 'function' qua abstract mathematical entity requires (a) that different aspects of this entity be understood as referring to the same mathematical entity (for example that the spatial representation of a function (whether it be a graph or a geometrical figure) and its algebraic form denote the same function), (b) that the abstract algebraic representation be grounded on the more tangible and observable spatial representation (observable in that the spatial representation lays out the relations expressed by the algebraic form in space rendering them available to the senses), which provides an initial concrete meaning to the function, and (c) that functions be not reduced to their spatial representational forms, since that gives rise to various misconceptions. In this paper, we address these ingredients of a proper understanding of the 'function' with a view to provide a theoretical framework concerning the relation between numbers and space that will allow the assessment of the different trends in the discussion regarding the interplay of algebraic and spatial representations of functions in understanding the concept 'function'. In the first section we argue that grounding basic abstract mathematical entities such as natural numbers in spatial configurations is necessary for any adequate understanding of these entities. We adduce two main reasons for this claim. The first, from developmental psychology, concerns the notion of number as it is initially formed. The second concerns the way infants and animals represent numbers as magnitudes, with spatial properties. Our main thesis is that numbers are grounded in space, and we call this phenomenon "the spatial intuition of numbers".