


# Chapter 11

## Piece by Piece: Awakening Computational and Geometric Thinking in the 1st Cycle of Basic Education – The Manipulation of Pattern Blocks

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### ABSTRACT

*The materials manipulation plays a key role in mathematics education by transforming abstract concepts into concrete experiences. This paper presents an exploratory qualitative study focused on how Pattern Blocks promote computational and geometric thinking in 25 first grade students from a Portuguese private school. Over five formative sessions, children participated in practical activities which echoed the national curriculum such as identifying, composing and decomposing shapes. Observations of classes, video recordings and document analysis were used to collect data. Both physical and digital Pattern Blocks facilitate mathematical learning by promoting spatial awareness, logical reasoning, pattern recognition,*

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*and problem-solving skills. The students developed their out-of-the-box and critical thinking, abstraction and collaboration. The study concludes that the integration of structured material promotes meaningful, student centered, active, and collaborative learning, while effectively developing computational and geometric thinking in early mathematics education.*

## **INTRODUCTION**

The integration of tangible learning tools in mathematics education has long been recognized for its effectiveness in making abstract concepts accessible to young learners. This idea is cemented by Mascarenhas (2012) who argues that “manipulable materials play an important role in learning geometry and measurements and should be used to facilitate the understanding and articulation of mathematical concepts and ideas” (p.147).

The Portuguese curriculum states that “learning to use multiple representations in mathematics is essential, verbal expression of ideas is valued, as well as representations involving manipulable materials” (ME, 2021, p. 9). Furthermore, the use of Pattern Blocks as manipulative tools serves not only to enhance engagement but also to promote deeper learning of both geometric and computational thinking skills.

This chapter presents findings from a qualitative exploratory study conducted in a private Portuguese primary school involving 25 first grade students. These students generally have a positive attitude towards exploring new mathematical concepts and, because their school fosters a hybrid learning environment – integrating technologies along all learning areas –, they are indeed comfortable with using digital tools.

That being the case, the study focus is on the use of Pattern Blocks by the students, which features a unique role in gathering computational and geometric thinking together. Pattern Blocks allow students to manipulate each piece of the set, arrange and rearrange the pieces, creating geometric figures and consequently developing a tangible understanding of shapes and their composition and decomposition. By physically building shapes and understanding their properties, students gain an entrance point into concepts that might otherwise seem abstract at this age and at the corresponding stage of mathematical thinking (concrete, pictorial and abstract).

The experience is rooted in hands-on learning which allows students to see and touch the shapes, make their own discoveries, and connect geometric forms with computational thinking processes. According to Bessa, Mascarenhas, Silva, Fernandes and Quadros-Flores (2023), this combination of abstract thinking with concrete material leads to a deeper grasp of these fundamental concepts.

In the context of the Basic Education in Portugal, it is advocated that “no one should be excluded from mathematics and that everyone should have the opportu-

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