

**PLAYFULNESS AS MOTIVATION IN MATHEMATICS CLASSES**  
**A LUDICIDADE COMO MOTIVAÇÃO NAS AULAS DE MATEMÁTICA**  
**EL JUEGO COMO MOTIVACIÓN EN LAS CLASES DE MATEMÁTICAS**



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**ABSTRACT**

The purpose of this work was to present the geoboard teaching material, showing its contributions to mathematics education, in an attempt to make the material more known and used in the classroom, since it is of great importance in the construction of knowledge, helping to break down the barriers of traditional teaching. As well as the dissemination of mosaics, it provides some examples of activities that can be explored on the geoboard and geometric grids. After a prior mathematical foundation on the recognition of the plane with regular and irregular polygons; moving on to the art of creating mosaic patterns, in the field of geometry, the main focus concerns planar tessellations, using geometric grids and the geoboard as pedagogical resources. In Elementary School, it is the responsibility of both the Art and Mathematics teachers to develop the geometric-spatial skills of the students.

**Keywords:** Geoboards. Geometric Grids. Mathematics.

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## RESUMO

O propósito deste trabalho foi expor o material didático geoplanos, mostrando as suas contribuições para o ensino de matemática, na tentativa que o material passe a ser mais conhecido e usado em sala de aula, visto que, é de grande importância na construção do conhecimento ajudando a quebrar as barreiras do ensino tradicional. Assim como a divulgação do mosaico, traz alguns exemplos de atividades que podem ser exploradas no geoplano e malhas geométricas. Após um embasamento matemático prévio sobre o reconhecimento do plano com polígonos regulares e irregulares; partindo para a arte de criar padrões em mosaico, no campo da geometria na qual o foco principal concerne às pavimentações planas, utilizando como recurso pedagógico as malhas geometrias e o geoplano. No Ensino Fundamental cabe tanto ao professor de Artes quanto ao de Matemática desenvolver as habilidades geométrico-espaciais dos alunos.

**Palavras-chave:** Geoplanos. Malhas Geométricas. Matemática.

## RESUMEN

El propósito de este trabajo fue presentar el material didáctico del geoplano, mostrando sus contribuciones a la enseñanza de las matemáticas, con el fin de difundir su uso en el aula, dada su gran importancia en la construcción del conocimiento y su contribución a la superación de las barreras de la enseñanza tradicional. Además de la difusión de mosaicos, se ofrecen ejemplos de actividades que pueden explorarse en el geoplano y las cuadrículas geométricas. Tras una base matemática previa sobre el reconocimiento del plano con polígonos regulares e irregulares, y pasando al arte de crear patrones de mosaico, en el campo de la geometría, el enfoque principal se centra en las teselaciones planas, utilizando cuadrículas geométricas y el geoplano como recursos pedagógicos. En la educación primaria, es responsabilidad tanto del profesorado de Arte como del de Matemáticas desarrollar las habilidades geométrico-espaciales del alumnado.

**Palabras clave:** Geoplanos. Cuadrículas Geométricas. Matemáticas.

## 1 INTRODUCTION

Analyzing the history of mathematics, we can say that the teaching of mathematics today is not very motivating, because it is associated with the practices of reproduction of mathematical procedures, which has not been attracting the clientele, since most students do not feel interested in classes.

Observing these aspects, I realized the need to innovate the learning process in relation to methodologies that seek students' commitment, offering a more dynamic and playful way to learn mathematical knowledge. In this aspect, it is worth mentioning that "no one educates anyone, no one educates himself, men educate themselves, medialized by the world". (FREIRE, 2006, p. 68).

Teaching mathematics is to develop logical reasoning and stimulate creativity and the ability to solve problems in a pleasurable way. Playful activities (games and play) should be experienced by students and educators, since they are indispensable ingredients in the relationship of the teaching-learning process, as well as a possibility for affectivity, self-knowledge, autonomy, cooperation, imagination and creativity to grow, allowing the student to learn through the pleasure of wanting to do and build.

Among the educational problems nowadays, we highlight the difficulties that the student encounters in learning mathematics. Thus, D'Ambrósio (1972) argues that it should be worked in a simple and attractive way, where the student can get involved, and although much research has contributed to the advancement of mathematics education, much still needs to be done.

## 2 THEORETICAL FRAMEWORK

Mathematics in the 1960s and 1970s was seen as a privileged access route for scientific and technological thinking and teaching began to have excessive concerns with abstractions internal to Mathematics itself, more focused on theory than on practice, exaggerating formalism, axiomatics. But, by bringing school mathematics closer to pure mathematical science, this pedagogical reform did not consider a basic point: what was proposed was out of the reach of students, especially those in elementary school.

With the ebb of this movement, problem solving became the focus of Mathematics teaching in the 80s and new directions were given to curricular discussions, which began to deal with the understanding of the relevance of social, anthropological and linguistic aspects in the learning of Mathematics.

According to works such as the PCN's (Brasil, 1997) and Onuchic (1999), the potentiality of mathematical knowledge should be explored in the broadest possible way in

elementary school, and thus lead the student, among other objectives, to understand and transform the world around him; solve problem situations, knowing how to validate strategies and results; develop forms of reasoning; to establish connections between mathematical themes and other areas.

By inserting play in elementary school, there is a move away from the traditionalist view that reserves the child a role of spectator ready to absorb knowledge that aims to prepare him for the role that will be charged in the following years at school to place him at the center of educational actions, in the role of an active subject capable of reflecting, by their own means, the social and cultural context in which they live.

Nowadays, the educator's ability to motivate students in the process of knowledge construction makes all the difference, the educator's active participation and his ability to transform traditional classes into sessions that arouse the student's interest and motivate him to learn is a legitimate means through which the teacher can achieve his pedagogical goals. The educator has to know how to transform his classes into work-game. (ALMEIDA, 1994, p. 68).

It is observed that playfulness is a liberating practice that removes the ties imposed by traditional education and places the child in conditions of interaction with the world around him, and with which he communicates through the act of playing that represents the child's way of assimilating and reconstructing, in a permanent and dynamic way, the reality around them.

It is worth highlighting the work of Moura (2000) entitled "The serious search in the game: of the ludic in mathematics", which leads us to a reflection on the role of the game as a cultural element that integrates the formation of concepts. The child learns and develops his cognitive structures by dealing with the game of rules that is impregnated with learning and allows the understanding of socially transmitted knowledge, subsidizing the child with new elements to appropriate the available knowledge. Piaget (1907, p. 392) points out that "[...] the interaction of subject and object is such [...] that it becomes impossible to conceive of one of the terms without the other. In other words, intelligence is the construction of relationships and not just identification [...]".

According to Macedo (2008, p. 85) "Piaget's great contribution was to study logical-mathematical reasoning, which is fundamental in school, and can be taught depending on the child's knowledge structure". Therefore, the environment and the situations that the teacher creates are fundamental for the development of logical-mathematical knowledge.

For Vygotsky (1993), concepts can be 'spontaneous' – they arise from the daily life prior to school, without a systematic organization, without awareness of their formation, and

'scientific' – those that come from formal instruction, from the natural, social and exact sciences and require awareness of action, that is, reflective awareness.

The pedagogical proposal based on concrete mathematical activities is the means through which we can achieve positive results, from the point of view of education. By proposing an educational line based on the valorization of practical activities, it appreciates the student as a subject in the process of knowledge construction, and understands action as a form of interaction between the child and the surrounding environment, through which the child can modify it according to his own experiences.

Some research carried out based on the difficulties of the students, in relation to the teaching-learning process of numbers, shows that there is only progress in learning when intervention is made with playful activities, working on the reality that students live in the classroom.

Playfulness represents a dimension in the process of knowledge elaborated by children. By using play, education recognizes the child as a subject capable of interpreting reality in his own way, considering the authenticity of his experiences in the social environment.

From birth, the child is in contact with the social environment and draws his experiences from it, but it is through play that he understands the environment around him and reconstructs the experiences acquired, forming a network of information about reality (WAJESKOP, 2001, p.21)

The teaching-learning of Mathematics should take into account the aspects of the relationship between school and society, emphasizing the use of the student's previous knowledge as a tool for the improvement of their learning and their reality. Mathematics can become pleasurable if there are no repressive and memorized practices. These practices lead to the withdrawal of students and reinforce the ingrained stigmas that learning Mathematics is difficult.

The acquisition of mathematical knowledge implies, therefore, a question of citizenship, at the same time that it reveals itself as a form of social inclusion, by enabling the creative capacity and positioning in the world in which we are inserted. In this way, the mastery of mathematics broadens our horizons, providing us, above all, with access to information and the production of knowledge.

We know that most students have difficulty mainly in geometry, as it requires greater concentration and a certain logical reasoning to understand abstract situations. Perhaps this difficulty is due to the materials that are used to work geometry with students, usually these

materials are books and notebooks, but this difficulty can be overcome with the help of concrete materials to work with geometry, as is the case with the Geoplane.

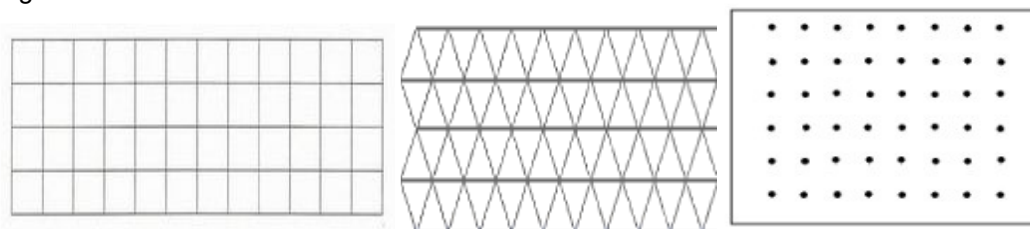
The geoplane will constitute a fundamental point of reference for those who are interested in the fascinating problem of paving the Euclidean plane linked to the teaching of mathematics, at the most variable levels, by bringing out the mathematics hidden in the mosaic patterns.

### 3 LEARNING GEOMETRY

Geometric meshes are resources used in mathematics that enable the student to introduce geometric concepts more easily, in order to lead him to an explicit understanding of the teaching of geometry.

Meshes are elements used in the development of activities, and can be squared, dotted, triangular or others, as can be seen below:

Figure 1



Source: Ochi et al (1992, p. 13)

Some types of meshes, preferably checkered ones, will be used as resources for the intuitive introduction of geometric concepts, aiming at a later understanding of these concepts and providing a significant learning of Geometry. Activities related to sequences, symmetries, congruences, similarities, area, perimeter and spatial visualization will be developed.

The geoplane is a very important pedagogical material for the teaching of mathematics, as it provides students with possibilities for a broad hypothetical development, allowing constructions and problem solving, since this student will have immediate contact with the relationships of geometry with measures and magnitudes, numbers and operations.

The use of the geoplane is directly related to the shapes of the meshes, whether they are squared, triangular, circular, etc.; From these, it will be possible to name which shape of the geoplane. It enables the exploration of activities that develop skills related to space exploration; visual discrimination; the construction of the notions of area and perimeter; comparison of areas and perimeters; to the understanding of the idea of fraction; the construction of irrational numbers; to the understanding of symmetry, reflection, rotation and translation.

According to Sabbatiello (1967) "the Geoplane is a mathematical model that allows us to translate or suggest mathematical ideas." It is a fact that the so-called concrete materials are interesting alternatives for students to formulate hypotheses, exchange ideas, make discoveries, that is, enrich the learning moment.

It is worth considering that the following are pedagogical resources: the geometric grid and the geoplane; As a learning tool, it is a resource of extreme interest to educators, since its importance is linked to the development of the student.

For all that has already been said, we propose the geoplane (board) with a focus on the teaching of geometry, highlighting symmetry and plane figures, in a dynamic and relaxed way, arousing interest in the student, curiosity about mathematical knowledge.

In this way, it is worth noting that the geoplane is a simple and easily accessible material that can be made with a natural wooden board or painted whose measurements will vary according to the desired shape that would serve as a base, medium nails preferably without the head or wooden pins, suitable for working with children and colored alloys or strings with which we can attach them to the nails by drawing and forming geometric figures on the geoplane. The distance between one nail and another, both vertically and horizontally, has to be the same, so there is a need to use a ruler or millimeter paper, in addition, we must consider a measurement not so large that it cannot be represented on the board, nor so small that it cannot be visualized, it is more indicated that the measurements are expressed by natural numbers.

With regard to the contents, it serves to work on the construction of polygons with sticks, the construction of Polyminos, the construction of segments of parallel lines, orthogonal, straight and non-straight lines, in addition to working on the game: "What is the piece?" and "What is the piece not?", and still with some challenges we can work on potentiation and can also make a contextualization with geography we can work on directions (North, South, East, West) and can be worked on in elementary II.

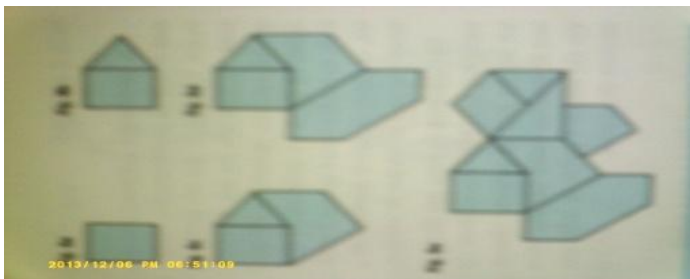
In addition to also encouraging students to learn by playing, it also works with recycling; Geometric Solids is used to work proportionalities, segments, plane and spatial figures, angles can be worked on in elementary school where it makes the student learn by playing.

#### 4 PAVING THE PLAN

According to Barbosa (1993) the concept of paving the plane is "a set of polygons is a paving of the plane if, it is only if, the set of polygons covers the plane without intersections". Therefore, each time we add a new polygon, side by side, we form a new frontier by expanding the previous one; So we say that a partial paving of the plan was done.

The paving of the plane can occur with regular polygons (squares, regular triangles, regular hexagons) and irregular polygons (rhombuses, rectangles, trapezoids, quadrilaterals, hexagons, pentagons). Let's look at some examples of how mosaics can be obtained from simple pieces:

**Figure 2**

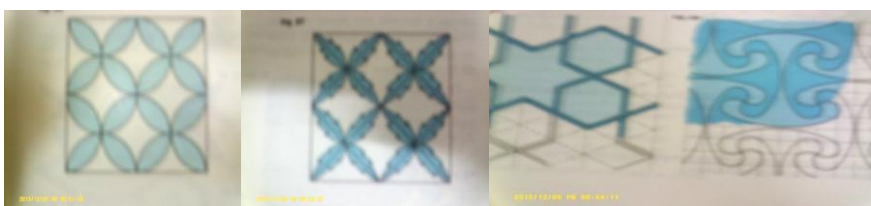


Source: Van de Walle (2009, p. 455)

Mosaics have been known since ancient times. They were present in the Assyrian, Babylonian, Persian, Egyptian, Greek, Chinese and other civilizations. Many mosaics found on floors, ceilings and wall panels, temples or palaces, in their constructions, the walls presented various patterns of symmetry never related to living beings, due to religious precepts. They attest to the intimate relationship between certain patterns and the art of decoration.

The built-in set of stones (painted or not) with which figures or designs named mosaic are formed. As conceptualized by Mini Aurélio (2001): Inlays of colored stones, arranged in such a way that they present designs. The mosaic can be constructed from squares, regular hexagons, equilateral triangles and with combined. Some examples of mosaic below:

**Figure 3**



Source: Van de Walle (2009, p. 451)

The teacher must be concerned with seeking to create greater interaction, through oral and written texts, with his students. There can be no value fair that determines the discourse of one superior and better than that of the other and the teacher knows this, or at least, should know and apply it in his daily practices in the classroom. According to Kishimoto (1996), using the game in education is the same as maximizing the teaching-learning conditions, through the playful properties of pleasure, the capacity for initiation, active and motivating action.

The use of the game values the exploration and construction of knowledge by the child to the extent that he is internally motivated to practice the action, however, the achievement of the pedagogical objectives requires a selection and offer of external stimuli, as well as a system of concepts generated in non-game situations, in addition to the establishment of criteria for the selection of toys appropriate to the intended objectives.

## **5 FINAL CONSIDERATIONS**

Mathematics, despite being present in our daily lives, is often seen in a way that is totally dissociated from reality and the language we speak. By relating some studies on learning problems in general, it shows the current trend of rescuing the pleasure of learning with creativity and communication, supported by the great merit of the PCN, which, with a post-constructivist theoretical foundation, seek to reconcile cognitive and affective-relational aspects, showing the need to understand that intelligence develops in interaction, in the organization of the world in which we live.

The use of geometric meshes and geoplanes as mediating techniques for school learning is a conception of education that recognizes in play the advantage of aggregating contents and stimuli for learning in the same activity or object.

To provide students with situations where they can develop through games and play their intellectual capacities that will serve as support for learning characterized by autonomy and the possibility of generating action alternatives that can meet the situational needs that arise in the social environment

The abandonment of the teaching of geometry in school is noticeable, especially by the teacher who focuses on operations and calculations; leaving aside the development of students' reasoning and spatial perception. Since the beginning, geometric knowledge has already been used to solve problems and needs. Allowing to pave the way for the evolution of the current geometry.

The school, as an agency par excellence for the production of knowledge, plays a role of fundamental importance in the process of acquisition of mathematical knowledge, by

developing it in a systematized way, attributing meaning to the learning of mathematics, through the interactions established in the school context.

The reflections undertaken about the teaching-learning process of mathematics reveal the multifaceted character of the school, in general, not having awakened in the student the taste and pleasure for geometry. The child, when he starts his school life, shows a lot of interest and expectation, but little by little he loses enthusiasm.

There are still traditional schools that only pay attention to reproducing ready-made and finished mathematical knowledge, without even providing something really meaningful to the student. It is of great value for the school and the teacher to instigate their students to build new knowledge, focused on their socio-cultural relations.

It was observed that the students made great progress in learning language. The fact that they presented different levels of knowledge contributed to a good performance of the activities, as those with greater knowledge in a way helped those who presented greater difficulties.

We also reintegrate numbers and texts as part of the routine, presenting in writing activities containing lists and memorized texts with a proposal for reflection on the writing system. We recommend the use of numbers problematizing and contextualizing with the students' reality.

It was noticed that the long and formal activities left the students unmotivated, when they were placed as active and participative subjects in the elaboration of the activities, they were enthusiastic in wanting to complete, socialize and interact during the tasks.

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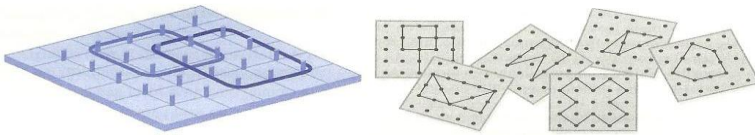
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## ANNEX

### ACTIVITY 1

Copy the shapes shown on the following cards into the geoplane:

**Figure 4**

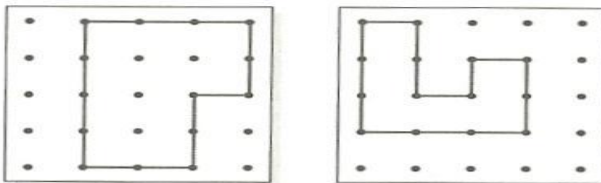


Source: Van de Walle (2009, p. 449)

### ACTIVITY 2

Copy the shapes of the cards into a grid or geoplane and compose, cut, or divide them into smaller congruent shapes.

**Figure 5**



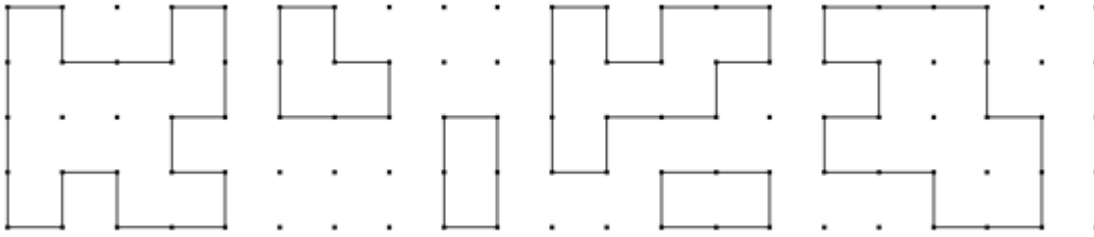
Source: Van de Walle (2009, p. 450)

- 1-What is the greater or lesser number of triangles that fill figure 1?
- 2-Fill figure 2 with three rectangles.

### ACTIVITIES 3

1. Let's reproduce the figures below on the Geoplane and calculate the area and perimeter?

**Figure 6**



Source: Van de Walle (2009, p. 450)

2. Construct on the geoplane all possible figures formed by four congruent right triangles, joined by the legs and the hypotenuse. We can build more than 10 different figures.