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# The role of the structure in early mathematics learning: Research with children aged four

Margarida Rodrigues<sup>1</sup>, Maria Cordeiro<sup>2</sup> and Paula Serra<sup>3</sup>

1 Instituto Politécnico de Lisboa, Escola Superior de Educação, UIDEF, Lisboa, Portugal, [margaridar@eselx.ipl.pt](mailto:margaridar@eselx.ipl.pt)

2 Associação Infantil e Juvenil "O Nosso Recreio", Lisboa, Portugal

3 Externato "O Poeta", Lisboa, Portugal

*This poster reports a broader project that aims to research the preschoolers' cognitive capacities in mathematics learning, and integrates two studies that were carried with four-year-old children aiming to understand: (i) the children's ability to subitize, and (ii) how the process of emergence of algebraic thinking develops. The results show the importance of structure in early mathematics education.*

**Keywords:** Structure, early mathematics learning, pattern.

## SUMMARY

Mathematics has been an important subject area within the Portuguese curricula for preschool education. Moreover current research has shown that young children can generalize mathematical ideas much earlier than previously supposed (Mulligan, 2013). Structure has a key role in the process of generalization. With appropriate designed and implemented learning experiences, young children are able to develop forms of reasoning involving the process of generalizing (Papic, Mulligan, & Mitchelmore, 2011).

Conceptual subitizing plays an advanced-organizing role (Sarama & Clements, 2009). In spatial patterns, some arrangements lend themselves to grouping facilitating the sudden recognition of the number using consciously strategies of decomposition linked to numerical structure.

This poster will present the results of two studies integrated into a broader project which aims to research the preschoolers' cognitive capacities in mathematics learning. Both studies were carried with four-year-old children. One of them intended to understand the children's ability to subitize and the other aimed to

understand how the process of emergence of algebraic thinking develops.

Both studies were developed in private schools in Lisbon and adopted a qualitative research methodology under the interpretive paradigm, emphasizing meanings and processes. The researchers took the dual role of teacher-researcher: each one conducted the study with her own children's group and in her own natural environment. Participant observation and document analysis (audio and video recordings, images and documents produced by the children) were used as data collection methods.

The research data of Cordeiro's study showed that children can subitize up until four and begin subitizing sets of five and six items with different spatial arrangements. Children do perceptive subitizing, but few children begin to show signs of doing conceptual subitizing which contributes to numerical structuring. Children are able to identify the number of dots in patterns, eventually become familiar with them and even start making mental relationships between numbers, composing and decomposing them, and developing their number sense. The most common spatial arrangement of sets in the cards (corresponding to the domino game) is the easiest to identify, followed by rectangular, and after by linear and circular arrangements. The structure marked by the use of two colors or by the use of two groups in the spatial arrangement of sets, in the cards, contributed to the emergence of conceptual subitizing, decomposing collections into smaller recognizable collections, and either using addition to determine the total.

The results of Serra's study indicate that children master the concept of repeating and growing patterns, and they are able to identify the unit of repeat, create

and analyze patterns of various simple repeating and growing patterns, evolving from simpler forms to more complex forms, in the case of pictorial repeating patterns. Children are aware of the pattern's structure when they identify either the unit of repeat or the regularity of a pictorial growing pattern. In this last case, children used a correspondence analysis of change indexing the figure number with the changing aspect of the dependent variable.

These results offer possible implications for the existing research in the area stressing the role of structure in early mathematics education, namely in the field of mathematical relationships.

### **THE WAY OF PRESENTING**

In the poster, we will illustrate the main results related with structure by exhibiting some of children's productions, communicating them in a pictorial format. Next to visual data there will be short sections: (1) Introduction; (2) Theoretical framework; (3) Methodology; (4) Results; (5) Final considerations; and (5) References.

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