Exploring Symmetry in Elementary Schools

Andreia Hall*[1]
Mathematics Department
University of Aveiro
Portugal
E-mail: andreia.hall@ua.pt

Rosa Amélia Martins
Mathematics Department
University of Aveiro
Portugal
E-mail: rosaamelia@ua.pt

Carlota Simões
Mathematics Department
University of Coimbra
Portugal
E-mail: carlota@mat.uc.pt

Abstract

Children of different classes of elementary schools in Portugal have participated in a mathematics project which aims at increasing the interest for Mathematics in Portugal together with developing skills for day-to-day problem solving and inter-relating Mathematics with other Sciences and Arts. In this talk we shall present some of the results obtained while exploring several topics related to symmetry. The examples given relate to tiling, kaleidoscopes, animal drawings and cooking.

1. Introduction

Back in 2005, a group of teachers and researchers of the Mathematics Department of the University of Aveiro created the **EECM** (Escola de Educação Complementar em Matemática - School for Complementary Education in Mathematics**)** project. It appeared from the recognition of a lack of mathematical culture of the Portuguese society in general and the preconception against mathematics. **EECM** reflects a collective need to promote a positive relation with mathematics. Since the beginning, its action consists in developing activities *in non formal teaching* that are implemented in the community, including elementary schools. In collaboration with colleagues from the University of Coimbra, several activities were undertaken during the past year, exploring symmetry from many different perspectives. Through symmetry, there is a natural link between Mathematics and Art and therefore it is not surprising that very interesting results are obtained, both from a Mathematical and an Artistic point of view. All the children involved in the project were aged 6 to 9.

2. Tiling

Tiling is a classical topic for exploring symmetry and patterns. We explored tiling using regular polygons, irregular polygons and other figures obtained through deforming tiling polygons. For the first two types of tiling, the children first created the basic pattern, and after replication through scanning and printed tiling patterns were created. Figure 1 illustrates the results obtained. Tiling in the first row of Figure 1 is performed with squares (a) and triangles (b). In the second row, lozenges (c) and rectangles (d) were used and in the third row squares were transformed to produce irregular shapes. In this last row, two different types of transformation were used: on the left the transformation of the sides of the square were transferred to opposite sides by translation (e); on the right, rotation of the sides was used instead (f). This type of tiling was based on some of Escher's works.

[1] This work was supported by Fundação para a Ciência e Tecnologia (Portugal) through the research unit Centro de Física Computacional of the University of Coimbra.

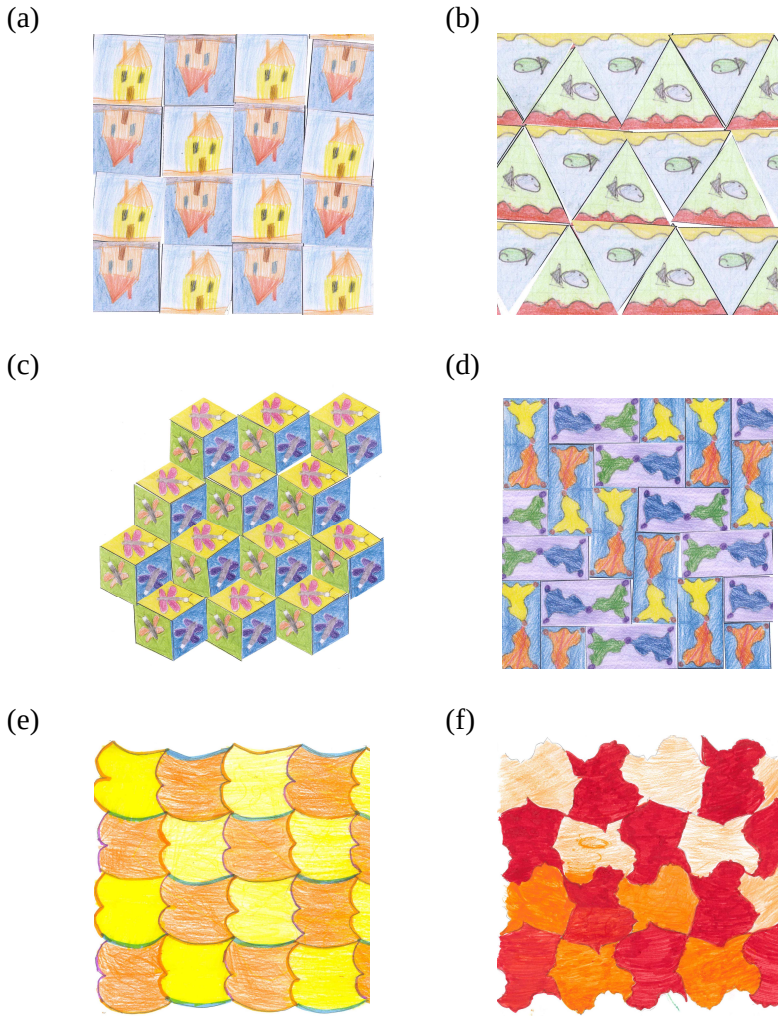

Figure 1: *Tiling*

3. Magic Tables

Using symmetry (reflection, translation and rotation) children created tables with missing cells which could be guesses through the symmetrical properties of the whole tables. Then, they exchanged tables and found out what was missing. Figures 2 and 3 show some of the obtained tables.

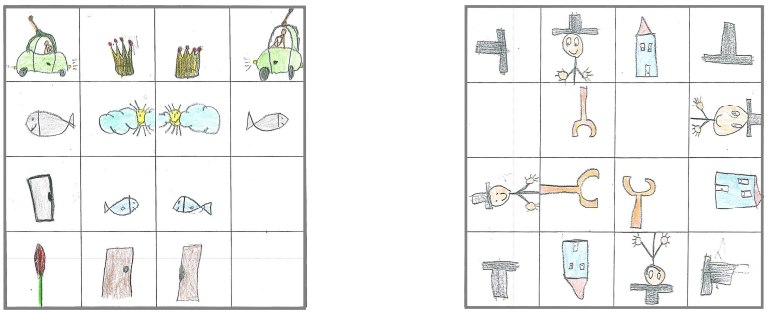

Figure 2: Magic tables (reflection symmetry (left) and rotation symmetry (right)).

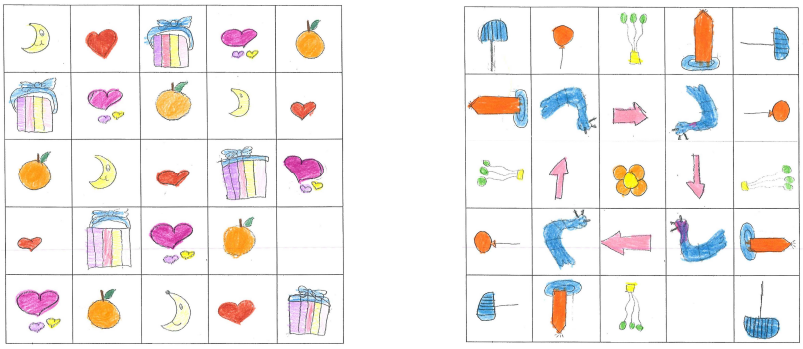

Figure 3: *Magic tables (translation symmetry (left) and rotation symmetry (right)).*

4. Kaleidoscopes

We explored kaleidoscopes using mirrors and alternatively by repeating the drawings. In the following example children were given a couple of equilateral triangles with a base drawing resembling a stained glass window. The two base drawings were symmetrical. In groups, the children colored the drawings alike and then arranged them in different ways. The following figure shows the same set of drawings displayed in three different ways.

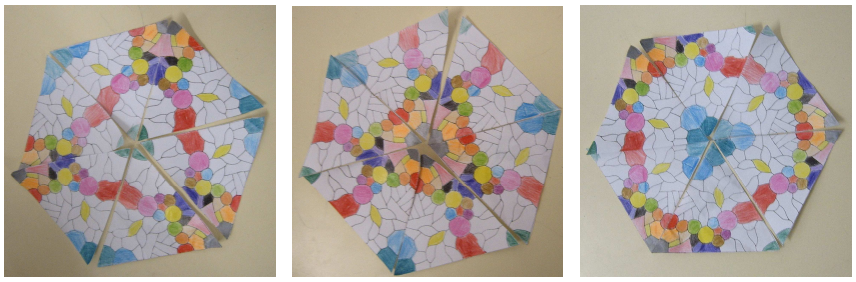

Figure 4: *Kaleidoscope drawings.*

5. Symmetry in Nature

Several activities were undertaken concerning symmetries found in nature. In one of them, the children were asked to create their own insect by placing paint in the middle of a sheet of paper and then folding it in half. After drying out, the antennae and the legs were added using crayons and a couple of eyes were glued on the head. Figure 5 shows some of the insects obtained:

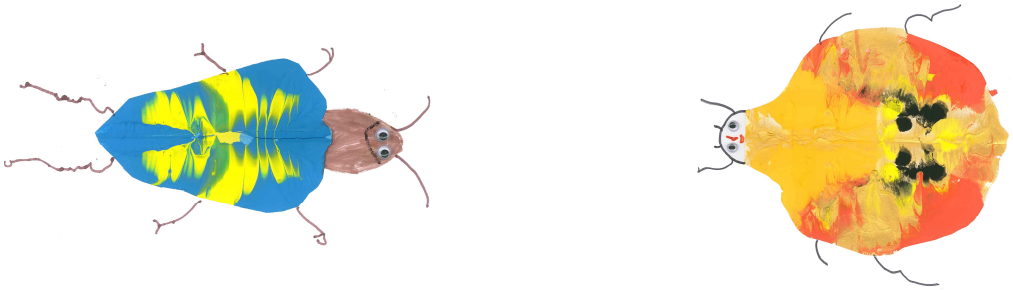

Figure 5: *Insect making using paint and paper folding.*

6. Symmetry in the Kitchen

Symmetry can also be explored at home, for instance in the kitchen. One of our nicest activities took place in the kitchen while making biscuits. Children were asked to cut the biscuit pastry using symmetrical figures. This was done through two different ways: one using cutting shapes and the other using polygons which could tile the plane (triangles, squares and rectangles). After backing the biscuits children were asked to decorate the biscuits using symmetry. Figure 6 shows some of the results obtained.

Figure 6: *Symmetrical biscuits.*

7. Conclusion

Symmetry has been explored in many different ways with children aged 6 to 9. All activities were linked to some real aspect of life (in the examples above we may mention tiling, magic shows, stained glass windows, animal life and cooking). One main concern was that the children should be an important part of the process and therefore they were asked to put their hands (and heads) to work in order to perform the required tasks.
Throughout this experience, we witnessed a great enthusiasm from the children when doing the activities. We believe this type of activities help the children not only to acquire new concepts more easily but also to remember them in the future.

8. References

Bellingeri, P., *O Ritmo das Formas*, Atractor, 2003.

Horn, C.E., *Geometric Symmetry in patterns and tilings*, CRC Press, FL, 2000.

Martin, George E., Transformation Geometry - An Introduction to Symmetry, Springer, NY, 1997.

Shepard, G.C. and Grunbaum, B., *Tilings and Patterns*, W.F.Freeman, NY,1989.

Simões, C. & Hall, A., *Ciência a Brincar: Descobre a Simetria*, Bizâncio 2010 (to appear).

Veloso, E., *Geometria - Temas Actuais - Materiais para Professores*, Instituto de Inovação Educacional, Lisboa, 1998.