THE TEACHING OF SOLID GEOMETRY FROM THE PERSPECTIVE OF AMAZONIAN CONTEXTUALIZATION: A KIT OF MANIPULATIVE AND DIGITAL ACTIVITIES FOR ELEMENTARY EDUCATION

O ENSINO DE GEOMETRIA ESPACIAL SOB A ÓTICA DA CONTEXTUALIZAÇÃO AMAZÔNICA: UM KIT DE ATIVIDADES MANIPULATIVAS E DIGITAIS PARA O ENSINO FUNDAMENTAL

LA ENSEÑANZA DE LA GEOMETRÍA ESPACIAL DESDE LA PERSPECTIVA DE LA CONTEXTUALIZACIÓN AMAZÓNICA: UN KIT DE ACTIVIDADES MANIPULATIVAS Y DIGITALES PARA LA EDUCACIÓN PRIMARIA

https://doi.org/10.56238/sevened2026.022-019

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ABSTRACT
This article presents a proposal for pedagogical intervention in the teaching of Solid Geometry for the 8th grade of Elementary Education through a kit of manipulative and digital activities. The initiative arises from the need to address students' recurring difficulties with three-dimensional concepts, as identified by the Amazonas Learning Verification Assessment (AVAM). The kit, composed of ten activities, integrates low-cost concrete resources and digital tools accessible through QR Codes, promoting active learning contextualized to the Amazonian reality. Grounded in Van Hiele's Theory of Geometric Thinking Levels and Ausubel's Theory of Meaningful Learning, the material seeks to develop visualization skills, logical reasoning, and geometric argumentation, in alignment with the National Common Curricular Base (BNCC). Although the educational product has not been empirically applied, its theoretical and methodological design offers an innovative and adaptable resource for educators, with the potential to transform the teaching of Solid Geometry, making it more dynamic, inclusive, and meaningful for students in the region. Regional contextualization is a central pillar, connecting geometric solids to elements of everyday Amazonian life in order to create meaningful learning anchors. This work aims to contribute to improving students' performance in external assessments and to inspire the development of analogous teaching materials.

Keywords: Solid Geometry. Elementary Education. Amazonian Contextualization. Manipulative Materials. Digital Technologies.

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RESUMO
Este artigo apresenta uma proposta de intervenção pedagógica para o ensino de Geometria Espacial no 8º ano do Ensino Fundamental, por meio de um kit de atividades manipulativas e digitais. A iniciativa surge da necessidade de abordar as dificuldades recorrentes dos estudantes em conceitos tridimensionais, conforme identificado pela Avaliação de Verificação da Aprendizagem do Amazonas (AVAM). O kit, composto por dez atividades, integra recursos concretos de baixo custo e ferramentas digitais acessíveis via QR Codes, promovendo uma aprendizagem ativa e contextualizada à realidade amazônica. Fundamentado na Teoria dos Níveis de Pensamento Geométrico de Van Hiele e na Teoria da Aprendizagem Significativa de Ausubel, o material busca desenvolver habilidades de visualização, raciocínio lógico e argumentação geométrica, alinhado à Base Nacional Comum Curricular (BNCC). Embora o produto educacional não tenha sido aplicado empiricamente, sua concepção teórica e metodológica oferece um recurso inovador e adaptável para educadores, com potencial para transformar o ensino de Geometria Espacial, tornando-o mais dinâmico, inclusivo e significativo para os estudantes da região. A contextualização regional é um pilar central, conectando sólidos geométricos a elementos do cotidiano amazônico, visando criar âncoras de aprendizagem significativas. Este trabalho visa contribuir para a melhoria do desempenho dos estudantes em avaliações externas e inspirar o desenvolvimento de materiais didáticos análogos.

Palavras-chave: Geometria Espacial. Ensino Fundamental. Contextualização Amazônica. Materiais Manipulativos. Tecnologias Digitais.

RESUMEN
Este artículo presenta una propuesta de intervención pedagógica para la enseñanza de la Geometría Espacial en el 8.º grado de la Educación Primaria, mediante un kit de actividades manipulativas y digitales. La iniciativa surge de la necesidad de abordar las dificultades recurrentes de los estudiantes en conceptos tridimensionales, según lo identificado por la Evaluación de Verificación del Aprendizaje del Amazonas (AVAM). El kit, compuesto por diez actividades, integra recursos concretos de bajo costo y herramientas digitales accesibles mediante códigos QR, promoviendo un aprendizaje activo y contextualizado a la realidad amazónica. Fundamentado en la Teoría de los Niveles de Pensamiento Geométrico de Van Hiele y en la Teoría del Aprendizaje Significativo de Ausubel, el material busca desarrollar habilidades de visualización, razonamiento lógico y argumentación geométrica, en consonancia con la Base Nacional Común Curricular (BNCC). Aunque el producto educativo no ha sido aplicado empíricamente, su concepción teórica y metodológica ofrece un recurso innovador y adaptable para los educadores, con potencial para transformar la enseñanza de la Geometría Espacial, haciéndola más dinámica, inclusiva y significativa para los estudiantes de la región. La contextualización regional constituye un pilar central, conectando los sólidos geométricos con elementos de la vida cotidiana amazónica con el fin de crear anclajes de aprendizaje significativos. Este trabajo busca contribuir a la mejora del desempeño de los estudiantes en evaluaciones externas e inspirar el desarrollo de materiales didácticos análogos.

Palabras clave: Geometría Espacial. Educación Primaria. Contextualización Amazónica. Materiales Manipulativos. Tecnologías Digitales.

1 INTRODUCTION

The teaching of Spatial Geometry in Elementary School represents a significant challenge for educators and students, often marked by abstract approaches that hinder understanding and engagement. In the Amazonian context, this complexity is accentuated by the need for contextualization that dialogues with the sociocultural reality of the students,

making learning more meaningful and relevant (Educational Product, p. 1) (Nunes, 2024). This article proposes to present and discuss a Kit of Manipulative and Digital Activities for Elementary School, entitled "The Teaching of Spatial Geometry from the Perspective of Amazonian Contextualization", developed for the 8th grade of Elementary School. The main objective is to offer Mathematics teachers a set of didactic materials that enable the teaching of Spatial Geometry in a playful, practical and interactive way, overcoming the recurring difficulties identified in assessments such as the Amazonas Learning Verification Assessment (AVAM) (Amazonas, 2020-2023).

The genesis of this educational product lies in the analysis of the AVAM descriptors, which, as of 2020, revealed gaps in students' understanding of specific geometric topics (D01 to D07). In response to this demand, the kit was designed with ten activities that integrate low-cost concrete resources, such as cardboard and toothpicks, and digital tools accessible via QR Codes, which lead to simulations and three-dimensional representations. This approach aims to promote active learning, the development of visualization skills, logical reasoning, and geometric argumentation, in line with the guidelines of the National Common Curriculum Base (BNCC, 2018) (BNCC, 2018).

Although the kit was not applied in the classroom in the present study, configuring itself as a theoretical-methodological proposal, its construction and analysis are based on consolidated theoretical references and aligned with the demands observed in state schools in the municipality of Manaus, in the state of Amazonas. Regional contextualization is a fundamental pillar, seeking to connect geometric solids to elements of Amazonian daily life, such as riverside stilts and straw hats, to create meaningful learning anchors (Ausubel, 2003). The guiding question that guided the research was: how can the contextualization of Mathematics problem questions, related to the daily life and sociocultural reality of students, contribute to meaningful learning and the development of students' critical reasoning? This article will detail the theoretical foundation, the methodology of product development, the characteristics of the activity kit, and the final considerations about its potential impact on the teaching of Spatial Geometry in the Amazon region.

2 THEORETICAL FRAMEWORK

The teaching of Spatial Geometry is a fundamental axis for the development of students' geometric, spatial and critical thinking. Understanding the shapes, sizes, positions, and properties of objects in space is essential not only for advancement in other areas of mathematics, but also for the interpretation of the physical world and for solving everyday problems (Lorenzato, 2006, p. 75). Historically, geometry has been a pillar of mathematics education, contributing to the development of superior cognitive skills, such as visualization, analysis, and deduction.

According to the National Common Curricular Base (BNCC, 2018), skills related to this field include the interpretation and representation of three-dimensional shapes, the association of solids with their flattening (EF06MA17) and the recognition of orthogonal views (EF09MA17). Such competencies aim to stimulate problem solving, argumentation, and the construction of increasingly abstract geometric reasoning (BNCC, 2018). However, the inherent complexity of geometric abstraction, combined with the lack of adequate and contextualized didactic resources, often results in learning difficulties and lack of interest on the part of students (Smole; Diniz, 2001, p. 15).

It is in this scenario that the theoretical foundation becomes crucial, providing the basis for the development of effective and innovative pedagogical practices. This theoretical framework will explore the main approaches that underpin the activity kit proposal, including Van Hiele's Theory, Ausubel's Meaningful Learning, Ethnomathematics, and the use of Manipulative Materials and Digital Technologies, all interconnected by the need for Amazonian contextualization.

Van Hiele's Theory and the Development of Geometric Thinking

Van Hiele's (1986) theory of levels is widely recognized for explaining how students evolve in their geometric understanding, going through five levels of development:

- Level O – Visualization (the student recognizes figures by their global appearance, without considering properties);
- Level 1 – Analysis (the student identifies properties of the figures, such as parallel sides, angles and measurements);
- Level 2 \u2012 Informal Deduction (the student can relate properties and justify conclusions);
- Level 3 – Formal Deduction (the student understands the role of definitions, axioms and theorems, building formal proofs);
- Level 4 – Rigor (the student is able to work with different axiomatic systems and non-

Euclidean geometries) (Van Hiele, 1986, p. 12-15).

This progression underpins the sequential organization of the activities proposed in this kit, aiming to lead the 8th grade student to move between the levels of Visualization, Analysis and Informal Deduction. According to Usiskin (1982), the progression through these levels is characterized by a fixed order, where the student cannot skip steps, because each level builds the vocabulary and the network of relationships necessary for the next (Usiskin, 1982, p. 4).

The importance of respecting this sequence is crucial to avoid gaps in learning and frustration on the part of students. In the context of the 8th grade, the transition from Level 1 (Analysis) to Level 2 (Informal Deduction) is critical, as it requires the student to stop seeing the properties in isolation and start to understand the logical interconnections between them, building small deductive chains. Barrera Mora and Reyes Rodríguez (2013) emphasize that each level has its own language and its own symbols, and communication between teacher and student is only effective if both are operating at the same level (Barrera Mora; Reyes Rodríguez, 2013, p. 3).

Oliveira and Leivas (2017) emphasize that visualization and geometric representation are skills that should be stimulated from an early age, as the lack of mastery over spatial geometry in Elementary School directly reflects on performance in later stages (Oliveira; Leivas, 2017, p. 12). The manipulation of concrete objects and the exploration of two- and three-dimensional representations are essential for the development of these skills. The use of dynamic geometry software, such as GeoGebra, combined with Van Hiele's theory, allows the student to experience "dynamic visualization", facilitating the transition between two-dimensional and three-dimensional (Almeida, 2023, p. 5). This technological approach, when well planned, can speed up the passage through the levels, making geometric concepts more accessible and concrete for students.

The importance of activities that promote interaction and reflection is highlighted by Clements and Sarama (2009), who argue that the development of geometric thinking is not automatic, but rather the result of carefully planned learning experiences (Clements; Sarama, 2009, p. 10). The proposed activity kit, by integrating manipulative materials and digital resources, seeks to offer an environment rich in opportunities for students to explore, conjecture and validate their findings, facilitating the transition between Van Hiele levels. The teacher's mediation, in this process, is fundamental to guide students, propose questions and stimulate mathematical communication, transforming the classroom into a space for the collective construction of geometric knowledge (Ponte; Serrazina; Guimarães, 2005, p. 30).

Van Hiele (1986) also proposed five phases of learning that guide instruction at each level: Information, where the teacher presents the new topic; Directed orientation, with structured activities to explore the theme; Explicitness, where students express their findings; Free guidance, with more complex problems that require investigation; and Integration, where students synthesize the knowledge acquired. The structure of this activity kit was designed to respect these phases, promoting a gradual and conscious transition between the levels of geometric thinking.

2.1 AUSUBEL'S MEANINGFUL LEARNING IN MATHEMATICS

The theoretical foundation of this product is also based on Ausubel's (2003) theory of meaningful learning, which emphasizes the importance of connecting new knowledge to students' previous knowledge (Ausubel, 2003, p. 2). For David Ausubel, meaningful learning occurs when new information is anchored in relevant concepts already existing in the learner's cognitive structure, the so-called subsumers. Unlike machine learning, where new knowledge is stored in an arbitrary and literal way, in meaningful learning there is an interaction between the new and the already existing, resulting in a modification of both (Ausubel, 2003, p. 3). This interaction is essential for the construction of lasting and applicable knowledge.

Huf et al. (2024) point out that, in mathematics teaching, the adoption of the Theory of Meaningful Learning (SAT) requires the teacher to identify this prior knowledge so that the new learning is not merely mechanical or memoristic (Huf et al., 2024, p. 2). The relevance of the material to be learned and the student's predisposition to learn are crucial factors for meaningful learning to occur. Katia (2018) adds that the teaching of mathematics should be a process of dialogical construction, supported by the principles of meaningful learning, where the student is the protagonist of his own learning (Katia, 2018, p. 3).

The use of "prior organizers", introductory materials that serve as a bridge between what the student knows and what he should learn, is an effective strategy to promote this anchoring (Ausubel, 2003, p. 6). Ausubel distinguishes two main types of prior organizers: expository, which presents general and comprehensive concepts before introducing details, and comparative, which integrates new ideas with similar concepts already existing in the learner's cognitive structure (Ausubel, 2003, p. 7). In the case of spatial geometry, the activity kit acts as a prior organizer, providing concrete experiences that facilitate the assimilation of abstract concepts of volume, surface area, and properties of geometric solids (Damian; Kaiber, 2025, p. 15).

Manipulating physical models and visualizing digital representations allow students to build a solid foundation of knowledge before delving into formulas and calculations. Active interaction with didactic material, whether concrete or digital, is a catalyst for the formation of subsumers, as it provides direct experiences that facilitate the assimilation of complex concepts (Moreira, 2011, p. 54). In this way, the activity kit is not just a resource, but a mediator between the student's previous knowledge and the new geometric concepts, making learning a dynamic and participatory process.

In addition, meaningful learning in mathematics is enhanced when the proposed problems are relevant to the students' lives, connecting school content to their daily lives and culture (D'Ambrosio, 2019). Amazonian contextualization, therefore, is not only a backdrop, but an intrinsic element in the promotion of meaningful learning, as it allows students to see the usefulness and applicability of geometric concepts in their own environment. This approach is aligned with both the BNCC guidelines and current research recommendations, reinforcing the importance of Spatial Geometry teaching based on active methodologies and innovative resources, with a specific focus on overcoming the difficulties mapped by large-scale evaluations of the state of Amazonas. The Theory of Meaningful Learning, by emphasizing the importance of the interaction between new knowledge and the preexisting cognitive structure, offers a robust framework for the development of didactic materials that truly promote the understanding and retention of learning.

2.2 ETHNOMATHEMATICS AND THE AMAZONIAN REALITY

The Ethnomathematics Program, proposed by Ubiratan D'Ambrosio (2019), argues that mathematics is a cultural response to the needs of survival and transcendence (D'Ambrosio, 2019, p. 1). He argues that mathematics is not a universal and apolitical knowledge, but rather a set of knowledge and practices developed by different cultures to deal with their realities and needs (D'Ambrosio, 2009, p. 16). In the Amazon, the traditional knowledge of riverside and indigenous communities offers a vast field for the contextualization of teaching, allowing mathematics to be perceived as an integral part of local life and culture.

Pessoa et al. (2026) highlight that ethnomathematics in the region should not be seen only as a cultural curiosity, but as a tool for social justice and sustainability, valuing local practices as legitimate forms of mathematical knowledge (Pessoa et al., 2026, p. 1). The inclusion of this knowledge in the school curriculum contributes to the appreciation of the cultural identity of students and to the construction of a more equitable and relevant education. Mathematics, in this context, ceases to be an imposed and abstract knowledge to become a tool for empowerment and understanding of the world. Ethnomathematics, by recognizing and valuing the ways of thinking and doing mathematics present in local cultures, promotes a more inclusive and democratic education (D'Ambrosio, 2009, p. 20). In the Amazonian context, this means integrating the practices of counting, measuring, classifying, and spatial organization of riverside, indigenous, and extractive communities, such as the construction of housing, river navigation, basket-making, and traditional agriculture, with the formal teaching of geometry (Silva; Bezerra, 2025, p. 15). This integration not only makes math more accessible and interesting for students, but also strengthens their cultural identity and sense of belonging.

In addition, ethnomathematics in the Amazon can be a powerful tool for environmental education, by exploring the relationship between traditional mathematical knowledge and the sustainability of local ecosystems. For example, the understanding of geometric shapes present in nature, such as the structure of leaves, flowers and fruits, or the growth patterns of plants and animals, can be used to teach geometric concepts in a contextualized and interdisciplinary way (Silva; Bezerra, 2025, p. 18). The analysis of the construction techniques of canoes, stilts and fishing traps, which involve complex geometric principles, offers a unique opportunity for students to apply mathematics in real and meaningful situations. This approach not only enriches the learning of geometry, but also promotes the appreciation of ancestral knowledge and awareness of the importance of environmental preservation in the region (D'Ambrosio, 2019, p. 25). Ethnomathematics, therefore, transcends the mere application of mathematical concepts, transforming itself into an instrument of cultural dialogue and the construction of a more relevant and transformative education for Amazonian students.

Valuing local knowledge and building a more meaningful curriculum are crucial aspects of ethnomathematics. By recognizing that different cultures develop their own forms of mathematics, teaching can become more inclusive and respectful of students' cultural diversity (Gerdes, 2010, p. 45). This is particularly relevant in the Amazon, where the cultural richness of indigenous and riverine communities offers a vast repertoire of mathematical knowledge that can be explored in the classroom. The inclusion of this knowledge in the curriculum not only makes mathematics more accessible and interesting, but also strengthens the cultural identity of students and promotes a sense of belonging (D'Ambrosio, 2009, p. 20). Ethnomathematics, in this sense, is not only a methodology, but an educational philosophy that seeks to value local knowledge and build a more meaningful and contextualized curriculum.

Another point to be considered is the intrinsic relationship between ethnomathematics and environmental education in the Amazon. The mathematics present in the practices of sustainable management of natural resources, in the social organization of communities and in the interpretation of natural phenomena can be explored to develop a critical environmental awareness in students (Silva; Bezerra, 2025, p. 20). By studying, for example, the geometric patterns of fishing nets or the ways of building houses that adapt to the flooding regime of rivers, students not only learn geometry, but also understand ancestral wisdom and the importance of sustainability for the region. This interdisciplinary approach, which connects mathematics to ecology and local culture, is essential to form citizens who are aware of and engaged with the preservation of the Amazon biome (D'Ambrosio, 2019, p. 35). Ethnomathematics, therefore, presents itself as a path to a more holistic education, which integrates scientific knowledge with traditional knowledge, promoting a deeper and more respectful understanding of the world.

Finally, ethnomathematics offers a perspective for building a mathematics curriculum that is truly relevant to Amazonian students. Instead of importing pedagogical models from other realities, ethnomathematics proposes that the curriculum be built from the experiences and knowledge of the students themselves, making learning more meaningful and engaging (Gerdes, 2010, p. 50). This implies a flexible curriculum, which adapts to the particularities of each community, recognizing and valuing their forms of knowledge. Ethnomathematics, therefore, is not only a pedagogical approach, but a commitment to equity and cultural relevance in mathematics education, especially in contexts of diversity such as the Amazon (D'Ambrosio, 2009, p. 22). Ethnomathematics, therefore, is not only a tool for teaching geometry, but an approach that aims to transform education, making it more just, equitable, and aligned with the needs and aspirations of Amazonian communities (D'Ambrosio, 2019, p. 40).

The connection between geometric solids and elements such as riverside stilts, the shape of canoes, local handicrafts (straw hats, basketry) or even the architecture of traditional houses allows students to perceive mathematics as something alive and present in their territory. This "multicultural" approach in mathematics teaching favors engagement and the construction of a positive identity in relation to the discipline (Vieira, 2008, p. 148). In addition, by exploring ethnomathematics, students develop critical thinking about the origin and application of mathematical knowledge, recognizing the diversity of ways of thinking and solving problems. Filho and Nicot (2020) emphasize the importance of using forest elements in the production of methodological resources for the teaching of Science and Mathematics in the Amazonian context, promoting an education that dialogues with the local reality (Filho; Nicot, 2020, p. 1- 2). Ethnomathematics, therefore, is not only a methodology, but an educational philosophy that seeks to value local knowledge and build a more meaningful and contextualized curriculum.

In this sense, ethnomathematics acts as a bridge between formal and informal knowledge, allowing students to recognize mathematics in their own experiences and, from there, build a deeper understanding of abstract concepts (D'Ambrosio, 2019, p. 30).

Valuing traditional knowledge does not mean replacing academic mathematics, but rather enriching it, making it more relevant and accessible to students in the Amazon. Magalhães' (2025) research on mathematics education in the Western Amazon highlights the importance of rescuing manipulable materials and pedagogical practices that consider the local reality, especially in times of digital restriction (Magalhães, 2025, p. 5). This perspective reinforces the need for education that is sensitive to the cultural and environmental particularities of the region, promoting education that is truly transformative and that contributes to the sustainable development of Amazonian communities. The integration of ethnomathematics into the curriculum is not limited to isolated examples, but seeks a restructuring that allows students to develop a more holistic and critical view of mathematics, recognizing it as a humanly and culturally situated construction (Gerdes, 2010, p. 45). This approach contributes to demystifying mathematics as a distant and abstract discipline, making it an integral part of the identity and cultural heritage of Amazonian students.

2.3 MANIPULATIVE MATERIALS AND DIGITAL TECHNOLOGIES IN THE TEACHING OF SPATIAL GEOMETRY

The use of manipulative materials and digital technologies in the teaching of spatial geometry is a crucial component for overcoming learning difficulties and for promoting a deeper and more lasting understanding of concepts (Nunes, 2024). Manipulative materials, such as logic blocks, geometric solids to assemble, or even everyday objects, allow students to physically interact with shapes, exploring their properties, relationships, and transformations in a concrete way (Smole; Diniz, 2001, p. 25). This tactile and visual interaction is fundamental for the development of spatial thinking, especially in the early levels of Van Hiele's theory, where visualization and analysis of figures are predominant.

According to Lorenzato (2006), the use of concrete materials in mathematics class is not an end in itself , but a means for the student to construct knowledge, moving from the concrete to the abstract in a significant way (Lorenzato, 2006, p. 80). The playfulness inherent in these materials stimulates student engagement, making learning more pleasurable and less intimidating. In the Amazonian context, the creation of low-cost materials, using local resources, not only makes the proposal more accessible, but also reinforces the contextualization and appreciation of the community's knowledge (Filho; Nicot, 2020, p. 3). The construction of models of geometric solids from elements of nature or recyclable materials, for example, can be an activity rich in meaning and learning.

Digital technologies, in turn, complement manipulative materials by offering new possibilities for visualization and interaction with geometric concepts. Dynamic geometry software, such as GeoGebra, augmented reality applications, and interactive platforms allow students to explore three-dimensional shapes from different angles, perform rotations, translations, and visualize planes dynamically (Almeida, 2023, p. 7). This virtual manipulation capacity enriches the learning experience, facilitating the understanding of concepts that would be difficult to visualize only in two-dimensional representations. The integration of QR Codes in the activity kit, directing to these digital resources, is a strategy that seeks to unite the best of both worlds: the concreteness of the manipulable material and the interactivity of the technology.

However, the mere presence of manipulative materials or digital technologies does not guarantee meaningful learning. It is essential that the teacher acts as a mediator, planning activities that stimulate the students' exploration, discussion and critical reflection (Ponte; Serrazina; Guimarães, 2005, p. 35). The continuing education of teachers for the effective use of these resources is, therefore, a crucial aspect for the success of innovative pedagogical proposals. The ability to adapt activities to the needs and realities of students, to propose challenges appropriate to different levels of geometric thinking and to promote interaction among students are essential skills for the contemporary educator (Scolaro, 2018, p. 40).

Additionally, it is important to consider the challenges of infrastructure and access to technology in many regions of the Amazon. In these contexts, the prioritization of low-cost materials and the use of digital technologies that can be accessed offline or with low connectivity become even more relevant (Magalhães, 2025, p. 8). The activity kit, by combining concrete and accessible digital resources, seeks to be a solution adaptable to different realities, ensuring that pedagogical innovation is not a privilege of a few, but an opportunity for all students. The combination of manipulative materials and digital technologies, when well planned and mediated, has the potential to transform the teaching of Spatial Geometry, making it more dynamic, interactive and, above all, meaningful for Elementary School students. In addition, the integration of these tools must be accompanied by a critical reflection on their use, preventing them from becoming mere substitutes for traditional pedagogical practices without adding value to learning (Valente, 2011, p. 45). The continuing education of teachers is, therefore, an essential pillar for the potential of these resources to be fully explored, ensuring that technology and manipulative materials are used as instruments of pedagogical mediation and not as ends in themselves (Moran, 2015, p. 60). This perspective emphasizes the importance of careful planning and constant evaluation of pedagogical practices , aiming to improve the teaching-learning process of spatial geometry. Furthermore, the integration of digital technologies, such as GeoGebra, is not limited only to the visualization of three-dimensional objects, but also allows the construction of interactive models, the exploration of geometric properties in a dynamic way, and the resolution of complex problems that would be unfeasible with traditional methods (Almeida, 2023, p. 10). The possibility of virtually manipulating geometric objects, rotating them, flattening them and observing their transformations in real time, contributes significantly to the development of spatial perception and abstract reasoning of students. However, it is crucial that the use of these technologies is intentional and pedagogical, preventing them from becoming mere entertainment tools without a clear educational purpose (Moran, 2015, p. 65). Training teachers in the competent and critical use of these tools is therefore an essential investment to ensure that technology is a catalyst for learning rather than an obstacle.

Another relevant aspect is the ability of digital technologies to promote collaboration and communication among students. Online platforms and virtual learning environments can be used for students to share their findings, discuss problem-solving strategies, and build knowledge collectively (Valente, 2011, p. 50). This collaborative approach, coupled with the manipulation of concrete and digital objects, creates a rich and diverse learning environment where students are encouraged to explore, experiment, and build their own understanding of geometric concepts. The combination of manipulative materials and digital technologies, therefore, is not only a strategy to make the teaching of spatial geometry more interesting, but a pedagogical approach that aims to develop cognitive, social, and emotional skills essential for the twenty-first century (Scolaro, 2018, p. 45).

In addition, ethnomathematics offers a path to the decolonization of the curriculum, by questioning the hegemony of a single form of mathematical knowledge and opening space for the plurality of knowledges (Knijnik, 2012, p. 78). By recognizing that different cultures have developed their own ways of quantifying, measuring, and organizing space, students are encouraged to value their own cultural heritages and to understand mathematics as a diverse and ever-evolving human construct. This perspective is particularly relevant in the Amazon, where cultural diversity is a striking feature and where the imposition of external educational models can lead to alienation and disinterest. Ethnomathematics, therefore, is not only a pedagogical strategy, but an ethical and political commitment to a fairer, more inclusive, and contextualized education (D'Ambrosio, 2019, p. 35).

Studies such as those by Ferreira, Gomes, and Silva (2022) highlight that the use of manipulative and digital materials contributes to making learning more meaningful, as it brings the student closer to concrete experiences of everyday life (Ferreira; Gomes; Silva, 2022, p. 112). The manipulation of concrete objects allows students to explore abstract concepts in a tactile and visual way, building a deeper and more lasting understanding. Lorenzato (1995) and Scolaro (2008) reinforce that the use of manipulable materials enhances learning by enabling students to build deeper cognitive relationships between two-dimensional and three-dimensional representations (Lorenzato, 1995, p. 8; Scolaro, 2008, p. 6). Lorenzato states that the mathematics teaching laboratory should be a space for experimentation, where manipulable material serves as a mediator between intuitive and formal thinking (Lorenzato, 1995, p. 8). Scolaro adds that the handling of physical objects allows the student to "feel" the geometric properties, something that the mere observation of drawings on the blackboard does not provide (Scolaro, 2008, p. 6).

Interaction with these materials develops spatial perception, visualization skills, and logical reasoning, essential skills for geometry. In addition, the playfulness present in games and activities with manipulable materials contributes significantly to student engagement, transforming learning into a pleasurable and motivating experience (Dantas, 2026, p. 35). The combination of different types of materials, such as logic blocks, geoplanes, dismountable geometric solids, and puzzles, allows us to approach the concepts of geometry from multiple perspectives, taking into account the different ways students learn (Cardoso, 2020, p. 255). The diversity of resources stimulates creativity, collaboration and problem-solving, crucial elements for the development of robust mathematical thinking.

In addition to manipulative materials, contemporary research indicates that the incorporation of digital resources, such as augmented reality (AR) and 3D modeling, can enhance spatial understanding (Silva; Andrade, 2025). These resources dialogue with the competencies of the BNCC by favoring active learning and promoting the integration between mathematical and technological knowledge (BNCC, 2018). Silva and Andrade (2025) argue that AR allows the overlay of virtual models on the real world, facilitating the understanding of orthogonal views and complex planning (Silva; Andrade, 2025, p. 55). The ability to rotate, zoom and interact with three-dimensional objects in a virtual environment enriches the learning experience and caters to students' different cognitive styles.

However, in the context of the state of Amazonas, where there are rural, riverside and indigenous communities without access to the internet or with limited connectivity, it is essential to consider viable pedagogical alternatives. In these places, the use of concrete materials, playful activities and everyday resources are elements that make up the proposed activity kit, ensuring accessibility and cultural relevance (Filho; Nicot, 2020, p. 1-2). Valuing local resources and adapting pedagogical strategies to infrastructure conditions are crucial to promote equity in access to mathematics education. In addition, the inclusion of elements of local culture in teaching materials not only makes learning more meaningful, but also strengthens the cultural identity of students (D'Ambrosio, 2019).

Borba et al. (2014) warn that technology alone does not guarantee learning; it must be inserted in a pedagogical design that stimulates reflection, collaboration and the construction of meaning (Borba; Scucuglia; Gadanidis, 2014, p. 10). The mere introduction of digital tools without a clear pedagogical proposal and without the proper training of teachers can result in superficial and ineffective use. Therefore, the harmonious integration between the physical and the digital, adapted to local realities and based on sound pedagogical principles, is the key to effective and inclusive spatial geometry teaching. The combination of manipulative materials and digital resources, as proposed in this kit, offers a flexible approach that can be adjusted to the different realities of infrastructure and connectivity, maximizing students' learning potential. It is essential, however, that teachers receive adequate training to use these resources effectively, understanding not only the technical functioning, but also the pedagogical potential of each tool (Mendes; Silva, 2021, p. 45). The continuing education of educators is a determining factor for the success of the implementation of innovative methodologies, ensuring that technology is an ally in the teaching-learning process and not an obstacle. In addition, the constant evaluation of the adequacy of materials and pedagogical strategies to the specific context of the classroom allows for continuous adjustments and improvements, ensuring that the kit remains relevant and effective for Amazonian students.

In contexts of low connectivity, such as many regions of the Amazon, priority should be given to low-cost and highly adaptable solutions. Traditional manipulative materials, such as those proposed in this kit, prove to be valuable tools, as they do not depend on electricity or internet access, ensuring the continuity of learning in any scenario (Cardoso, 2020, p.

255). Cardoso's (2020) research highlights that the use of concrete materials, even in environments with limited resources, can promote deeper and more lasting learning, especially for geometric concepts that require visualization and manipulation (Cardoso, 2020, p. 255). The simplicity and ubiquity of these materials make them ideal for the Amazonian reality, where technological infrastructure is still a challenge.

On the other hand, the integration of digital technologies, even if in a one-off or offline way, can complement and enrich the experience. The use of QR Codes that direct to explanatory videos or 3D simulations preloaded on mobile devices (when available) can offer a differential, as long as access is facilitated and technology does not become an obstacle. The key is the complementarity between analog and digital, where each resource is used to maximize its potential, without overloading existing infrastructure or excluding students with limited access (Silva; Pereira; Mikuska, 2025, p. 3). The training of teachers for the pedagogical use of these tools, both concrete and digital, is an essential pillar for the success of the proposal, ensuring that technology is a tool at the service of learning and not an end in itself (Borba; Scucuglia; Gadanidis, 2014, p. 10).

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3 METHODOLOGY

The methodology adopted in the construction of the educational product is based on principles of active learning, exploring manipulative and digital resources as a strategy to favor the understanding of geometric concepts. The process of creating the didactic kit occurred in stages articulated between bibliographic research, pedagogical planning and practical elaboration of materials (Educational Product, p. 1).

In the first stage, a bibliographic research was carried out in order to identify theoretical references and successful experiences in the teaching of Spatial Geometry with concrete and digital materials. This review highlighted the importance of integrating active methodologies and technological resources, corroborating authors such as Borba, Scucuglia and Gadanidis (2014), who highlight the role of digital technologies in the reconfiguration of teaching and learning in Mathematics (Borba; Scucuglia, Gadanidis, 2014). At the same time, the results of the AVAM were analyzed, which pointed out the most critical Geometry descriptors, directing the focus of the product to these specific learning needs (Amazonas, 2020-2023).

In the second stage, the pedagogical planning was elaborated in line with the BNCC skills for Elementary School II and the AVAM descriptors. Objectives were defined such as recognizing properties of geometric solids, relating planes to three-dimensional figures, and developing spatial perception through experimentation. The sequence of ten activities was progressively organized according to the levels of Van Hiele (1986), starting with visual recognition activities, passing through property analysis and culminating in challenges that promote informal deduction and problem solving (Van Hiele, 1996)

The selection of solids for the cuttable flattening included cube, parallelepiped, prisms, pyramids and cylinder, whose didactic relevance is widely recognized (Nunes; Ponte, 2019), and that allow for an integrated approach to the descriptors identified as critical (Nunes; Ponte, 2019). The integration of digital resources via QR Codes aimed to expand the possibilities of exploration and meet different learning styles.

The third stage consisted of the practical elaboration of the materials that make up the kit, including: physical materials (cuttable plans, prototypes of the games and structures for practical activities); digital resources (multimedia content and QR Codes for 3D simulations); and supporting documentation (Teacher Guidelines Manual and the Geometer's Logbook, an instrument designed for reflective registration of the student) (Educational Product, p. 1).

Finally, the product underwent a theoretical and instructional design validation, ensuring its pedagogical coherence and configuring it as a complete tool ready for future pilot application, directly aimed at the needs of the Amazonian context. It should be noted that, as the kit was not applied, the focus was on its conception and theoretical validation, based on the demands diagnosed by the AVAM and the curricular references.

4 RESULTS AND DISCUSSIONS

The main result of this work is the development of the "Kit of Manipulative and Digital Activities for the Teaching of Solid Planning: Exploring Spatial Forms in the 8th Grade of Elementary School". This educational product was conceived as a response to the persistent difficulties of 8th grade students in Spatial Geometry, as evidenced by the critical descriptors of the Amazonas Learning Verification Assessment (AVAM) (Amazonas, 2020-2023). The proposal aims to transform traditional teaching, often abstract and decontextualized, into an active, playful and meaningful learning experience, especially adapted to the Amazonian reality.

The kit consists of ten carefully designed activities, which integrate low-cost materials and digital resources, seeking a pedagogical progression aligned with the Van Hiele Levels. The activities are:

- Cuttable Solid Planes: Allows the construction and manipulation of solids, understanding the relationship between two-dimensional and three-dimensional shapes.
- Solid Bingo: Game that encourages the recognition of solids by their properties, working on the levels of visualization and analysis.
- Geometric Memory: Associates images of solids to their planes, promoting the fixation of concepts.
- QR Codes with Digital Resources (AR Solids): Integrates technology for 3D visualization and dynamic exploration of plans, overcoming access barriers in some regions by allowing the use of local materials as an alternative.
- Mathematical Escape Room: Collaborative activity of solving geometry problems, stimulating logical reasoning and cooperation.
- Maker Station \u2012 Polyhedron Construction: Uses simple materials to construct polyhedron skeletons, making concepts such as vertices, edges, and faces tangible.
- Mystery Tactile Box: Inclusive resource that stimulates spatial perception by touch, catering to different learning styles.
- Dominoes of Flattenings and Solids: Reinforces the relationships between two-dimensional and three-dimensional representations.
- Geometric Treasure Hunt at School: Investigative activity that applies geometric concepts in real contexts of the school environment.
- Workshop "Turn a Wrong Planning into a Correct One": Challenges students to identify and correct errors in planning, developing critical thinking.

Each activity was designed to promote meaningful learning, according to Ausubel (Ausubel, 2003), by connecting geometric concepts to elements of Amazonian daily life. For example, the association of a rectangular prism with a riverside stilt house or a cone with a straw hat (Educational Product, p. 1). This contextualization, inspired by the principles of Ethnomathematics, D'Ambrosio (2019) and Pessoa (2026), aims to create learning anchors that facilitate the understanding of abstract concepts based on cultural and visual references familiar to students from Manaus. The integration of manipulative and digital resources, as highlighted by Ferreira, Gomes and Silva (2022) and Silva and Andrade (2025), enhances spatial understanding and student engagement.

Although the kit was not applied empirically in this phase of the study, its theoretical and methodological conception represents a significant advance. The Teacher Guidance Manual and the Geometra Logbook are essential components that provide support for implementation, planning of classes aligned with the BNCC, and formative assessment. The manual suggests the active mediation of the teacher, the formation of heterogeneous groups and inclusive adaptations, ensuring that the kit is flexible and adaptable to the different school realities (Educational Product, p. 1).

For the future validation of the efficacy and pedagogical impact of the kit, a multidimensional evaluation protocol of mixed nature (qualitative and quantitative) is proposed. This protocol includes three main axes:

- Learning Assessment: Application of pre-test and post-test with questions aligned with the descriptors of the AVAM and skills of the BNCC, complemented by the analysis of the students' productions (solids assembled, corrected planning, records in the Logbook).
- Usability and Engagement Assessment: Student perception questionnaires (Likert scales and open-ended questions) and systematic classroom observation to record indicators of engagement, participation, and collaboration.
- Evaluation of Teaching Practice and Material Adequacy: Semi-structured interviews or focus groups with teachers to collect feedback on ease of use, adequacy to class time, and feasibility of pedagogical management, as well as suggestions for improvement (Educational Product, p. 1).

The triangulation of the data obtained by these instruments will allow a robust analysis of the effectiveness of the kit in overcoming learning difficulties, its motivational and didactic potential, and its feasibility of implementation in real contexts. Thus, the kit is configured as a promising tool for the teaching of Spatial Geometry, with a clear plan for its empirical validation and continuous improvement.

5 FINAL CONSIDERATIONS

This work culminates in the presentation of an innovative educational product, the "Kit of Manipulative and Digital Activities for the Teaching of Spatial Geometry from the Perspective of Amazonian Contextualization". Its conception represents an effort to transform the teaching of Spatial Geometry in the 8th grade of Elementary School, addressing the learning gaps identified in diagnostic assessments. The pedagogical proposal of the kit is based on a solid theoretical base, which integrates the stages of development of geometric thinking and the importance of connecting new knowledge with students' previous experiences.

The kit stands out for its contextualized approach, which seeks to bring abstract concepts of geometry closer to the reality experienced by students in the Amazon region. By using cultural elements and local daily life, the material aims not only to facilitate understanding, but also to promote greater engagement and appreciation of mathematics. The combination of low-cost manipulative resources with accessible digital tools demonstrates a practical and adaptable solution to the infrastructure and technology access challenges present in diverse communities.

The structure of the kit, which includes a detailed guide for the teacher and a logbook for students, has been carefully crafted to fully support classroom implementation. This organization allows educators to adapt activities to the specific needs of their classes, promoting inclusive and dynamic teaching. The flexibility of the material and the attention to different learning styles are crucial aspects for the success of the proposal.

Although the empirical application of the kit was not the focus of this step, the transformative potential of the material is evident. It is believed that this educational product can serve as a catalyst for new pedagogical practices, inspiring the development of other didactic resources that consider cultural richness and regional particularities. The path to the validation of its effectiveness and impact on student learning is outlined, and it is hoped that future investigations will confirm the value of this proposal for the teaching of Spatial Geometry in Brazil, especially in the Amazon.

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