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Mathematical teaching resources for hospital classrooms in Ecuador

Recursos didácticos para la enseñanza de la Matemática en aulas hospitalarias de Ecuador

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Abstract

Children and young people facing chronic or long-term illnesses often find their academic education interrupted. To address this need, hospital classrooms have emerged as an alternative that guarantees continuity of learning. Mathematics is one of the most complex disciplines and faces several challenges, requiring adaptation to innovative teaching resources that maintain student motivation and interest. Ecuador's official curriculum establishes learning standards that must be met even in hospital settings. This highlights the need for curricular adaptations to respond to students' unique conditions. The purpose of this study is to investigate which teaching resources support mathematics learning. This is an exploratory qualitative study, supported by the empirical method, that is, the researcher's direct experience. The results obtained from the interview script indicate that among the teaching techniques applied in the hospital setting, the visual and motor channels prevail, through the use of graphic materials, pictorial representations, and body dynamics. These techniques allow the abstract contents of Mathematics to become meaningful sensory experiences, enhancing learning and adapting to cognitive needs and styles.

Keywords

Hospital classrooms, teaching, Mathematics, teaching resources.



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Resumen

Niños y jóvenes que enfrentan enfermedades crónicas o prolongadas suelen ver interrumpida su formación académica. Para responder a esta necesidad han surgido las aulas hospitalarias como una alternativa que garantiza la continuidad del aprendizaje. La Matemática es una de las disciplinas más complejas y tiene varios desafíos, pues, necesita adaptarse a recursos didácticos innovadores que mantengan la motivación y el interés del estudiante. El currículo oficial de Ecuador establece estándares de aprendizaje que deben cumplirse incluso en contextos hospitalarios. Esto resalta la necesidad de realizar adaptaciones curriculares para responder a las condiciones particulares de los estudiantes. El propósito de este estudio es indagar sobre cuáles son los recursos didácticos que favorecen el aprendizaje de la Matemática. Es una investigación de enfoque cualitativo exploratorio, apoyado en el método empírico, es decir, la experiencia directa de la investigadora. Los resultados obtenidos a partir del guion de la entrevista señalan que entre las técnicas de enseñanza aplicadas en el contexto hospitalario prevalecen el canal visual y motriz mediante el uso de materiales gráficos, representaciones pictóricas y dinámicas corporales. Estas técnicas permiten que los contenidos abstractos de la Matemática se conviertan en experiencias sensoriales significativas, potenciando el aprendizaje y adaptándose a necesidades y estilos cognitivos.

Palabras clave

Aulas hospitalarias, enseñanza, Matemática, recursos didácticos.

1. Introduction

The right to education is fundamental for the development of children and adolescents, but those facing chronic or long-term illnesses often find their academic education interrupted. To respond to this need, hospital classrooms have emerged as an alternative that guarantees continuity of learning by adapting pedagogical strategies to the students' conditions. In Ecuador, these classrooms are part of the inclusive education model promoted by the Ministry of Education, which establishes the guidelines for the development of this modality. Their objective is to ensure that students receive an education adapted to their needs, based on various approaches, including rights-based, inclusive, comprehensive care, well-being, and ecological-contextual approaches. These approaches seek to ensure that education in hospital settings is accessible, flexible, and of high quality. It is recognized that students in this condition require personalized methodologies, innovative pedagogical strategies, and adequate materials to maintain their academic development.

One of the main challenges of hospital education is the teaching of mathematics, given that this subject requires continuity, abstraction, and constant practice. Despite efforts to ensure equitable education, the implementation of specific strategies for teaching mathematics in these settings remains a challenge. There are limitations regarding teacher training in adapted methodologies, the availability of appropriate teaching resources, and the curricular integration of these students. Therefore, the main objective of this research is to analyze teaching resources that promote mathematics learning in a hospital setting.

Regarding methodology, this study adopts an exploratory qualitative approach based on the empirical method, that is, the researcher's direct experience. A semi-structured interview technique was used to collect information; the data collected using the instrument allowed



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for the establishment of the following categories: methodology, strategy, technique, topics, student age, and student satisfaction scale.

The article is structured into six sessions: the second session presents the state of the art and a brief review of other research related to the topic. The third session provides a conceptual overview of the teaching resources used for mathematics learning. The fourth session addresses a curricular analysis based on the National Model for Hospital and Home Educational Management and Care in Ecuador. The fifth session presents the methods and materials used for this study. The sixth session presents the results of the research and explains which teaching resources maintain educational continuity, reduce anxiety, and promote mathematics learning in a hospital setting.

2. State of the art

In 2016, in Ecuador, the Ministry of Education and the Ministry of Public Health implemented the National Model for Hospital and Home Educational Management and Care. The goal was to guarantee access, retention, and learning for students experiencing illness through comprehensive, high-quality educational care. The model was built on principles of equity, inclusion, and rights, incorporating flexible, personalized, and fun methodologies to facilitate the educational process in hospital or home settings. Its results include the consolidation of an inter-institutional public policy that allows for the implementation of the program in several hospitals across the country, benefiting thousands of children and adolescents. The conclusions highlight the importance of coordinating the health and education sectors and recognizing the specific needs of hospitalized students. The goal is to promote a pedagogy that fosters both the academic development and emotional well-being of students and their families

In 2017, in Paris, UNESCO published the Guide to Ensuring Inclusion and Equity in Education, a study that, while not focused exclusively on hospital classrooms, provides key foundations for inclusive education that encompass non-conventional settings such as these. Among its findings, the report identifies the urgent need to adapt teaching resources to diverse contexts, including those marked by prolonged medical conditions that prevent regular attendance in traditional classrooms. The guide concludes that ensuring equitable and inclusive education involves developing policies that integrate all students, including those in vulnerable situations due to health reasons, and ensuring that educational resources effectively respond to their learning needs.

In 2017, in Bogotá, Colombia, a study entitled "Design and Implementation of Teaching Resources in Mathematics Classes for a Hospital Classroom," prepared by Salgado and Castro, was conducted. This research arose in response to the need to guarantee the right to education for hospitalized children and young people. Among its results, it was evident that the use of manipulative materials and games as teaching aids enabled patient students to acquire meaningful learning. Furthermore, it strengthened socio-mathematical skills and maintained a positive attitude toward mathematics. In conclusion, the study highlights the importance of a flexible and contextualized pedagogical approach, in which teaching resources foster the understanding of mathematical concepts and promote social interaction and emotional well-being in hospitalized settings.

In 2018, a study titled "Implementation of Teaching Resources for Mathematics: An Experience in a Hospital Classroom" was conducted in Bogotá, Colombia, by Salgado and



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Castro. This study arose from a lack of adequate teaching materials for teaching mathematics to hospitalized students. Through a collaboration between the Francisco José de Caldas District University and the LeBeM curriculum project, students designed and donated various teaching resources, such as the neutralizer, the egg tangram, the factoring dominoes, and Papy's minicomputer. These resources were implemented and adapted to the conditions of the clinical setting. The results showed a positive change in students' attitudes toward the subject, increased interest and motivation for learning, and improvements in socio-mathematical skills. The conclusions highlight that the use of teaching resources designed using the Universal Design for Learning (UDL) approach promotes educational inclusion. It addresses diversity and improves access to knowledge in unconventional settings such as hospital classrooms.

In 2021, Bolívar and Galindo conducted a study titled "Implementation of Resources and Strategies to Generate Learning Environments in Hospital Classrooms Regarding Mathematics Teaching" in Bogotá, Colombia. The objective was to improve mathematics teaching and learning processes in a hospital classroom through the use of inclusive teaching resources and pedagogical strategies. The results showed that resources designed as math games, manipulatives, and interactive activities generated a positive and motivating environment for hospitalized students. The conclusions indicated that teaching resources, when appropriate to the physical, cognitive, and emotional conditions of patients, facilitate learning and positively impact their emotional state and overall well-being.

3. Related concepts

3.1 Teaching resources for teaching mathematics

The resources used in educational settings are essential for promoting the acquisition of new knowledge in mathematics. According to Lugo et al. (2019), "in the learning process, logical-mathematical concepts constitute a fundamental and useful tool, because through them children express their knowledge every day in each of their educational training experiences" (p. 20). Therefore, a resource is understood to be anything that accompanies and facilitates the implementation of pedagogical strategies, such as games, songs, visual representations, and teaching materials.

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3.2 Mathematical role-playing games

Mathematical role-playing is a teaching strategy that allows students to apply mathematical concepts in real-life situations by playing different roles. According to Salgado and Castro (2017), "the use of teaching resources in the mathematics classroom can be achieved through play, which is why one of the aspects to consider is that of play as a teaching device" (p. 1). This methodology promotes the understanding of numbers and operations through social interaction and contextualized problem-solving. In a hospital classroom, learning should be flexible; role-playing offers a fun and meaningful way to enhance both academic and emotional levels. Within mathematical role-playing, various dynamics can be employed,



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such as shopping simulations. Students assume the roles of sellers and buyers to practice addition, subtraction, and calculating change. Material distribution activities can also be designed, in which children must distribute objects in equal parts or according to certain criteria, promoting the learning of fractions and proportions. A complementary strategy has been observed to involve the use of negotiation games, where students propose agreements and solve mathematical problems through reasoning and dialogue. These activities strengthen numerical skills while promoting critical thinking and conflict resolution.

3.3 Painting and mathematics

Painting is a teaching resource that combines art with mathematics teaching, allowing students to visualize and understand abstract concepts creatively. According to Vallejo (2011), "the artistic dimension of mathematics is reflected in numerous pictorial works; such that contemplating and working on them can serve to strengthen basic and more complex elements of mathematics" (p. 76). Therefore, this strategy is especially useful in hospital classrooms. Through the use of color, shapes, and artistic composition, children can represent mathematical relationships without having to rely solely on numbers and symbols. Furthermore, painting encourages individual expression, concentration, and emotional well-being, which contributes to more meaningful learning.

Various painting activities can be developed within painting, such as representing symmetries, where students create figures reflected on an axis to understand the concepts of balance and proportion. Likewise, it is possible to work with geometric patterns and sequences, in which children must identify and reproduce series of shapes and colors to reinforce mathematical logic. An effective strategy is the use of fractions in painting, in which students divide canvases or drawings into proportional sections to visually represent fractions and percentages. These activities stimulate students' creativity and spatial perception in inclusive education contexts.

3.4 Modeling with plasticine or clay

Modeling with plasticine or clay is a didactic tool that allows students to manipulate and create three-dimensional figures, favoring the understanding of geometric and spatial concepts in a concrete manner. According to Bolaños and Mogro, (2004).

Modeling is the most beautiful expression of giving shape with your own hands, with easy-to-handle materials, for example, plasticine, dough, clay, etc. With modeling, it is possible to create great things like fantastic works of existing forms, thus educators lead children to understand the value, meaning and representative nature of manipulating the material (p. 68).

In this sense, this strategy is particularly effective in hospital classrooms where teaching must be adaptable and provide a practical approach for students. By modeling objects, children can tangibly experiment with mathematical concepts such as volume, shape, proportions, and symmetry, which facilitates the abstraction of these concepts. Furthermore, the modeling process fosters fine-motor coordination, creativity, and problem-solving, which in turn contributes to students' emotional well-being.

Within modeling, activities can be developed focused on the construction of three-dimensional geometric figures. In this approach, students create shapes such as cubes, spheres, pyramids, and cylinders using different materials. Through this process, they are able to identify the properties of each figure and understand aspects such as the number of



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faces, vertices, and edges. This experience also strengthens skills such as fine-motor coordination, spatial perception, and logical reasoning applied to geometry.

One educational activity involves creating fraction models, where children divide clay into equal parts to represent fractions of a whole, allowing them to visualize abstract concepts in a concrete way. Shape composition exercises can also be developed, in which students combine different shapes to create more complex objects.

3.5 Mathematical narratives and stories

Mathematical storytelling is a teaching resource that integrates mathematics into narrative contexts, facilitating the understanding of abstract concepts through engaging and creative stories. According to Sánchez et al. (2013):

The ability to express any topic, no matter how abstract, in a story, whether spoken or written, opens the door for teachers to use different representative strategies to explain difficult mathematical content. For example, assigning to concepts that are not perceptible or real (such as the magnitudes of the forces or energies they measure and that are not visible to the human eye (p. 20).

Therefore, in hospital classrooms, this approach allows students to face mathematical challenges within a story, making learning more accessible and relevant. Narrative captures children's attention and encourages the development of logical thinking and problem-solving skills, as students must apply their mathematical knowledge to follow the story and solve situations within it. Within mathematical stories, activities such as solving addition and subtraction problems can be included within a narrative in which characters face situations such as sharing resources or dividing objects. Multiplication and division problems can also be included as characters need to divide something among several or calculate the total of elements in different groups.

An interesting activity involves solving equations through mathematical puzzles integrated into a story or plot. This strategy encourages the use of logic and strengthens algebraic skills by presenting problems in an engaging context. Furthermore, it allows students to develop reading comprehension, creativity, and the ability to solve situations reflectively and independently.

3.6 Body Expression and Mathematics

Body language as a teaching resource in mathematics teaching allows students to learn through movement, using their bodies to represent and explore mathematical concepts. According to Fernández-Díez and Arias-García (2013):

The starting point of all learning in children is in the body. This body is located at a point or position in space that provides a series of pieces of information that will be completed with the creation of spatial relationships motivated by movement. Without adequate observation of this position and movement, spatial relationships will be unproductive for spatial cognitive development and, by extension, mathematical development (p. 160).

Therefore, this strategy is especially useful in contexts such as hospital classrooms, where it is essential to maintain student interest through meaningful and active experiences. Through body language, children connect abstract thinking with physical action, which



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strengthens memory, comprehension, and psychomotor development. It also allows for the incorporation of play, coordination, and collaborative work, all of which are key aspects for emotional well-being in sensitive educational environments.

Among the activities proposed by this resource is the representation of geometric figures using the body as a means of expression. Students form triangles, circles, or rectangles in space, either individually or in teams, with the goal of identifying and understanding the basic properties of each figure. This dynamic promotes kinesthetic learning, stimulates body coordination, and promotes collaborative work in the classroom. A complementary activity is the simulation of sequential movements or rhythmic patterns. In this activity, students perform a series of steps that imitate mathematical sequences, such as counting by twos or fives. This activity promotes the recognition of regularities and patterns, in addition to strengthening number sense and motor memory. It also promotes active learning by integrating the body into the construction of mathematical thinking.

Similarly, dramatization of operations can be used, where students "act out" addition, subtraction, or group distribution, allowing them to experience the operations in a concrete and fun way. This type of activity combines mathematical learning with physical education, generating multisensory experiences that strengthen both knowledge and the student's overall development.

3.7 Music and mathematical rhythms

Music and mathematical rhythms as teaching resources promote mathematics learning by linking sound patterns with numerical concepts. This strategy is beneficial in hospital classrooms. It promotes a cheerful environment, stimulates auditory memory, and reduces stress, which can interfere with the educational process. According to Alsina et al. (2022):

The relationship between music and mathematics and the interest this topic arouses are aspects that have been studied and researched throughout the history of music and mathematics. As a result of this trajectory, some teachers have been considering for years now extending this relationship to the educational field to observe and clarify the repercussions of music education for mathematical learning and vice versa (p. 2).

Therefore, by integrating music into math activities, students develop counting, sequencing, pattern recognition, and logical reasoning skills, all within a single environment. Putting music into learning also improves concentration and internal rhythm, which supports both mathematical understanding and emotional self-regulation.

Within this resource, activities such as using songs to practice multiplication tables can be used. Students memorize operations to the rhythm of catchy melodies, facilitating their retention. Also, activities can be carried out with clapping or percussion instruments, in which children create rhythmic patterns that represent numerical sequences (for example, clapping every two numbers or marking a beat with multiples of three), promoting the understanding of regularities.

Likewise, fractional rhythms can be used, where a piece of music is divided into equal parts to understand the concepts of fractions and proportions. These strategies help consolidate mathematical knowledge and, in turn, generate enthusiasm, participation, and well-being in students. These aspects are essential for learning in hospital settings.



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3.8 Board games

According to Remón and Manero, board games represent an effective teaching resource for teaching mathematics, especially in sensitive contexts such as hospital classrooms, where the playful component is highly relevant for maintaining student motivation. The use of games contributes to strengthening problem-solving skills, facilitates the acquisition of knowledge and intellectual abilities similar to those developed in other educational settings, and increases motivation, interest, and class attendance. It also has a significant influence on affective learning and promotes socialization. It can be used as a means to assess students' values, attitudes, and behaviors (Remón and Manero, 2018).

Through these games, children can practice basic operations, develop logical thinking, improve their concentration, and work as a team, all within a relaxed and enjoyable environment. "Play constitutes a fundamental preparation for children to develop their activities throughout adult life" (Carmona and Cardeñoso, 2019, p. 60). Furthermore, games allow mathematical content to be adapted to each student's pace and level, making them a flexible and inclusive tool for meaningful learning. Among the activities that can be implemented with this resource is the use of numerical dominoes. In this approach, students match pieces containing the results of operations or numerical equivalences, allowing them to reinforce mental calculations in a playful way. This dynamic stimulates agility in mathematical reasoning, improves attention, and encourages participation through play.

Another teaching option is the use of puzzles with geometric or arithmetic content. In these types of activities, students must match pieces according to certain mathematical properties, such as shape, area, or the result of an operation. This resource not only promotes the understanding of key concepts but also stimulates logical thinking, concentration, and the ability to solve problems strategically. Together, these games contribute to strengthening various mathematical skills in a dynamic and participatory way.

3.9 Manipulative materials

Manipulative materials are essential teaching resources in mathematics teaching. They allow students to physically interact with concrete objects to build their understanding of abstract concepts. This methodology is effective in hospital classrooms, as it requires more visual, tactile, and dynamic learning experiences. The most basic level of thinking development lies in the ability to identify a specific characteristic of an object (Novo-Martín, 2021). By using materials that can be touched, moved, and combined, children develop logical and mathematical skills.

"Manipulation is essential in early childhood education, as it helps children acquire knowledge and build mental representations" (Berga-Espona, 2013, p. 65). Among the most effective manipulative materials are the abacus, ideal for representing units, tens, and hundreds, facilitating the understanding of the decimal number system. Cuisenaire rods, meanwhile, allow for exploring the relationship between numbers, operations, and fractions in a visual or colorful way. This allows students to internalize the concepts of addition, subtraction, and equivalence. They can also work with the tangram, a geometric puzzle that encourages shape recognition, the composition and decomposition of figures, and spatial thinking. All of these materials make learning mathematics more accessible and meaningful. They also stimulate creativity and active exploration, fundamental elements in the educational process in hospital settings.



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4. Curricular connection

This study is part of the mathematics area, coordinating with the cross-cutting theme of inclusive education and attention to diversity, as established by the National Curriculum of Ecuador. The proposal responds to the need to guarantee the right to education for children and young people in vulnerable situations, especially those receiving educational services in hospital classrooms. In this sense, it is directly linked to the problem-solving theme, by promoting the development of logical-mathematical thinking through the use of teaching resources adapted to non-conventional contexts.

The use of teaching resources in teaching Mathematics in hospital classrooms is supported by the National Model for Hospital and Home Educational Management and Care of Ecuador, whose purpose is to guarantee access, retention, and learning for children and adolescents who, due to medical conditions, cannot attend their educational institution regularly. This model promotes quality, flexible, and adapted education through methodological strategies that respond to the needs of students who are ill, hospitalized, undergoing treatment, or are on prolonged medical leave. Within this framework, the use of playful, flexible, personalized, and innovative proposals is proposed to maintain educational continuity, reduce anxiety, and promote students' emotional, social, and cognitive development.

This approach aligns with the mathematics standard, which establishes that students solve everyday problems by applying observation processes to events in their immediate environment (Ministry of Education of Ecuador, 2016). This criterion is appropriately adapted to hospital settings, where meaningful learning must be developed through real-life situations that are understandable to students. Through teaching resources such as role-playing games, mathematical stories, manipulative materials, modeling, and body language, educational experiences are created that connect Mathematics with students' daily lives. From an inclusive and interdisciplinary approach, the teaching of Mathematics is articulated with areas such as Language and Literature (through storytelling), Cultural and Artistic Education (through music, painting, and body expression), and Citizenship Education (through cooperative play), promoting the understanding of abstract concepts through concrete and adapted experiences. This allows students not only to solve numerical or spatial problems, but also to observe and represent information from the hospital environment in which they find themselves.

Finally, it responds to the principles of the Ecuadorian National Curriculum: inclusion, participation, relevance, and flexibility, seeking to guarantee the right to a meaningful education for all students, especially those with health conditions that limit their presence in the conventional classroom. This fosters the development of exit profile competencies such as problem-solving, collaboration, autonomy, and the application of knowledge in real-life contexts.

5. Methods and materials

This exploratory qualitative study is based on an empirical method based on the researcher's direct experience. The steps followed for the study are described below:

- Location of the study area. The research focused on the pediatrics department of the Carlos Andrade Marín Hospital in Quito, Ecuador.
- Sample selection. 42 instructors from the Mathematics and Physics program at the Faculty of Philosophy of the Central University of Ecuador participated. They applied the Hospital Classrooms project to 58 children admitted to the pediatrics department of the Carlos Andrade Marín Hospital.



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- Design and application of the research instruments. Data collection was carried out using semi-structured interviews. It should be noted that this instrument was validated by experts in the area of Pedagogy of the Experimental Sciences of Mathematics and Physics and experts in the area of psychopedagogy from the Faculty of Philosophy of the Central University of Ecuador. The data collected using the instrument subsequently allowed for the establishment of the following categories: methodology, strategy, technique, topics, student age, and student satisfaction scale.
- Data processing. The interview was transcribed for data processing. Subsequently, based on the previously established categories, the main codes (which were extracted from the quotes) were identified using Atlas ti. Furthermore, with this program, the codes and quotes were recorded in a matrix, and a semantic network was created for each category to establish the relationship between the codes.
- Analysis and discussion of results. Using the matrix of relevant codes, semantic networks, and the research framework, the results were theorized and discussed, leading to the final conclusions of the study.

6. Results

Table 1 presents a summary of the categories: teaching methodologies, teaching strategies, teaching techniques, topics covered, age and student satisfaction, in the field of Mathematics teaching in hospital classrooms in Ecuador, with their codes and frequencies of rooting derived from the study. The most relevant aspects for the aforementioned categories are then described through the representation of semantic networks.

Category	Code	Frequency
Methodology	Experience-Based Learning	3
	Skill-Based Learning	1
	Game-Based Learning	19
	Problem-Based Learning	11
	Cooperative Learning	3
	Gamification	11
Strategy	Active Learning	2
	Experiential Learning	2
	Cooperative Learning	4
	Detecting and Adapting to Student Needs	3
Technique	Guided Practice	1
	Rewards	3
	Problem-Solving	12
	Challenge-Solving Through Games	28
	Motor Skills Learning	9
	Games	7
	Brainstorming	1
	Teaching Materials (Graphic Worksheets, Math Worksheets, Drawings, Crossword Puzzles)	5
	Visual	29



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Topic	Sets and Subsets	2
	Equations	8
	Geometric Figures	6
	Basic Operations	22
	Operations with Fractions	2
Student Ages	1 year	1
	10 years	2
	11 years	4
	12 years	9
	13 years	2
	14 years	6
	15 years	1
	5 years	7
	6 years	4
	7 years	2
Student Satisfaction Scale	8 years	3
	9 years	4
	Totally satisfied	42

Table 1. Summary of categories: Teaching methodologies, teaching strategies, teaching techniques, topics to be covered, age and student satisfaction in the field of teaching Mathematics in hospital classrooms

From the frequency analysis in Table 1, it can be seen that there are patterns in teaching practices and teaching resources used by teachers in the context of hospital classrooms in Ecuador. Below is a detailed analysis for each category studied, contrasted with its semantic network and frame of reference:

6.1 Teaching methodology

In this category, it is observed that game-based learning or gamification (with a rooting frequency of 30) is positioned as the most used central methodology, followed by problem-based learning, with a rooting frequency of 11 records. Likewise, methodologies such as cooperative learning and experience-based learning were identified with a lower rooting frequency (3), which suggests that these strategies take a complementary and not a primary role.



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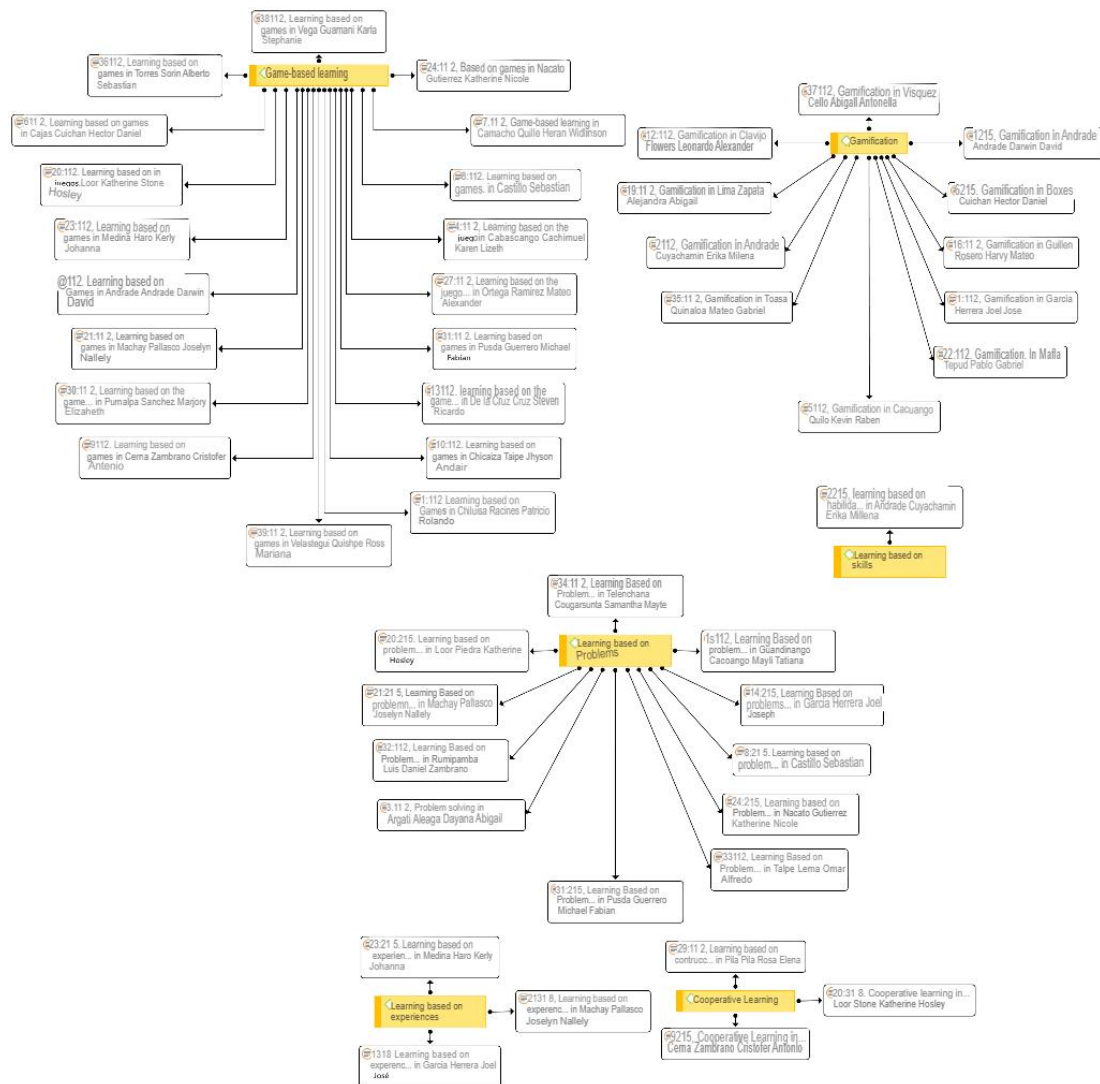


Figure 1. Semantic network category Teaching methodology

When comparing the data in Table 1 with the semantic network in Figure 1, which belongs to the Teaching Methodology category, a preference for the use of active methodologies is evident, emphasizing gamification and problem-solving. The use of these methodologies is highlighted because they facilitate the teaching of Mathematics in clinical contexts, allow adjustment to the emotional and physical situation of students, and maintain student interest, ensuring meaningful learning.

6.2 Teaching strategies

Regarding teaching strategies, the use of fun challenges with mathematical challenges (rooting frequency of 31) stands out as a central teaching strategy for learning. Subsequently, problem-solving appears as a second central strategy, indicating a tendency to work from logical reasoning and contextual analysis. Finally, other strategies such as cooperative learning (frequency 4) and personalized adaptation (frequency 3) show a concern for social interaction and the individual needs of students.



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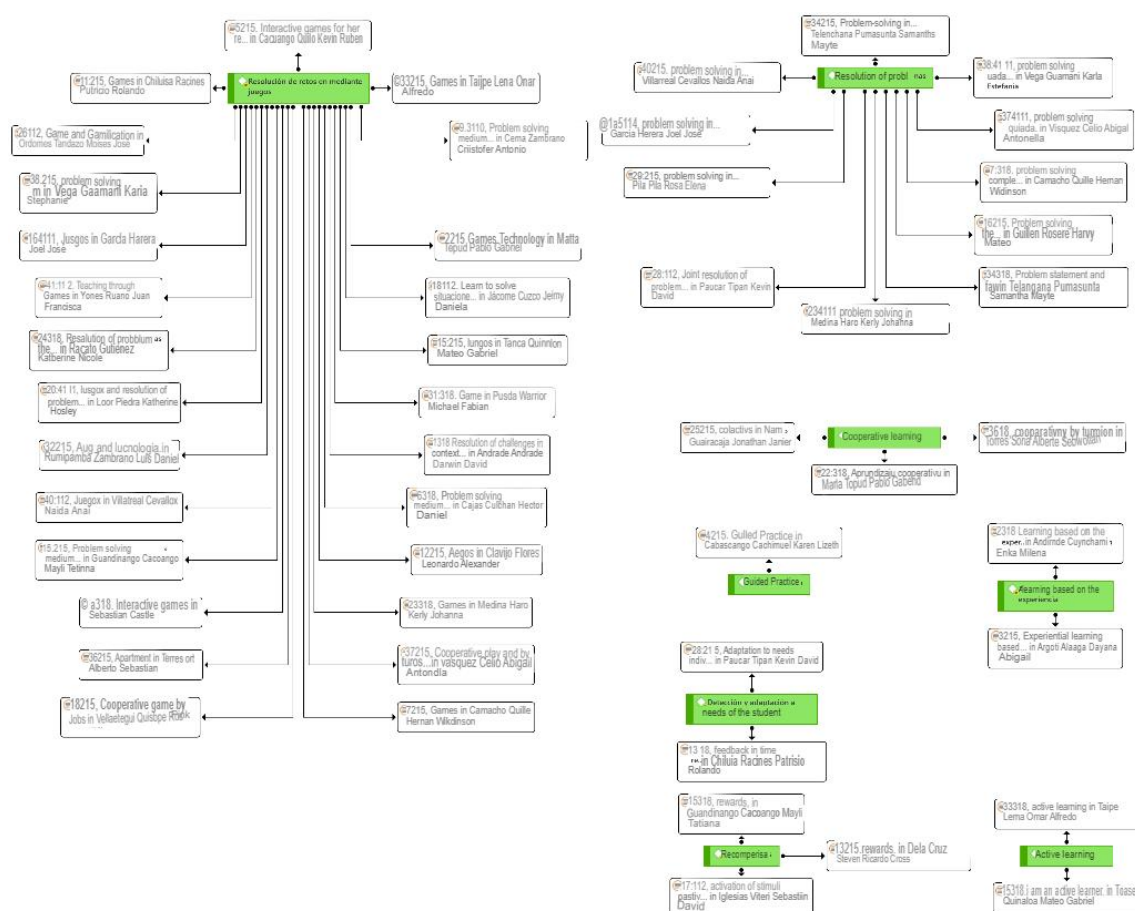


Figure 2. Semantic network category Teaching strategies

By comparing the information with the semantic network in Figure 2, it can be seen that the use of playful, flexible, and emotionally stimulating proposals coincides with what has been proposed in specialized literature on hospital pedagogy. In this sense, authors such as Ochoa et al. (1999) state that "educational resources should be adapted to the student's health status, allowing each student to progress at their own pace" (p. 2); and authors such as Alsina et al. (2022) highlight the importance of "integrating environmental elements such as play, art, or music to generate meaningful learning experiences" (p. 211).

Finally, it is important to mention that the National Model for Hospital and Home Educational Management and Care (Ministry of Education and Ministry of Health, 2016) emphasizes the importance of proposing comprehensive pedagogical care approaches centered on people and not solely on content, thus validating the use of flexible, student-centered strategies and methodologies.

6.3 Teaching techniques applied by teachers:

Regarding teaching techniques, it can be observed that visual techniques (graphics, drawings, etc.), with a frequency of 29 mentions, are predominant in the context of hospital classrooms. Also notable are motor learning and games with a frequency of 16 mentions, as well as the use of structured teaching materials (graphic cards, crossword puzzles, etc.)



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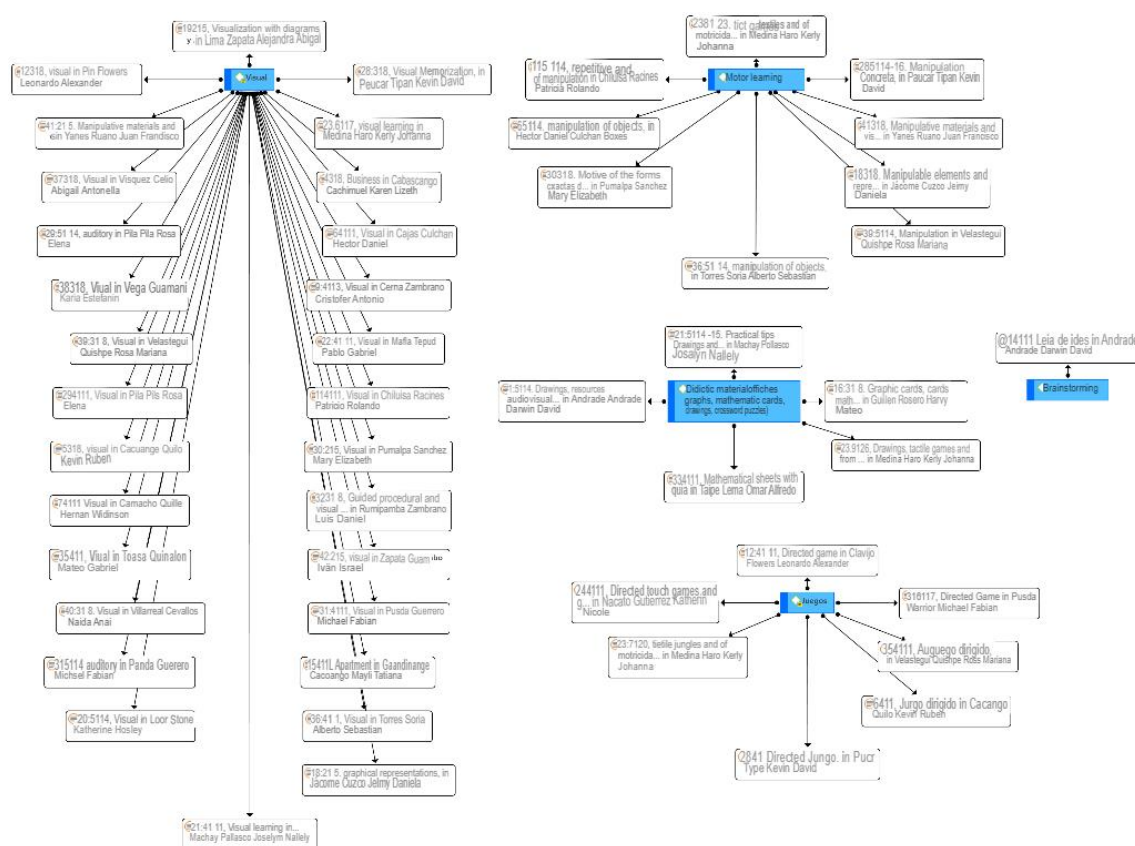


Figure 3. Semantic network category Teaching techniques applied by teachers

When comparing the analysis of the category teaching techniques applied by teachers with its semantic network (Figure 3), it is evident how visual and motor techniques are predominant in the hospital context. Thus, visual techniques allow learning to be facilitated through images, diagrams or graphic representations. And motor learning reinforces the active and corporal dimension of learning. In this regard, authors such as Vallejo (2011) "highlight the importance of graphic materials in the teaching process, stating that images allow mathematics to be visualized from a more creative, understandable and meaningful approach" (p. 75).

6.4 Topics covered

According to the analysis of Table 1 and the semantic network (Figure 4), it was determined that the curriculum focuses heavily on teaching basic mathematical operations (addition, subtraction, etc.), with a rooting frequency of 22 mentions. Subsequently, recurring topics appear such as elementary geometry (rooting frequency 12) and applied problems (rooting frequency 12).



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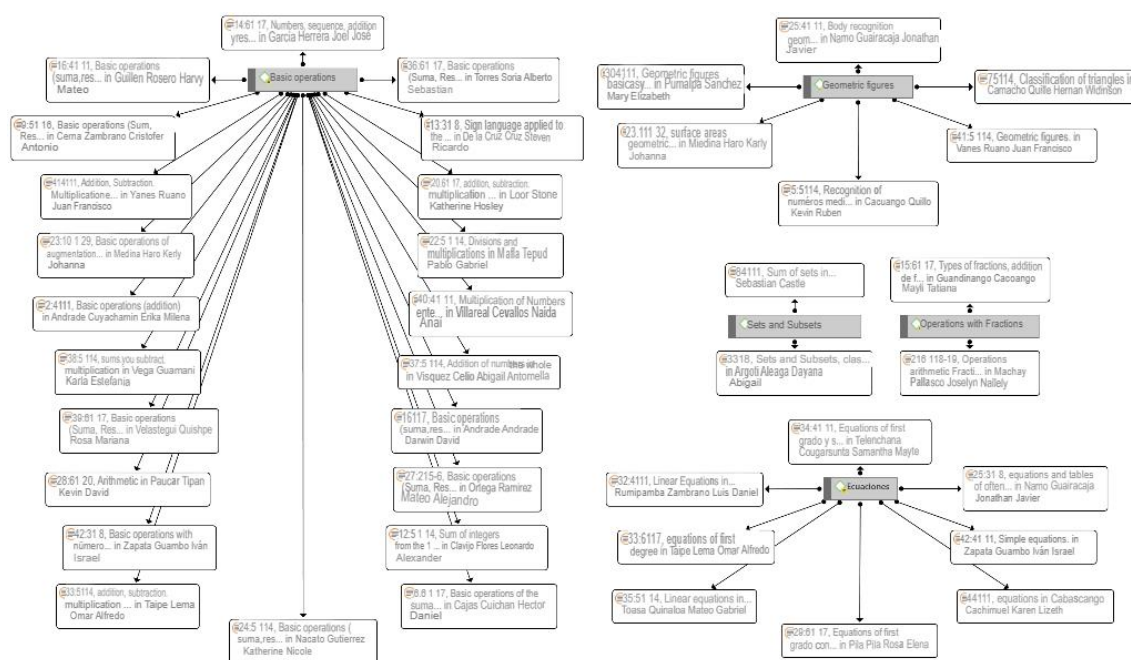


Figure 4. Semantic network category Topics covered in hospital classrooms

In this sense, it is evident that the topics most frequently covered (basic operations, elementary geometry concepts, and the reading and interpretation of graphs) are part of the mandatory curriculum and, even more importantly, are part of everyday life activities. Furthermore, it is important to highlight that the content covered was largely integrated with playful methodologies and strategies and resources such as painting, board games, puzzles, etc., allowing students to construct learning in a playful and contextualized manner.

6.5 Ages of the student body

Regarding the semantic network in Figure 5 and the analysis in Table 1, in this category it can be seen that the age range of the students extends from 5 to 14 years, and that most of the pedagogical interventions are concentrated from 7 to 10 years old. This diversity of ages forced teachers to carry out flexible planning adapted to the specific needs of each student, which was evidenced in the previous results that already used several methodologies, strategies and teaching techniques. In this regard, the Ministry of Education of Ecuador and the Ministry of Public Health of Ecuador (2016) in the National Model of Management and Educational Care in Hospitals and at Homes maintain that hospital teaching must respect individual development and provide proposals in accordance with each evolutionary stage, an aspect that the teachers participating in this study have been able to apply with solvency.



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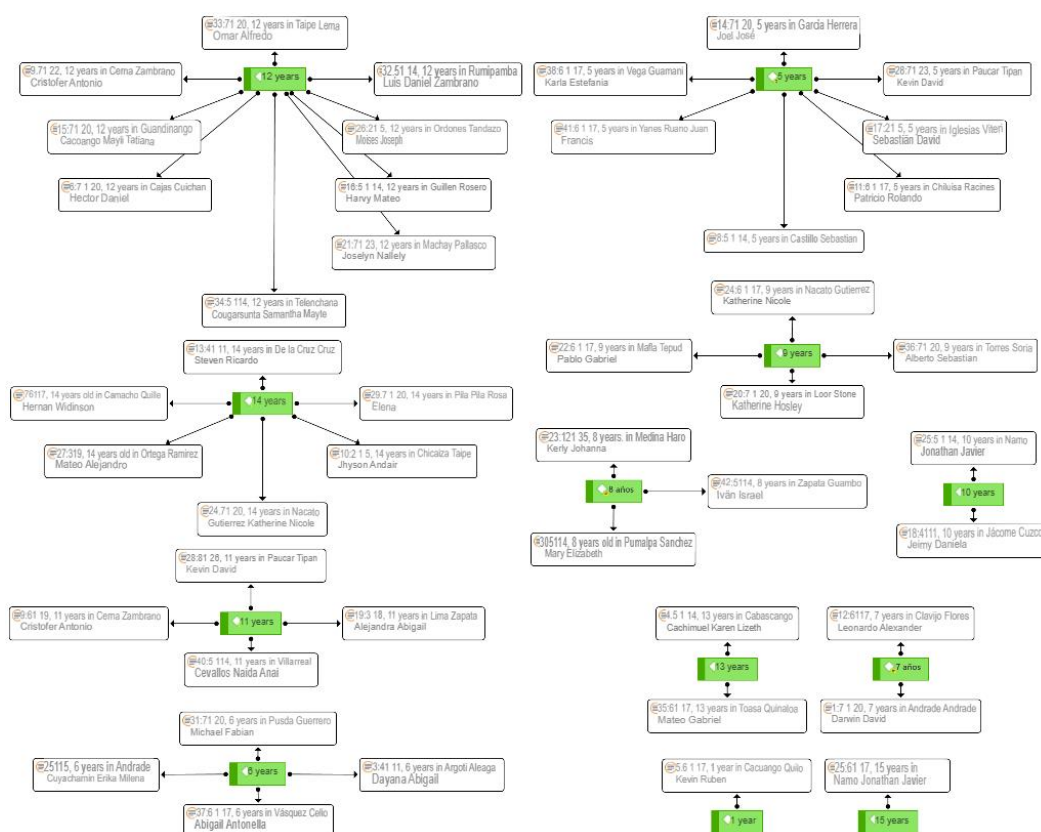


Figure 5. Semantic network category Student ages

6.6 Student satisfaction

From the analysis of Table 1 and the semantic network (Figure 6) it is evident that all students are "totally satisfied" with the pedagogical interventions carried out in the hospital classrooms. These results demonstrate the human quality of the educational process by the participating teachers, since they provided emotional support, containment and motivation to the students.



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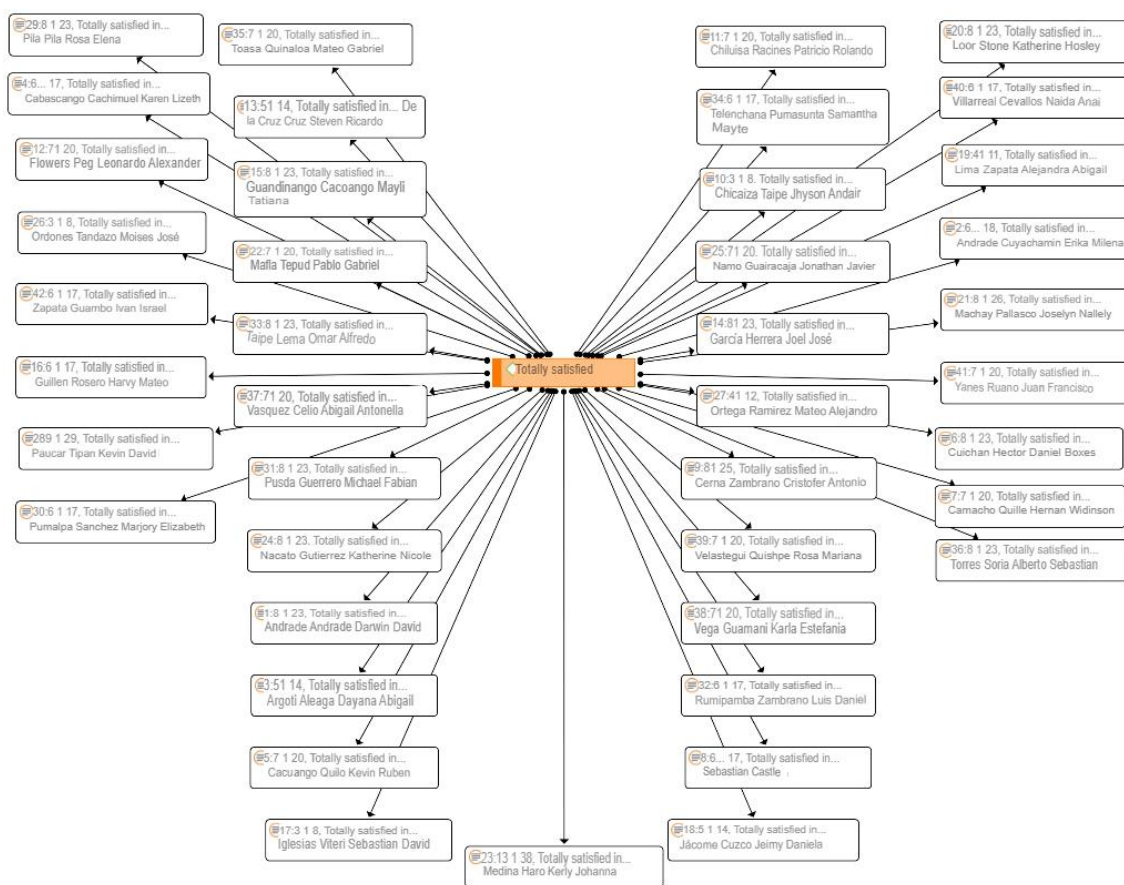


Figure 6. Semantic network category Student satisfaction

7. Conclusions

By comparing the qualitative and quantitative data, as well as the framework of this study, it is established that mathematics teaching in hospital classrooms in Ecuador should be based on active, inclusive, and adaptive practices; and that the use of concrete materials and playful methodologies should be fundamental pillars of mathematics teaching in hospital classrooms.

Regarding teaching methodologies, it was established that active methodologies such as gamification (game-based learning) are effective in the hospital setting because they encourage participation and motivation, and maintain student interest, ensuring meaningful learning. Regarding teaching strategies, it was determined that student-centered strategies, such as the use of manipulative materials and personalized teaching, are highly effective in generating lasting learning in the hospital classroom. Teaching strategies in the hospital classroom context should foster student motivation and participation. In this regard, the application of strategies such as playful challenges, logical reasoning, and cooperative learning and personalized adaptation are suggested to ensure individual attention tailored to the needs of students.

Regarding the teaching techniques applied in the hospital setting, visual and motor channels prevail through the use of graphic materials, pictorial representations, and body dynamics. These techniques allow abstract mathematical content to become meaningful sensory



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experiences for students, enhancing their learning and adapting to their needs and cognitive styles. Finally, it is important to mention that the age diversity of the student body (5 to 14 years) represented a significant challenge for teachers, as it was necessary to develop flexible and differentiated teaching plans for each program beneficiary. In this context, it is essential to continue researching and designing strategies that strengthen the teaching of mathematics in these settings. This guarantees the right to an equitable and inclusive education for hospitalized students.

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