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Implications of Philately in Highlighting Geometric Features for the Primary Cycle

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Authors' contributions

This work was carried out in collaboration among all authors. Authors ML and BVC designed the study, performed the literature searches, and wrote the first draft of the manuscript. Authors BVC and ALP managed the analyses of the entire study. All authors read and approved the final manuscript.

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ABSTRACT

The development of mathematical skills, especially those specific to geometry, for the primary cycle is a triple challenge in the current context of education in Romania. The first of the challenges is given by the fact that classical education, but also the online one, has become an activity, still unstructured, concerning movements, decisions, and political pressures, implicitly with the changes that occurred in the ministerial apparatus. The second challenge is given by the methodological changes and of the school curriculum, which comes as a completion of the first challenge, being felt even in the teaching-learning-evaluation specific to geometry. The third challenge is given by the weight that teachers face in making geometry a discipline that appeals to students, attractive. In this sense, the challenge for us is to show that this triple barrier can be overcome. As such, the present study proposes a mixed method of presenting the geometric contents in the classroom for the preparatory group, class I and II, through the prism of the instruments offered by the Romanian

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thematic philately. The results of the study are presented in the form of worksheets, of which we present only fragments to summarize the possibilities arising from the association of thematic philately with notions of geometry.

Keywords: Representation skills; geometric shapes; philately; educational perspectives.

1. INTRODUCTION

The process of forming geometric concepts, unlike others, raises psychological and pedagogical problems among the most special. How the concepts of abstract geometry are reached as mental entities is a complex and long process [1]. As such, those who deal with the training of students in the formation of mathematical skills, in particular geometry, implicitly the development of the so-called "plane-space vision", must arm themselves with great patience.

For example, the mathematical competence of students of mathematics and computer science consists in their ability to apply in practice the system of acquired mathematical knowledge, skills, and knowledge in the study of mathematical models of professional problems [2], including the ability to think logically, to evaluate, select and use information, to make decisions independently on a particular issue. Moreover, according to the literature, geometric skills are limited to knowledge of planar and spatial shapes, to which is added the ability to find the basic correlations between their numerical characteristics [2].

In general, the main goal pursued in the teaching of mathematics, implicitly of geometric notions, is not limited to the informative side [3], but aims especially at the development of reasoning and receptivity, skills of logical thinking, a clear and precise definition of notions, of creative adaptation to the dynamics, ever-increasing demands of today's society.

The cultivation of creativity in mathematics lessons, but especially geometry, is done under specific conditions. The orientation of students towards the new, towards the unexplored, the instilling by the teacher of his style of creative, free, and independent thinking, are just some of the premises [4]. In addition, ensuring an optimal climate for the spontaneous manifestation of students, an atmosphere conducive to independent exploration, without fear of error, knowing that error is a source of learning, are favorable conditions for their openness to self-instruction and lifelong learning. Only by ensuring these conditions can one overcome the limiting beliefs about mathematics and geometry alike, according to which "geometry is difficult" [5] or "mathematics is a foreign language" [6]. Replacing the above statements with statements such as "math is challenging" or "geometry is interesting" [5] is a first step, often very difficult to achieve, in terms of changing students' beliefs and impressions about math.

Through this study, to respond to the current concerns of those who teach primary school classes, especially those who teach notions related to geometry, we decided to implement a mixed methodology of teaching-learning assessment of geometry. In this sense, starting from our current concerns regarding the combination of new - modern information technologies as part of e-learning [7,8], with the old - thematic philately, as part of philately [9,7], we have proposed a new approach to attempts to develop geometric skills among young people.

2. MATERIALS AND METHODS

The present study started from a variant of the curriculum for the discipline “Mathematics and environmental exploration” [11], issued and validated by the relevant ministry in 2013, from which only the part related to geometry was extracted. Over this, after adapting and updating the information, the pedagogical approach achievable through the Romanian thematic philately was superimposed [7]. The latter emphasizes, this time, only the location in the plan and space of the various illustrated elements, without taking into account the nominal value of the pieces.

As for the philatelic pieces that were used, strictly in the sense of exemplifying the different shades that the geometry wears, they were "purchased online" through open-source platforms with specific content. For example, postage stamps, as presented in worksheets, as part of various geometry-specific requirements, are collected from the Colnect® open-source platform [12], while maximum postcards or other philatelic effects have been obtained from the Delcampe® [13] and PicClick® [14] platforms, which also

have an open-source regime. The applicable teaching methods to which we refer in the study can contribute both to the development of students' general culture and the development of geometric skills. To demonstrate this aspect we start from the idea that there are philatelic pieces that contain elements that are suitable to be discussed with a given plan or space. The discussion can be extended to the geometric shapes and bodies encountered in the curriculum for primary education.

3. RESULTS AND DISCUSSION

The usefulness of mathematics in everyday life is often questioned by students and not only, most often without a good reason. Many of the abstract aspects of this discipline may seem disconnected from everyday life, without an apparent practical basis [15]. Under these conditions, the application of mathematics, especially geometry, in a way understandable to students, carefully calibrated on its practical values and personal development, has become an important personal goal, which we tried to suggest in teaching. Thus, “mathematics through philately” and later “geometry through philately” took shape as a way to practically apply the information accumulated during the mathematics classes.

Highlighting the geometric characteristics of objects located in the environment has proved and proved to be a difficult test for both children and their teachers. Geometry has, without doubt, a practical side that must first of all be meticulously presented. Moreover, it takes a lot of patience, especially in exemplifying the various features of geometry, inputting the child on the right path to the formation of a consistent geometric vision.

3.1 Orientation and Movement in Space to Specified Landmarks/Directions

Orientation and movement in space to given landmarks/directions, using phrases such as: in, on, above, below, near, in front, behind, left, right, horizontal, vertical, oblique, inside, outside, etc., it is the first aspect debated in class in the sense of highlighting the geometric characteristic of various bodies.

Specific requirements for the age group of children in the preparatory class and those in the first and second grades include:

- identification of the position occupied by various objects in drawings, in the immediate reality or space with other specified objects;
- presenting one's person according to the position in the class and by reporting to other colleagues;
- games for positioning objects in space with other specified objects (eg: “Place the yellow pencil to the left of the red ones!”, “What is in front of the Romanian Athenaeum in Fig. 1b?”, etc);
- games for identifying objects from immediate reality or images (stamp illustration), depending on their position on a landmark (see Fig. 1) [16,17];

(a) (b) (c)

Fig. 1. An excerpt from the exercise: "Identify and specify the position of the various elements represented in the adjacent postage stamps" [16,17]

- making simple drawings, based on given conditions (eg: draw a triangle, on its left, draw a star, and under it draw a horizontal line);
- identification of the vertical, horizontal, or oblique position of some objects in the drawing or the immediate reality (eg: “Circle the objects drawn in a horizontal position”, “Color objects drawn in an oblique position”, etc.);
- composing/associating graphic elements to obtain stylized shapes of real-life elements;
- games that require orientation in tables and the use of the words "row" and "column", respectively, identifying the inside and outside of a figure or object;
- observing the symmetry of flat geometric figures, both objects and beings in the immediate environment.

3.2 Locating Objects by Establishing Coordinates

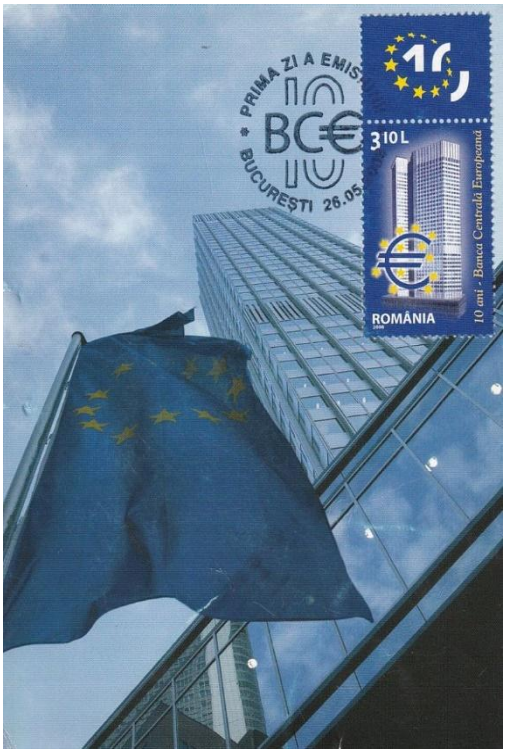
Locating objects by establishing coordinates to a given reference system, using the learned phrases, is the second stage through which we aim to familiarize the student with geometry. This step is very important because together with the orientation and movement in space, it captures the essence of positioning objects in space.

This time, the scenarios of working with students are summarized in the tracing, solving, and feedback received from the following set of tasks:

- identification of the position of various objects in the drawing/immediate reality, with other specified objects (direct reference is made to the position of the various elements in the stamps, or to the position where the stamps are applied on a certain philatelic material - letter, postcards, postcard, etc.);
- establishing the coordinates of an object in a plane with a given reference system - eg: "it is located on the wall with the door", "to the left of the closet", "in the upper right corner of the philatelic envelope", "on the back, bottom left, to the illustrated postcard", etc. (see Fig. 2) [18-20];

(a)

(b)



(c)

Fig. 2. An excerpt from the exercise: "Identify and specify the position of the stamps represented in the adjacent maximum postcards" [18-20]

- positioning objects in space, to other specified objects, and describing the structure of a set of objects with their spatial position;
- recognizing the vertical, horizontal, or oblique position of some objects from the immediate reality or in some drawings, as well as comparing the position of two objects;
- identification of the interior and exterior of a figure, as well as the intuitive perception of symmetry in flat geometric figures, objects, and beings in the immediate environment or which are illustrated (including stamps).

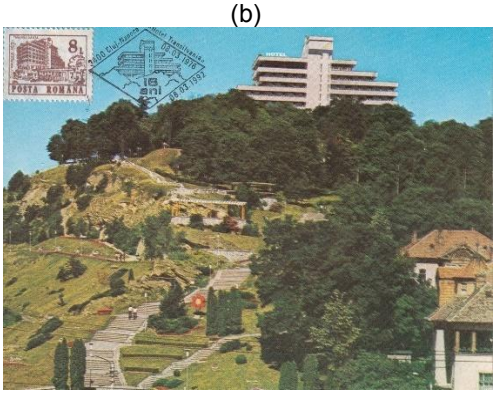
3.3 Identification of Plane Geometric Shapes and Geometric Solids

The identification of plane geometric shapes (squares, triangles, rectangles, circles, etc.) and geometric bodies (cubes, cuboids, sphere, etc.) in objects manipulated by children and in the environment are reduced to a series of somewhat more interesting requirements. , to the above, of which we mention:

- identification and naming of flat shapes: square, triangle, rectangle, circle, etc .;
- identification and naming of geometric bodies: cube, sphere, cylinder, cone, etc;
- recognition and description of geometric figures and bodies in the immediate environment;
- reproduction, by drawing, of flat geometric shapes (squares, triangle, rectangle, circle, etc.) with the help of patterns or with your free hand on a sheet with squares;
- using geometric shapes (squares, rectangles, circles, triangles) in making drawings (houses, robot, ship, etc.) with vellum sheet or with squares;
- recognition of geometric figures in the environment and various printed materials, mainly postage stamps and occasional philatelic envelopes (Fig. 3) [21-23];

(a)

(b)



(c)

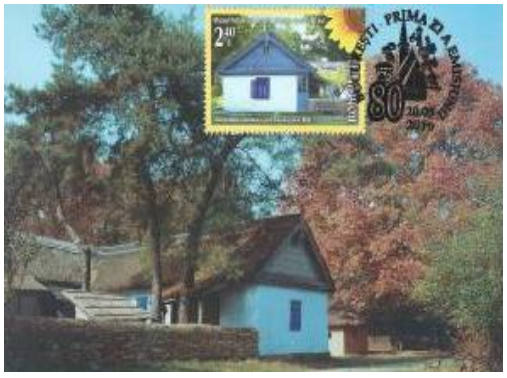
Fig. 3. An excerpt from the exercise: "Identify and specify the geometric shapes of the postage stamps and stamps represented in the maximum postcards" [21-23]

- contour cutting of flat geometric shapes of different sizes, made on various supports (glazed paper, cardboard);
- decorating objects with geometric motifs by drawing or collage;
- making drawings/collages with the help of learned geometric shapes;
- construction games using wooden or plastic parts.

3.4 Description of Simple Repetitive Phenomena/Processes/Structures from the Immediate Environment, in Order to Identify Regularities

After mastering some basic notions regarding both plane and space forms, a foray into the identification, description, and analysis of simple repetitive phenomena/processes/structures in the immediate environment, which are based on these forms, is welcome. To be able to identify, describe, and analyze the extent to which there are a series of regularities within simple repetitive phenomena/processes, it is appropriate to develop, solve, and interpret together with students, both in class and online, a series of requirements, such as:

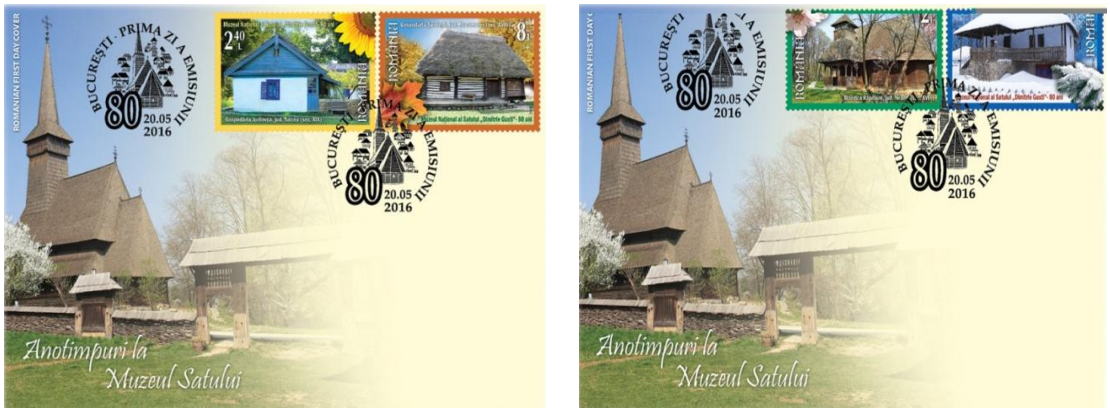
- continuation of repetitive patterns represented by objects, drawings, or numbers;
- discovering the “intruder” in a repetitive pattern;
- finding the elements of a set, given the elements of the other set and the rule of correspondence between them;
- various exercises of associations and correspondences (eg: “doll-dress”, “shoe-foot”, “car-driver”, “rain-umbrella”, “square-line”, etc.);
- games like: "What season is it?" for recognizing and differentiating natural phenomena, in real situations or images (eg: on the maximum postcards), depending on the specific characteristics observed (as shown in Fig. 4) [24,25];



(a)

(b)

(c)



(d) (e)

Fig. 4. An excerpt from the exercise: "Identify and specify the position of the stamps represented in the adjacent maximum postcards. Explain each identified season" [24,25]

- completing a calendar or an agenda for a week/month with the weather, by pasting/drawing some symbols - clouds, sun, wind, etc;
- direct observation in the natural environment of changes in human, animal, and plant life depending on the season.

3.5 Composing and Solving Problems by Observing Regularities in the Immediate Environment

Simple phenomena, processes, and/or repetitive structures in the immediate environment, which involve a series of regularities are found in our current activity more than we would be willing to believe. As such, in this last stage of our study, we set out to address the issues associated with the regularities that may occur in the immediate environment. Of course, in the sense of those achieved so far, to acquire various geometric skills with the observation of regularities in the immediate environment, we propose some requirements:

- making / transcribing repetitive patterns respecting a certain rule;
- discovering the algorithm for solving some exercises and verbalizing the way to solve some problems;
- inventing operating rules and applying them in games;
- identification of the rules for constructing a series of numbers or geometric shapes (see the examples proposed in Fig. 5a-d) [26-29];

(a) (b)

(c) (d)

Fig. 5. An excerpt from the exercise: "Identify and complete the string of geometric shapes represented in the adjacent philatelic materials" [26-29]

- recognizing the organs of the human body and locating them using images from atlases or molds;
- making collages/drawings that represent the human body with the main organs;
- establishing by observation the main structures of the bodies of animals and plants, and specifying the geometric shapes they have (where possible);
- carrying out experiments that highlight the state transformations of the water, and implicitly the geometric shapes that it can generate (solidification, ice melting, evaporation, boiling, condensation, etc.);
- drawing the position of the sun in the morning and at noon, at the same time and with the same landmark, for a week and highlighting the regularities;
- highlighting the force of wind and water as energy sources by using models (eg: mill, wheel set in motion by running water/tap water, etc.).

4. CONCLUSION

Through mathematical reasoning, geometric vision, and scientific thinking, the student can more easily understand the other educational disciplines and is trained and develops the ability to work organized and rhythmic. It also matters both the involvement that it manifests towards mathematics, in the case of this study towards geometry and the involvement of one/those who train it, teachers or parents.

Through this study, we show that the teacher, but also the parents involved in education, has access to a diverse and extremely dynamic range of means, tools, and methods in making the child understand and love geometry. Moreover, we want this study to stand the test of time and to certify the need for a multidisciplinary approach with each of the disciplines to be studied. In this sense, we hope that the understanding of a subject, such as notions and geometric shapes, is much more objective and effective.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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