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Didactic And Methodological Strategies In Mathematics Education: A Systematic Review

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Abstract

This article aims to review the didactic and methodological strategies that have been used in the teaching of mathematics from 2017 to date, emphasizing those that are implemented more frequently and that provide results in favor of significant learning of mathematics. For this, the study is framed in a qualitative approach, from an exploratory systematic review in the databases Dialnet, Google Scholar, and EBSCO. The results show a predominance of research in Colombia in primary and secondary education, which shows the implementation of various strategies such as games, cooperative learning, problem-based learning, project-based learning, the use of concrete material, and increasingly the use of digital tools. Gamification, the inverted classroom or Flipped Classroom, geometric software, and augmented reality have been of great importance, emphasizing teaching based on the context of the students and with real applications of mathematics. The results of this article can serve as input to retake contributions of successful results or some recommendations of didactic and methodological strategies used in the analyzed studies

Keywords: *Didactics, Teaching, Teaching Strategies, Mathematics, Methodology.*

Resumen

En el presente artículo se pretende hacer una revisión de las estrategias didácticas y metodológicas que se han empleado en la enseñanza de las matemáticas desde 2017 hasta la fecha, haciendo énfasis en aquellas que se implementan con mayor frecuencia y que aportan resultados a favor de aprendizajes significativos de las mismas. Para esto, el estudio se enmarca en un enfoque cualitativo, desde una revisión sistemática exploratoria en las bases de datos Dialnet, Google Académico y EBSCO. Los resultados muestran un predominio de investigaciones en Colombia en educación primaria y secundaria, que evidencian la implementación de diversas estrategias como el juego, el Aprendizaje Cooperativo, el Aprendizaje Basado en Problemas, el Aprendizaje Basado en Proyectos, uso de material concreto, y cada vez más el empleo de herramientas digitales. La gamificación, el aula invertida o Flipped Clasroom, softwares geométricos, y la realidad aumentada han sido de gran importancia, haciendo énfasis en una enseñanza basada en el contexto de los estudiantes y con aplicaciones reales de la matemática. Los resultados de este artículo pueden servir de insumo

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para retomar aportes de resultados exitosos o algunas recomendaciones de estrategias didácticas y metodológicas empleadas en los estudios analizados.

Palabras clave: Didáctica, Enseñanza, Estrategias, Matemáticas, Metodología.

Introduction

Mathematics is considered fundamental for the development of logical thinking, for orderly reasoning, and as a preparation of the mind in thought processes, criticism, and abstraction, which helps people not only to solve scientific problems but also to face situations that require logical processes to propose different solutions. Talking about mathematics is commonly related only to numbers, rules, symbols, and problems, without considering that "doing mathematics implies reasoning, imagining, discovering, intuiting, proving, generalizing, using techniques, applying skills, estimating, verifying results" (Medina Hidalgo, 2018, p. 126). In addition, Mathematics is an important pillar in the generation of the ability to deduce, establish cause-effect relationships, detect patterns, decode codes, reason, think critically, and propose different solutions to the same problem, among others (Patiño Espinal, 2019; Ramírez de la Cruz et al., 2020).

Despite all the above, the learning and teaching of mathematics have been the subject of study for various reasons. For example, for the poor relationship with the context of the learners, for the feelings and emotions that are generated around this area of knowledge throughout the educational process, for the teaching methods used by mathematics teachers, for the poor performance of students both internally and externally, among others. For this reason, the study of the problem is approached from perspectives related to the teacher, in terms of the teaching methods used and the coherence between teaching, learning, and evaluation. Thus, this article aims to review the didactic or methodological strategies that have been used in teaching, especially in mathematics from 2017 to date, emphasizing those that are implemented more frequently and that provide results in favor of significant learning of mathematics.

Regarding didactic strategies, several authors agree that they are the set of procedures, activities, techniques, means, and resources that the teacher uses intentionally reflexively and flexibly to promote meaningful learning and facilitate the processing of new contents deeply and consciously (Jiménez-Consuegra et al., 2021; Díaz-Barriga and Hernández, 2010 cited by Neira-Camacho & Rodríguez-Ardila, 2021). In addition, according to Neira-Camacho and Rodriguez-Ardila (2021), it is important to emphasize that the success of these goes beyond the spontaneous development, and the attitude of the teacher, as well as it is not limited only to implementing the techniques or procedures mentioned. However, it is a process where the reflection process of teacher is important to carry out an intentional planning and focused on the achievement of an accomplishment, as well as the knowledge of the target population is also relevant to achieve the construction of knowledge in the way it is desired.

It should be clarified that "the didactic strategy is classified into teaching strategies, those used by the teacher, and learning strategies, those used by the student"(Camarena Gallardo, 2017, p. 5). In terms of teaching strategies, which is the main emphasis of this research, the following are the most important ones.

> It should be considered that the strategies oriented by the teacher shape to a great extent the learning process and the relationship established by the student with the contents and topics that allow him/her to generate knowledge throughout his/her life (Pamplona-Raigosa et al., 2019, p. 14)

In this way, current teaching is called to conceive the student as an active generator of his knowledge, with the capacity to be cognitively independent, to mobilize thoughts within the framework of logic, and to be able to apply his knowledge in different situations (Hernández Navarro et al., 2017). Therefore, it is essential to implement more dynamic and constructive pedagogical strategies that promote curiosity, creativity, inquiry, and the construction of their learning according to their interests and previous knowledge. However, it seems that these strategies are being implemented in the opposite direction to that proposed from the constructivist perspective (Patiño Espinal, 2019).

On the other hand, methodological strategies tend to be more a system of short, medium, and long-term actions that direct the teaching-learning process, taking into account methods and procedures focused on the achievement of the objectives determined in an established time (Rodriguez MA and Rodriguez A, 2004 cited by Pereida Hernández et al., 2018). In this sense, methodological strategies "make it possible to identify principles, criteria, and procedures that shape the way teachers act about the programming, implementation, and evaluation of the teaching-learning process" (Medina Hidalgo, 2018, p. 126). Thus, the use of strategies allows for a better classroom methodology, that is, it implies that the teacher not only knows mathematics but also how to teach it with creativity, innovating and motivating students to build their learning.

All of the above is necessarily linked to didactics, which etymologically comes from the Greek 'Didaskein' "meaning to teach, instruct, explain, make know, and demonstrate" (Neira-Camacho & Rodríguez-Ardila, 2021, p. 94) and that in its broadest sense is more concerned with how it is taught than with what is to be taught. For this reason, it is now recognized the need for didactics centered on the learner, that is, oriented to the learning process, with environments or scenarios that promote the development of skills, the appropriation of knowledge, and its mobilization towards the resolution of problems of their environment in the present and their future professional life (Amechazurra Oliva et al., 2018). Thus, the didactics of mathematics is a discipline that focuses on the art of teaching mathematics and tries to solve problems related to the teaching and learning of mathematics in a real context (Chacón Benavides & Fonseca Correa, 2017). In this sense, the term Didactic Content Knowledge (CDC) becomes important, which, according to (Shulman, 2005) cited by (Patiño-Cuervo et al., 2019), is related to how the teacher makes teachable what he/she knows, with emphasis on changing the conception of students as passive beings to whom content is transmitted and bearing in mind that the teacher as mediator of the learning process is responsible for creating the didactic devices required to propitiate the optimal conditions for learning. Thus, Didactic Content Knowledge (CDC) implies that being an expert in a knowledge does not necessarily mean being a teaching professional, since he/she may lack didactic knowledge. Therefore, the teacher must have didactic knowledge, which enables him/her to have at his/her disposal multiple possibilities to carry out his/her classes and promote the development of competencies and skills that allow for optimal learning.

Method

The article is framed in a qualitative approach, from the exploratory systematic review, which according to (Jiménez & Aldana, 2020) "is a process that describes the existing knowledge of a concept, theme or particular problem to make known the state of research on a problem" (p. 1). For its implementation in this study, Biolchini, Gomes, Cruz, and Horta (2005) protocol was followed as cited by Holguín García et al. (2020), "which focuses mainly on five aspects:

(i) Formulation of the Research Question, (ii) Search Strategy, (iii) Selection of Studies, (iv) Extraction of Information, and (v) Summary of Results" (p.64).

Formulation of Research Questions

In this article, four questions were designed to guide the research, which are:

What didactic and methodological strategies predominate in the teaching of mathematics today?

What are the didactic and methodological strategies that have had better results in the learning of mathematics?

What are the strategies that have shown improvement in students' academic performance in mathematics?

What are the trends in mathematics didactics?

Search Strategy

An organized and systematic search was carried out using the descriptor "strategy AND didactic OR methodological AND mathematics", in the databases Dialnet, Google Scholar, and EBSCO, taking into account as Selection Criteria that they were articles only in Spanish, full text, since 2017 and with the initial exclusion of monographs and theses. A total of 356 articles were obtained in this search.

Study Selection

To select the definitive articles, the first step was to eliminate duplicate documents, excluding those that did not present a clear methodology or did not develop the search descriptors, i.e., articles whose title, keywords, abstract, and content were not directly related to the categories and/or research questions. It was also prioritized that the studies were in the area of mathematics; however, 9 articles from other areas were included due to their conceptual relevance. They were initially organized according to their relevance to the conceptualization of the categories of analysis, and subsequently according to the research questions. Table 1 shows in detail the number of articles found, duplicated, excluded, and analyzed, for each database.

Table 1 Detail of the number of articles found, duplicated, excluded, and analyzed, for each database.

Database	Found	Duplicates	Excluded	Analyzed
Dialnet	33	0	14	19
EBSCO	94	3	84	7
Google Scholar	229	24	177	28
Total	**356**	**27**	**275**	**54**

Information Extraction

To extract the information, a matrix was used to "analyze, in condensed form, the complete set of data, to be able to see literally what is there" (Huberman & Miles, 1994, p. 424, cited by Montoya and Arroyave (2021) and the Research Analytical Summary (RAI) proposed by González Palacio (2019), and adjusted to the needs of this review, was used. This study systematizes information related to the database consulted: title, author, year of publication, name of the journal, level, area, country, problem or situation addressed, objective of the study, method, type of study, population, instruments, as well as quotations and comments related to the development of the subcategories related to didactic or methodological strategies. Finally, after the analysis of the documents that met the selection criteria, a database was generated in Excel for subsequent analysis in the Atlas ti v.7 software.

Results

Within the results of the search performed with the descriptor that related the concepts of didactic or methodological and mathematical strategy between the years 2017 and 2022, it can be observed that about 70 % of the analyzed studies are between 2019 and 2021 (Figure 1). About the databases shown in Figure 2, there is a predominance of relevant articles present in the Google Scholar database with 52%, followed by Dialnet with 35% (Figure 2). In addition, according to the educational level at which the research was conducted (Figure 3), 69% was at the school level, between elementary, junior high, and high school, followed by research at the university level (30%).

As for the geographical distribution of the studies, Figure 4 shows that most of the research was carried out mainly in Latin America (87%), especially in Colombia (41%). All the above demonstrates that the subject matter studied is very current and that the information serves as input for the study of this type of strategy since most of the studies are found in databases that are freely accessible and easy to consult. In addition, all the strategies analyzed could serve as a basis for future studies within the Latin American context and with possibilities of application in national institutions and at any educational level.

Figure 1
Time distribution of studies

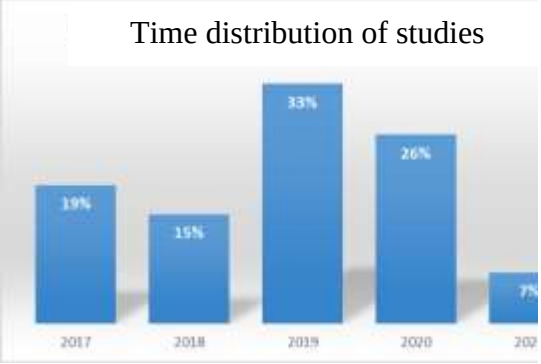


Figure 2
Databases consulted

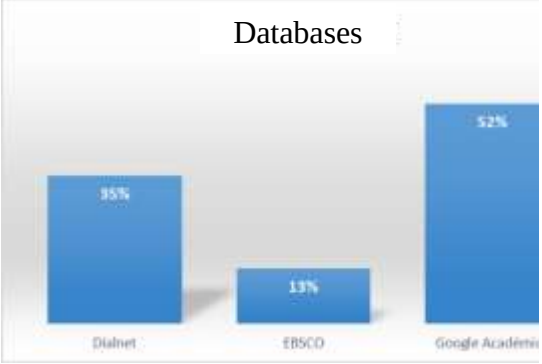


Figure 3
Countries where research was conducted

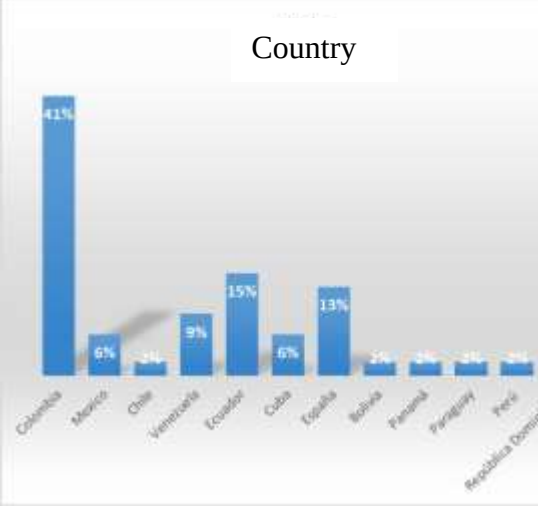
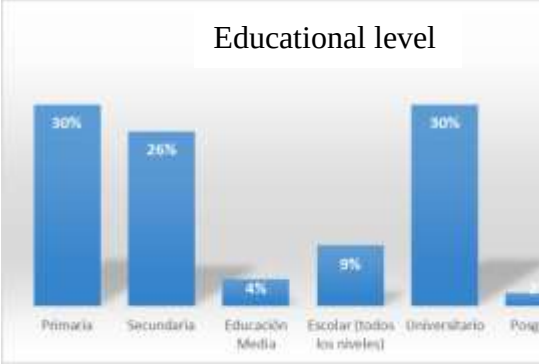


Figure 4
Educational level at which the strategies are applied



Source: Own elaboration

After systematizing and analyzing the information obtained from the articles, the most relevant results are presented following the research questions that guided the search.

What didactic and methodological strategies predominate in mathematics teaching today?

Because not all people learn in the same way, a range of didactic and methodological strategies arise, which are supported, for example, by playfulness, the diversity of problems with multiple solutions, contextualized situations, the use of technological resources, access to graphic materials, the development of projects, cooperative groups, among others, which offer possibilities of work in the classroom where there are different learning styles and rhythms. About the teaching and learning of mathematics, the activities that students carry out when learning should be considered, for them to develop logical reasoning skills and increase their conceptual bases in the area.

According to Montaluisa-Vivas et al. (2019), 2 learning styles predominate and should be taken into account when proposing strategies to teach and learn mathematics, the active learning style and the pragmatic learning style, where the first one is related to teamwork strategies, use of graphic materials, and computer. In addition, students with this type of style require planning and carrying out field trips to places of interest, good motivation on the part of the teacher, diverse ways of evaluation, and classroom activities that involve students explaining, analyzing, interpreting, and applying mathematical concepts.

On the other hand, the pragmatic style demands student participation in academic expositions and contests, orientation in study techniques and methods, and evaluation of knowledge, competencies, values, and attitudes, so that a practical approach is given to everything they are expected to learn. The following are the strategies used in the articles analyzed in this review, with their respective descriptions and contributions to these forms of learning.

What is the basis for the didactic or methodological strategies that have had better results in mathematics learning?

For a better review of the strategies, they were grouped according to the learning that they developed, or the resources used.

Reality-based or socially focused strategies

This classification could include Critical Mathematics Education, the use of real environments, and the didactics of mathematics in context. All of them seek the formation of a critical subject, with the social use of mathematical knowledge, that proposes to analyze mathematics for life, with great utility for scientific, technical, and civil society, so that students develop skills that allow them to understand and face diverse situations that are meaningful to them because they are based on interest, promoting autonomous learning. In addition, this type of strategy offers a diversity of learning environments with pedagogical resources and from real and close environments, including different languages such as visual, written, and auditory, among others (Alvis-Puentes et al., 2019; Alvis et al., 2019; Camarena Gallardo, 2017; Muñoz, 2020; Neira-Camacho & Rodríguez-Ardila, 2021).

Mathematical Modeling also fits into this classification because it is a strategy that allows linking mathematics with reality. Through the identification of a real situation, which is then simplified, idealized, and represented in graphs or diagrams for better understanding. Subsequently, it is mathematized using mathematical language and a model is proposed to describe the situation, the mathematical work is done formalizing the model, which can be verified and validated from the mathematical and its social relevance (Cabello-Mora et al., 2021; Guzman Machaca, 2019).

Playful strategies with concrete material

Some research uses play, also called serious play, as a playful way of organizing the teaching process (García Gaitán & Martínez Guevara, 2019), emphasizing the importance of this in several aspects, such as favoring active participation, motivation and interest, concentration, communication among students and with the teacher, constant feedback, diversity of environments and their adaptation for the learning of students with more difficulties (Vallejo and López, 2002, cited by Ribosa and Durán, 2017; Quintanilla, 2020; Pinos-Morales et al., 2018). According to Illescas-Cárdenas et al. (2020), "Games manage to transform the most complicated subjects into entertaining activities, which is why they should be implemented more frequently in the most complex areas" (p. 539).

Through some well-planned games with components, dynamics, and mechanics, whose main purpose is not to contribute to leisure in the classroom, but to educate, it is possible to develop in students connections at a mental level that enhance logical skills, lateral thinking, mental arithmetic, among others, as well as the use of cooperative environments and learning by discovery, since they focus their attention on the game and its environment, without realizing that during it significant learning is achieved (García-Tudela et al., 2020; Kiernyezny Rovate & Agüero de Talavera, 2019; Martínez-Villalba et al., 2019). Such is the case of "Intelligent Games" such as Cuissenaire's strips, the Tangram, the Geoplano and the Poliominos, which allow enhancing mathematical knowledge, Escape room, "Maya" method for multiplication, A3 strips for the understanding of addition of fractions, among others (Chacón Benavides & Fonseca Correa, 2017; García-Tudela et al., 2020; Martínez-Villalba et al., 2019; Maya Ruiz, 2020).

Cooperative strategies

The vast majority of the strategies analyzed have a teamwork component, with special emphasis on the fact that this group work must be done in a cooperative way, which favors an adequate exchange of lessons among peers, learning strategies, different possibilities for problem-solving, as well as the negotiation of meanings when analyzing the different situations presented, also allowing students to be more responsible for their learning, as well as minimizing the students' dependence on their teachers. However, cooperative learning requires knowledge of the students' learning context, i.e., the zone of proximal development, which promotes higher learning (Morales-Maure et al., 2018; Rondón et al., 2017).

According to Johnson et al. (1999, cited by Huaman Camillo et al., 2020), There are five dimensions in cooperative work: 1) positive interdependence, related to one's success, a product of the team's success; 2) interaction, related to working together sharing their knowledge; 3) individual and group responsibility, referring to the contributions of each one in terms of the team; 4) interpersonal and group skills, each member contributes their strengths to achieve the proposed goal; and 5) group evaluation, which has to do with the constant analysis of the functioning of the group. Iglesias Muñiz et al. (2017) used a series of cooperative learning methods that well implemented can positively influence the learning of mathematics, among which, the following stand out: numbered heads, pencil to the center, building a problem. With the application of any method or cooperative technique inside or outside the classroom, students are expected to appropriate the information, reinterpret it from their schemes, and provide them with meaning (Neira-Camacho & Rodríguez-Ardila, 2021).

Strategies focused on the development of problem-solving skills

Problem-solving within the teaching-learning process of mathematics should be promoted as a habitual practice, and as the raison d'être of all mathematical activity, because the search for viable solutions allows metacognitive development and promotes autonomy in learning (Mato-

Vázquez et al., 2017). Among the strategies analyzed that promote problem-solving skills, is the Singapore Method (CPA approach: concrete, pictorial, and symbolic), which includes the use of resources such as structured and unstructured concrete material, games, and collaborative learning techniques, allowing to increase the motivation to learn to solve mathematical problems even in children who showed apathy towards mathematics (Meneses-Patiño & Ardila, 2019). Also in this sense of pictorial analysis, photography has been used as a resource that allows to establishment of relationships between elements, as well as to build mental representations necessary for problem-solving (Tirado Carvajal et al., 2019).

On the other hand, the Pólya Method, which is based on a series of criteria, such as data analysis, identification of relevant information, elaboration of a plan, correct application of algorithms, and confrontation of results, has become very popular in classroom practices to achieve an adequate understanding and solution of mathematical problems (Meneses & Peñaloza, 2019). These criteria or stages facilitate the problem-solving process and only the achievement, often without a proper understanding, of the answer to the problems (Díaz & Ruiz, 2019). Another strategy is PBL (Problem-Based Learning) which is proposed as a pedagogical experience with a situated and experiential character, transcending from the mechanization of procedures to the construction of arguments, since the problems to be developed arise from the interest and motivation of the students in a problem situation, which normally has several ways of solution (García Gaitán & Martínez Guevara, 2019; Ortega Iglesias et al., 2020) promoting an "active role in their learning that allows them to develop cooperation, responsibility, skills and attitudes with resources that will benefit them personally and academically" (Tapia-Vélez et al., 2020, p.756).

Technology-mediated strategies

Countless strategies rely on technology to create more engaging learning environments for students, which promote interest and motivation, and enhance self-learning, imagination, creativity, and critical thinking, however, many teachers do not make optimal use of it as a resource for education, either because of its low utilization or because it is introduced in traditional teaching practices only as an additional resource (Alvarez-Sampayo et al., 2021).

Among the most used strategies, according to this review, it is worth highlighting the use of free software as an educational resource, such as Geogebra, which allows the visualization and dynamism of different representations, so that students can develop skills beyond memorization (Campo-Meneses & Cruz Rojas, 2020; Jaraba Gutierrez, 2020). As well as Scratch, using programming activities in this software, promotes autonomy, creativity, critical sense, commitment, and responsibility in students, both individually and as a group, always tending to the negotiation of meanings when proposing solutions to situations posed (Vivas Silva et al., 2017).

In this category and especially since 2020, gamification has gained great strength, which consists of video games at the service of the educational process, so that students learn while enjoying virtual worlds and environments or environments enriched with audiovisual effects, promoting discovery, by following game rules, and the application of strategies and knowledge, for the resolution of mathematical problems that may or may not have real application (Castillo & Jiménez, 2020; Holguín García et al., 2020). The use of Augmented Reality (AR) and educational robotics (for example, with LEGO MINDSTORMS robotic devices) has also been strengthened as didactic support in the teaching of mathematics, since, through them, stimulating, immersive, and disruptive learning spaces can be built, allowing students to apply different concepts, procedures and tools in the resolution of problems (George, 2020; Murcia & Henao, 2017; Ovalles Germosén et al., 2018).

Another widely used strategy is the Flipped Classroom or inverted classroom: The Flipped Classroom methodology allows working outside the classroom certain teaching-learning processes, which are normally worked on in the classroom. This methodology facilitates access to educational content in a more pleasant format, which can be consulted when and how you want, responding to different learning rhythms. In addition, class time is optimized in the classroom, since practical tasks or those that require more interaction can be studied in depth (C. Sánchez-Cruzado et al., 2019; C. M. Sánchez-Cruzado et al., 2018).

It is important to emphasize that none of these strategies are adequate or conducive to learning unless the teachers who direct the pedagogical process are trained in the selection, design, and use of these strategies since they involve not only technological management but also the knowledge and management of resources, context, content, among others (Ortega Iglesias et al., 2020).

Other strategies

Strategies such as Lesson Studies also appear, which use different representation systems (tangible, graphic, verbal and symbolic) to improve teaching materials (Martínez-Juste, 2019); CPE (teaching for understanding) that takes into account different dimensions, not only what, but also how, why and what for, through forms of expression and communication that can be applied to daily, professional or scientific-technical life (Angulo Escamilla et al., 2017) and academic accompaniment, focused on the interactions between students and monitors, which facilitate comprehension processes, since "they feel closer in their mental functioning, oral and written language than with a teacher" (Uzuriaga- López & Mejía- Rojas, 2019, p. 650).

What are the strategies that have shown improvement in students' academic performance in mathematics?

In general, all the strategies employed seek to improve aspects related to comprehension, communication, motivation, but also academic performance. Thus, in the studies, the following strategies stand out as those that have shown improvements in academic performance:

- Cooperative learning, which allowed not only to improvement of socio-affective relationships but also achievements in some cognitive and metacognitive skills, which improves students' performance and contributes to increasing their motivation to study (Iglesias Muñiz et al., 2017; Morales-Maure et al., 2018; Rondón et al., 2017), demonstrating that there is a relationship between cooperative work and meaningful learning (Huaman Camillo et al., 2020).
- The Singapore method: this improves the level of textual comprehension of the problems, which allows him to improve his cognitive processes because it is not only about solving problems in a mechanical way and without analysis of the situation but also about solving them in a more systematic way (Meneses-Patiño & Ardila, 2019).
- Playful strategies and serious play, where students learn mathematics normally with the group, from the group, and thanks to the support of the group, while having fun, improve mathematical skills, deepening their knowledge of mathematics (Chacón Benavides & Fonseca Correa, 2017; Quintanilla, 2020; Ribosa & Durán, 2017). However, methodology alone does not guarantee meaningful learning if it is not properly planned, designed, and developed (Illescas-Cárdenas et al., 2020).
- Gamification has been shown to have a significant impact on students' academic performance when the applications have been designed under appropriate cognitive parameters and with teacher support (Holguín García et al., 2020), including students with Special Educational Needs (Castillo & Jiménez, 2020).

- The free Scratch software, by generating pleasant spaces for the construction of knowledge, promotes meaningful learning of mathematics (Vivas Silva et al., 2017), and Geogebra software, contributes significantly to improving students' skills by enabling them to analyze and solve problems in dynamic environments (Jaraba Gutierrez, 2020).
- The “Flipped Classroom” methodology, allows for the production of higher quality work, typical of students who develop competencies in the following areas (C. M. Sánchez-Cruzado et al., 2018), and also, the use of didactic resources such as discussion forums and the course Web page allow for a better understanding of the mathematical contents, the communication of ideas by students and the achievement of favorable results in the final mathematics exam (Hernández Pérez et al., 2018).
- The Pólya method, which is a tool that allows the development of problem analysis skills, as well as the development of different solution strategies; is evidenced by how the students' performance improves gradually as the process progresses (Meneses & Peñaloza, 2019).
- PBL (Problem-Based Learning), through which metacognitive strategies are applied, reasoning logically, and in turn significantly improving the level of understanding and learning of students (Mato-Vázquez et al., 2017; Tapia-Vélez et al., 2020).
- Academic support contributes to improving students' learning by creating study habits, continuous counseling, and permanent questioning (Uzuriaga-López & Mejía-Rojas, 2019).

What are the trends in mathematics didactics?

According to the research analyzed, the main trends in mathematics didactics point to a teacher who understands how fundamental mathematics is for the intellectual development of students, who carries out well-structured planning taking into account previous knowledge and the context and interests of students, generating diverse forms of logical thinking, with the establishment of clear learning objectives and the selection of didactic methods and resources following the processes he/she guides, in a way that enables the understanding and learning of mathematics, who has good theoretical training in his/her discipline and the knowledge of teaching (Mato-Vázquez et al., 2017; Meneses-Patiño & Ardila, 2019; Meneses & Peñaloza, 2019; Ortega Iglesias et al., 2020; Quintanilla, 2020). It also promotes learning based on collaborative problem-solving and continuous questioning (Camarena Gallardo, 2017; Ribosa & Durán, 2017), awakening “students' concerns and learning needs, inside and outside the environment considered as formally educational, and also trying to foster a future active and responsible citizenship” (C. Sánchez-Cruzado et al., 2019, p. 41). The trend is towards more practical and experimental classes that adjust to different types and rhythms of learning and promote the development of autonomy, research, problem-solving and creation, interdisciplinary work, information management, self-regulation, among other skills in students (Camarena Gallardo, 2017; Guzman Machaca, 2019; Neira-Camacho & Rodríguez-Ardila, 2021; C. Sánchez-Cruzado et al., 2019) The approach is proactive and efficient classes focused on reasoning and solving real problems based on the mathematical learning constructed. This type of “didactics seeks to make the student go beyond the proposed idea, the approach is practical and is oriented to constructivist learning” (Coloma Andrade et al., 2019, p. 2).

Conclusions

In any educational process, it is vital to keep in mind aspects such as teaching methodology, the role of the teacher and the student in the learning process, the didactic moments, as well as the use and application of materials and resources that promote the construction of knowledge and the interaction between the actors involved in it. According to the review of didactic and methodological strategies used in Mathematics Education, there is a tendency towards

Cooperative Learning, with special emphasis on the construction of joint learning, fostering social skills, individual and social responsibility, as well as autonomy, Problem-Based Learning, which favors the development of logical reasoning skills and possibilities of learning applicable to reality, the use of concrete material for Game-Based Learning, which offers fun environments, while developing logical and cooperative skills focused mainly on overcoming challenges, and undoubtedly, strategies involving ICT have become one of the most used, due to the possibility of developing multiple activities in motivating environments, with access to information at all times and as support for the mental and social processes already mentioned.

It is also relevant to keep in mind that most of the didactic and methodological strategies used inside or outside the mathematics classroom, currently seek the formation of active subjects, with the ability to analyze different situations and points of view, critical and proactive, which is encouraged through learning environments that are based on reality and their interests, which propose to analyze mathematics for life, with great utility for scientific, technical and civil society. Additionally, it should be kept in mind that, for the implementation of any of these strategies, and the achievement of favorable results tending to adequate learning, it is the didactic knowledge of the teacher, since ignorance of this implies the implementation of didactic and methodological strategies without pedagogical foundation, which could generate results completely contradictory to the expected ones.

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