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# Mathematics and art in primary education textbooks

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## Introduction

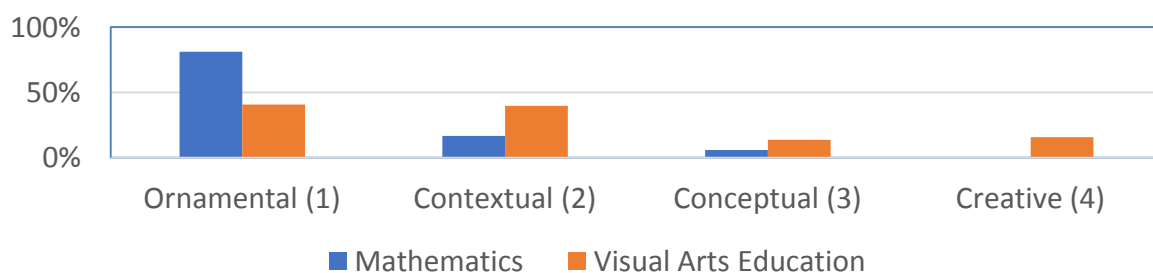
This research aims to analyze how the relationship between art and mathematics is established in the Spanish primary education. We analyze the art-mathematics connections in school textbooks, as this is the educational tool most widely used by teachers. In recent years, the educative community has become increasingly aware of the impact of modern art on society and the emergence of new forms of artistic expression. In fact, official documents promote interdisciplinary learning through a STEM approach that incorporates the creative and aesthetic dimension of Art into the so-called STEAM education. According to Holland (2017) students who follow a learning process based on STEAM develop creative skills, becoming better problem solvers and critical thinkers. The Spanish curriculum (MEC, 2014) specially connects Mathematics and Visual Arts. The Mathematics curriculum emphasis a competency-based learning grounded on the applicability of mathematics into daily life contexts, and aiming to connect this subject with the science, technology and art disciplines. Similarly, the Visual Arts subject offers a valuable opportunity to interact with other school subjects in particular, with mathematics (Brezovnik, 2015), through the analysis of different art forms including drawing, painting, sculpture, and photography (Freedman, 2003).

## Method

The present study was undertaken under a documentary analysis approach (Bardin, 1991), adopting a simplified version of Diego-Mantecón et al.'s (2018) framework which lays down six dimensions that we turned out into four: (1) the use of 'artistic representations' and 'mathematical objects' with an *ornamental purpose*; (2) the use of art and mathematics as *a context to carry out activities*; (3) the use of art as a way of *learning mathematical concepts* and the use of mathematics to *illustrate artistic concepts*; and (4) the *creation* of art through mathematics. The data were collected from a purposive sample of 72 Mathematics and 24 Visual Art school textbooks, being the one most often used in the Spanish primary education. The textbooks analyzed cover all six years of compulsory primary education (6 to 12 years old). Textbooks were released between 2009 and 2015. The analysis focused on identifying 'artistic representations' (e.g. sculpture, drawings, and mosaics) and 'mathematical objects' (e.g. identification of types of lines and proportion relations) in the Mathematics and Visual Art textbooks and analyzing how the art-mathematics connection is established in the textbooks.

## Results and conclusions

As Figure 1 shows, the analysis revealed that in both the Mathematics and Visual Arts textbooks the ornamental dimension (1) prevails (81,18% in Mathematics and 40,74% in Visual Arts Education textbooks) over the remaining dimensions. In Mathematics textbooks Art works fundamentally as a purely illustrative and decorative element, without any reference to the name of the artistic work nor to its author. In Visual Arts textbooks, Mathematics plays a more active role, expanding part of the artistic content with geometric concepts and measurement procedures which contextualize the exercise (39,81%, contextual dimension (2)). In Mathematics textbooks, this dimension has one much lower percentage (16,85%). By other side, in Mathematics and Visual Arts only 5,94% and 13,89% respectively of the artistic manifestations and mathematical objects are included in the conceptual dimension (3). Creative dimension (4) is non-existent in Mathematics textbooks, and it has a very limited presence in the Visual Arts books (15,74%).



**Figure 1: Percentage of dimensions in textbooks**

From this, preliminary results, we can conclude that the textbooks analysed do not reflect the art-mathematics connection, at the level suggested in the Spanish curriculum.

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