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# Active learning through projects in mathematics: a strategy for effective implementation of curriculum design

## *Aprendizaje activo a través de proyectos en matemáticas: una estrategia para la implementación efectiva del diseño curricular*

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## Abstract

This article analyzes the use of Project-Based Learning (PBL) as an active teaching strategy to strengthen mathematics teaching at the upper elementary and high school levels. This research arose from the need to align pedagogical practices with current curriculum design, promoting meaningful learning that transcends memorization and fosters the development of competencies. The objective of this work is to evaluate the effect of PBL on mathematics teaching within the Ecuadorian curriculum context, identify relevant teaching activities for its implementation, and design a methodological guide to support teachers in its application.

The study adopted a mixed approach, with an interpretive perspective, combining qualitative and quantitative techniques. Data collection was conducted through surveys administered to 160 students and 30 teachers from different public and private educational institutions in Quito, Ecuador. The findings reveal that PBL is highly valued for its ability to generate contextualized and relevant learning, although it faces obstacles such as a lack of resources, limited time, and insufficient teacher training. PBL contributes to a better understanding of mathematical content by integrating it with real-life problems, in addition to enhancing skills such as critical thinking, collaboration, and problem-solving. Students prefer active methodologies that connect learning to their environment, which underscores the importance of reinforcing this approach through actions that mitigate its limitations.



## Keywords

Project-based learning, meaningful learning, curriculum, mathematics instruction, active methodologies.



## Resumen

El presente artículo analiza el uso del Aprendizaje Basado en Proyectos (ABP) como estrategia didáctica activa para fortalecer la Enseñanza de la Matemática en los niveles de básica superior y bachillerato. La investigación surge de la necesidad de alinear las prácticas pedagógicas con el diseño curricular vigente, promoviendo un aprendizaje significativo que trascienda la memorización y fomente el desarrollo de competencias. El objetivo de este trabajo pretende evaluar el efecto del ABP en la enseñanza Matemática dentro del contexto curricular ecuatoriano, identificar actividades didácticas pertinentes para su implementación y diseñar una guía metodológica que apoye a los docentes en su aplicación. El estudio adoptó un enfoque mixto, con una perspectiva interpretativa, combinando técnicas cualitativas y cuantitativas. La recolección de datos se realizó a través de encuestas aplicadas a 160 estudiantes y 30 docentes de distintas instituciones educativas fiscales y particulares en Quito-Ecuador. Los hallazgos revelan que el ABP es bien valorado por su capacidad para generar aprendizajes contextualizados y relevantes, aunque enfrenta obstáculos como la escasez de recursos, el tiempo limitado y la insuficiente formación docente. El ABP contribuye a una mejor comprensión de los contenidos matemáticos al integrarlos con problemas reales, además de potenciar habilidades como el pensamiento crítico, la colaboración y la resolución de problemas. Los estudiantes prefieren metodologías activas que conectan el aprendizaje con su entorno, lo cual subraya la importancia de reforzar este enfoque a través de acciones que mitiguen sus limitaciones.



## Palabras clave

Aprendizaje basado en proyectos, aprendizaje significativo, currículo, instrucción Matemática, metodologías activas.

## 1.Introduction

In the current educational context, there is a growing need to apply methodologies that promote meaningful learning, the development of competencies, and the connection between theoretical knowledge and its practical application. The demands of the 21st century require pedagogical approaches oriented toward the development of competencies applicable to real-life contexts, preparing students to address authentic challenges through practical skills (Ramírez-Díaz, 2020, p. 7). In this sense, PBL has established itself as an active methodology with great potential, especially in areas traditionally considered abstract, such as mathematics. This research addresses a central problem that affects the quality of the teaching-learning process in higher basic education and high school: the difficulties teachers face in effectively implementing PBL in the classroom. Quimis-Cajamarca et al. (2024) identified that "68% of mathematics teachers report significant difficulties when implementing active methodologies" (p. 112). The nature of the problem lies in the fact that, while PBL offers multiple benefits such as fostering critical thinking, collaboration, accountability, and contextualizing learning, its practical application in the classroom presents numerous obstacles.

The challenges identified in this study include a lack of time within curriculum planning, a scarcity of adequate teaching resources, and limited teacher training in active methodologies. These obstacles create a gap between contemporary pedagogical proposals and their actual implementation in the classroom. As Martínez (2021) points out, "many teachers perceive PBL as a methodology that is difficult to adapt to the teaching of mathematics, due to its conceptual and abstract approach" (p. 67). Furthermore, teachers often perceive PBL as a methodology that is difficult to adapt to the teaching of mathematics, due to its conceptual, abstract, and systematic approach. The importance of addressing this problem lies in the transformative potential of PBL to improve not only students' academic performance but also their motivation and engagement in the educational process.

The main objective of this research is to identify strategies that support teachers in overcoming the aforementioned barriers, thus facilitating the effective application of PBL in the teaching of mathematics. The questions guiding this study include: What factors hinder the implementation of PBL in mathematics at the upper elementary and high school levels? What perceptions do teachers and students have about the use of active methodologies? What strategies can contribute to a more effective implementation of PBL in this discipline? The research is geographically focused on educational institutions in the city of Quito and primarily addresses mathematics subjects at the upper elementary and high school levels, without extending to other educational levels or disciplines. The purpose of this article is to offer a comprehensive look at the problems of implementing PBL in mathematics, providing empirical evidence and developing a practical and contextualized methodological proposal that contributes to improving the quality of the educational process.

Regarding the structure of the article, section 2 presents the basic definitions related to the research, section 3 details the process by which the study was carried out, section 4 presents the results of the pretest and posttest through a descriptive statistical analysis, section 5 addresses the discussion based on the analysis of the dimensions of the study, and finally, section 6 formulates the conclusions based on the results obtained.

## 2. Theoretical Foundation

Active methodologies are based on the premise that learning is more effective when students actively participate in their own learning process, becoming protagonists in the construction of their knowledge. Ruiz (2013) argues that thinking is a tool designed to resolve problematic situations that arise in the course of activities (p. 106). These methodologies, among which PBL stands out, seek to break with the unidirectional teaching model by promoting the integration of theory and practice through the resolution of real and significant problems, which fosters more meaningful and contextualized learning (Cosquillo-Chida et al., 2025, p. 273).

PBL is based on pedagogical constructivism, a movement that views students as active agents in their learning process. López (2020) argues that this approach facilitates the acquisition of key competencies through the research, design, execution, and evaluation of projects that respond to specific needs (Cosquillo-Chida et al., 2025, p. 273). In the field of mathematics education, various studies have shown that this methodology favors the development of competencies such as logical thinking, analytical skills, and teamwork by engaging students in real-life situations that require the integrated and collaborative application of knowledge. For example, García and Martínez (2019) report that the implementation of PBL in mathematics classes significantly improved students' problem-solving and logical reasoning (García and Martínez, 2019, p. 78).

The Ministry of Education of Ecuador (2016) establishes that the national curriculum is based on a competency-based approach that prioritizes practical and contextualized skills, thus promoting comprehensive education adapted to the real needs of students (Ministry of Education of Ecuador, 2016, p. 23). According to this organization, "education should prioritize the application of knowledge in real-life settings, fostering student autonomy" (Ministry of Education of Ecuador, 2016, p. 32).

The implementation of PBL includes selecting the topic and posing the guiding question, forming teams, defining the final product, planning, researching, analyzing and synthesizing information, developing the product, presenting it, providing a collective response to the initial question, and finally, evaluating and self-assessing (Granda-Roblez & Solórzano-Martínez, 2022, pp. 16-17). This structure allows teachers to guide and support the learning process, ensuring relevance and the achievement of educational objectives. However, proper implementation of PBL requires addressing obstacles such as limited teacher training, a lack of teaching materials, and opposition to methodological innovation. Therefore, it is essential to design strategies and guides that facilitate its incorporation into the classroom, adapting them to specific educational contexts.

### 2.1 Active methodologies

The challenges of the modern world require students to develop critical, creative, and collaborative skills to face the challenges of the 21st century. In this context, traditional education based on memorization of content has shown limitations, especially in subjects such as Mathematics, where conceptual understanding is fundamental. "Active methodologies comprise those pedagogical approaches that transform the teaching process into experiences that promote direct student involvement in their learning" (Labrador-Piquer and Andreu-Andrés, 2008, p. 35). These methodological proposals represent an effective solution, enabling students to construct knowledge by addressing real-life problem situations and establishing bridges between theoretical foundations and their practical applications.

However, the implementation of these approaches in the school setting presents significant challenges, particularly regarding instructional design and learning assessment processes. To face these challenges, the Ministry of Education of Ecuador (2021, p. 34) recommends implementing the following active methodologies: project-based learning, problem-based learning, question-based learning, collaborative learning, gamification, and flipped classroom.

### 2.1.1 Project-based learning

Constructivism is a pedagogical model that views students as active subjects, capable of making decisions and judgments. This approach implies an interactive dynamic between teachers and students, where a constant exchange of knowledge takes place, enabling the joint construction of knowledge. According to Martí et al. (2010), Project-Based Learning "centers on the student and promotes intrinsic motivation" (p. 13) and has among its objectives "to promote greater responsibility for one's own learning" (p. 14), thus placing students as protagonists of their learning process and fostering their autonomy. This participation not only favors the application of knowledge in real-life contexts but also significantly improves the retention and assimilation of information.

According to López (2020), PBL is "an innovative teaching methodology that enables students to acquire knowledge and develop skills by developing projects aimed at solving real and meaningful problems" (p. 78). This pedagogical approach places students as active participants in their learning, connecting academic content with real-world situations while developing comprehensive skills. As a constructivist methodology, PBL facilitates deep and transferable learning, preparing students to solve complex challenges beyond the school context.

### 2.1.2 Phases of Project-Based Learning

Granda-Roblez and Solórzano-Martínez (2020) describe project-based learning has several phases:

> topic selection and guiding question, where a relevant topic is chosen and a question is formulated to guide the investigation. Team formation, where students are organized into groups to encourage collaborative work. Definition of the final product, where a final product such as a presentation, brochure, or model is created, which requires evaluation. Planning, where students must create a work plan to carry out the project activities. Research, where students must seek and share information for their project, with the teacher acting as a guide. Analysis and synthesis, where students give their perspective and share ideas to answer the question posed. Product development, where students must use all the learning acquired to create a product that answers the question posed at the beginning. Presentation and evaluation: the product must be presented through an exhibition and evaluated using a rubric. (pp. 16-17).

These phases allow for the planning, development, and execution of innovative projects for the construction of knowledge through the effective participation of students.

## 2.2 Project-based learning competencies

The implementation of PBL in the area of Mathematics not only strengthens the understanding and practical application of theoretical concepts but also promotes the development of various essential competencies for students' comprehensive learning. In this sense, competence is manifested in individuals' ability to mobilize knowledge, skills, attitudes, and values in diverse and complex contexts, allowing them to solve problems effectively and adapt to new situations (Ministry of Education of Ecuador, 2023, p. 6). This approach allows students not only to solve mathematical problems effectively but also to adapt to new situations and challenges, fostering meaningful and transferable learning to real-life scenarios. In this context, Gómez and Santos (2012) identify three fundamental skills that are developed through PBL in mathematics: critical thinking and research, collaboration, and communication. As the authors point out, "these combined skills allow students to approach mathematical challenges with greater autonomy and creativity." (p. 81).

## 2.3 Relationship of PBL with the current curriculum design in Mathematics

The current Mathematics curriculum in Ecuador is divided into three curricular blocks: Algebra and Functions, Geometry and Measurement, and Statistics and Probability (Ministry of Education of Ecuador, 2016, p. 23). This design seeks to develop competencies that integrate knowledge, skills, attitudes, and values, enabling students to solve problems effectively and adapt to new situations. Mariñez-Báez (2024) emphasizes that the competency-based approach to teaching mathematics "involves the combination of knowledge and the development of skills put into action in a contextualized situation" (p. 144), thus promoting practical application and fostering comprehensive student development.

PBL is closely aligned with the current curriculum design for teaching mathematics in Ecuador. This methodological approach promotes active and participatory learning, where students investigate, reflect, and make decisions to solve problems presented by the teacher. This dynamic is consistent with the Ecuadorian curriculum, which emphasizes the development of practical skills and competencies in real-life contexts. According to Tustón-Villacrés (2020), this relationship is supported by stating that "active methodologies such as PBL emerge as a response to the lack of interest generated by traditional approaches, significantly increasing student motivation and a deeper understanding of mathematical content." (p. 112).

## 2.4 Application of PBL in the classroom

PBL is an active, student-centered methodology that promotes the development of competencies through the resolution of real-life problems. As established by the Ministry of Public Education, in the classroom, it allows students to research, design, implement, and evaluate meaningful projects, fostering autonomy and critical thinking. PBL engages students in complex and authentic tasks that integrate knowledge from different areas. Furthermore, it highlights that this methodology promotes teamwork and effective communication, essential skills for comprehensive education. Project-based learning increases student motivation and engagement by allowing students to take an active role as protagonists of their own learning process (Ministry of Public Education, 2022). In the current educational context, its application in the classroom represents an effective strategy for linking theory and practice, respecting diverse learning rhythms. It also strengthens the connection between school content and the student's social reality. Therefore, PBL is a powerful tool for transforming traditional teaching into a more meaningful and participatory experience.

## 3. Methodology

The study adopted a mixed-method approach, combining structured questionnaires with 160 students and structured and semi-structured interviews with 30 teachers to gain a deeper understanding of perceptions. This approach was chosen for its ability to "integrate the strengths of both methods and provide a more complete understanding of the phenomenon studied" (Creswell & Creswell, 2018, p. 215). This approach was chosen for its ability to capture both measurable outcomes and participants' subjective perceptions, providing a more holistic understanding of the effects of the implemented strategies. Its implementation was structured in three fundamental stages that allowed, on the one hand, to apply the methodological strategy in real-life classroom contexts, and on the other, to qualitatively analyze its impact from the perspective of educational stakeholders. First stage: the initial phase of the project focused on identifying the main weaknesses in the application of PBL in the Mathematics classroom and in understanding the existing pedagogical practices, the proposal was developed in the context of regular Mathematics classes in public and private educational institutions in the city of Quito, this stage included the following activities:

- **Questionnaire application:** A questionnaire was designed and applied to collect data on students' perceptions of the use of PBL in the Mathematics classroom, including their levels of motivation, confidence, and attitude toward the subject. Probabilistic sampling was used, as the population exceeded 200 individuals. To ensure the confidentiality rights of participating students, the header of the data collection instrument specified the context regarding the objective of the survey, including authorization from the educational institution, a commitment to reliability, informed consent, and ethical implications of biosecurity.

- **Interviews with teachers:** Structured and semi-structured interviews were conducted with all teachers to explore their perceptions, experiences, and reflections on the use of PBL in mathematics. This allowed us to identify the teaching methodologies used, common classroom challenges, and teacher training needs. In this case, no sampling technique was applied since the population was less than 200 individuals. These interviews revealed a strong focus on traditional methods, with an emphasis on memorization and mechanical problem-solving, as well as a low level of incorporation of technological tools.

The methodological approach adopted placed students as the protagonists of their own learning, guided by a teacher who assumed the role of facilitator. The initial activities included the administration of a multiple-choice pretest to assess the level of prior knowledge on the selected topics. Subsequently, the students worked in collaborative groups developing projects that required the use of mathematical tools for decision-making, data analysis, and reasoning solutions.

Second stage: The second stage of the research aimed to deepen the understanding of the effects of PBL from a qualitative perspective. To this end, a representative group of teachers and classes were selected, in which a structured observation sheet was applied. The intervention was based on the Fundación Chile (2021) model, which establishes that an effective approach to Proect-Based Learning requires three essential elements: detailed planning, the availability of adequate resources, and formative assessment that accompanies the entire process. This instrument allowed for the systematic recording of evidence of PBL use at different stages of pedagogical practice: planning, implementation, and evaluation.

Based on the findings, innovative pedagogical strategies were designed and implemented to address the identified critical areas. This phase was characterized by a focus on teacher training, the reorganization of classroom practices, and the introduction of active methodologies.

- **Teacher training workshops:** Intensive workshops were held to train teachers. These workshops included training in active methodologies, such as problem-based learning (PBL), promoting a more dynamic and participatory approach in the classroom.
- **Reorganization of classroom practices:** Traditional lectures were transformed into interactive learning environments, where students actively participated by using strategies such as problem-based learning (PBL) and solving problems related to real-life situations. The use of practical and experimental activities was promoted to connect mathematical concepts with concrete applications, fostering deeper and more meaningful understanding.
- **Cooperative learning strategies:** Students worked in heterogeneous groups, which facilitated the exchange of ideas, the development of social skills, and collaborative problem-solving. Group dynamics were designed to encourage equitable participation, ensuring that each team member contributed to the achievement of common goals.

Third Stage: This stage of the project focused on measuring the impact of the implemented strategies and collecting feedback from participants to identify opportunities for improvement.

Finally, a post-test was administered to measure students' academic progress. The results showed a significant improvement compared to the initial diagnostic assessment. Triangulation between quantitative data (post-test results and statistical analysis using Pearson's correlation coefficient) and qualitative data (testimonials, observations, and interviews) confirmed the existence of a very high positive correlation ($r = 0.906$) between the use of PBL and improvements in the teaching-learning processes of mathematics. The results showed significant improvements, corroborating what López (2023) stated: "Systematic PBL increases the understanding of abstract mathematical concepts by 40%" (p. 148). The activities carried out in this phase included:

- **Post-tests:** Post-tests were designed and administered to assess progress in students' skills. These tests were aligned with the project objectives and allowed for comparison of results with baseline data. The results showed significant improvement in student performance, with notable increases in their ability to solve problems and apply mathematical concepts practically.
- **Interviews and focus groups:** Interviews were conducted with students and teachers to explore their perceptions of the project experience, identifying strengths and areas for improvement in the strategies implemented. The focus groups provided a space for open discussions, where participants shared their opinions and suggestions on the project's impact on their teaching and learning processes.
- **Comparative data analysis:** Post-test results were compared with baseline data to assess the degree of improvement achieved. Qualitative data collected from the interviews and surveys were also analyzed to identify relevant patterns and trends.

This research does not include hypotheses, so the proposal concluded with the preparation of a final report that integrated the results obtained and offered recommendations aimed at the continuous improvement of teaching practices. These include the need to systematically incorporate PBL into curriculum planning, strengthen teacher training in active methodologies, and foster an institutional culture that values pedagogical innovation in the area of Mathematics.

## 4. Results

The results of the study confirm the existence of a significant relationship between the application of Project-Based Learning (PBL) and the improvement of teaching-learning processes in Mathematics, according to the data obtained through statistical analysis..

| INDICATOR | PRETEST | | POSTEST | |
|---|---|---|---|---|
| **Always** | 6 | 20 % | 18 | 60% |
| **Almost always** | 14 | 46.67 % | 11 | 36.67% |
| **Sometimes** | 8 | 26.67 % | 1 | 3.33% |
| **Almost never** | 2 | 6.66 % | 0 | 0% |
| **Never** | 0 | 0 % | 0 | 0% |

Table 1. Results of activity 1, use of active methodologies

| INDICATOR | PRETEST | | POSTEST | |
|---|---|---|---|---|
| **Always** | 13 | 43.33 % | 19 | 63.33% |
| **Almost always** | 11 | 36.67 % | 8 | 26.67% |
| **Sometimes** | 5 | 16.67 % | 3 | 10% |
| **Almost never** | 1 | 3.33 % | 0 | 0% |
| **Never** | 0 | 0 % | 0 | 0% |

Table 2. Results of activity 2, PBL optimizes time for key content

| INDICATOR | PRETEST | | POSTEST | |
|---|---|---|---|---|
| **Always** | 15 | 50 % | 20 | 66.67% |
| **Almost always** | 11 | 36.67 % | 10 | 33.33% |
| **Sometimes** | 3 | 10 % | 0 | 0% |
| **Almost never** | 1 | 3.33 % | 0 | 0% |
| **Never** | 0 | 0 % | 0 | 0% |

Table 3. Results of activity 3, PBL facilitates the connection with everyday life

The data obtained from the pretest and posttest reveal a significant impact of implementing Project-Based Learning (PBL) in three key areas: the adoption of active methodologies, the optimization of time for priority content, and the connection between learning and everyday life.

Regarding the use of active methodologies, notable progress was observed. While in the pretest, only 20% of teachers reported always using them, this percentage tripled in the posttest, reaching 60%. Furthermore, responses indicating sporadic ("sometimes") or almost nonexistent ("almost never") use decreased dramatically, demonstrating a more consistent and widespread adoption of these strategies. This change reflects that PBL not only promotes innovative pedagogical practices but also manages to permanently integrate them into the classroom dynamic. Regarding the optimization of time for key content, the results show that 63.33% of teachers perceive that PBL allows them to address essential topics more efficiently, compared to 43.33% who considered this to be the case before its implementation. The disappearance of responses such as "almost never" (which fell from 3.33% to 0%) suggests that PBL is recognized as an effective method for managing time without sacrificing depth of learning.

Finally, in the dimension of connection with everyday life, 66.67% of teachers state that PBL always facilitates this connection, a considerable increase from the initial 50%. The elimination of negative responses ("sometimes" and "almost never") reinforces the idea that this methodology is especially effective in contextualizing knowledge and making it relevant to students. The results confirm that PBL is an effective method for transforming educational practices, fostering more active, efficient, and meaningful learning. To consolidate these gains, it is recommended:

1. Strengthen teacher training in PBL project design and evaluation.
2. Promote spaces for reflection where teachers can share experiences and adjust their practices.
3. Include students in project evaluation, gathering their feedback to continuously improve the methodology.

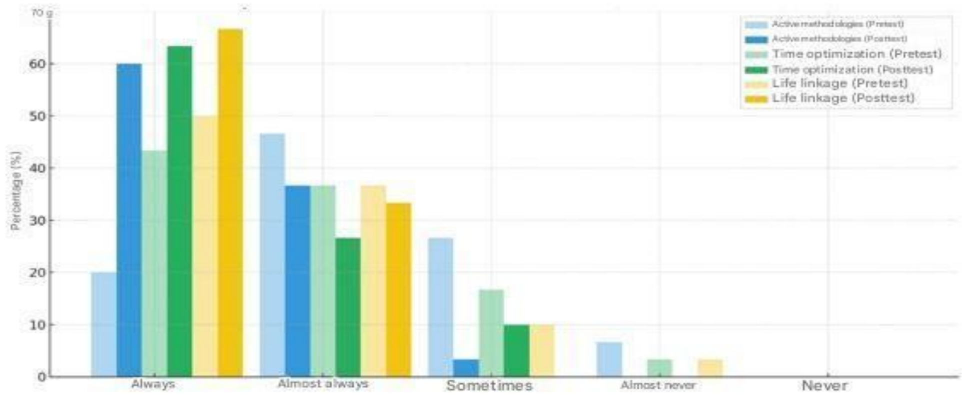


Figure 1. Variation in the increase in the percentage of correct answers between the pretest and posttest

In summary, the discussion of these results confirms that Project-Based Learning is a methodology that enhances the teaching of mathematics, allowing for greater conceptual understanding and better connections to everyday life, in addition to fostering student autonomy and critical thinking. However, its implementation still faces significant challenges that must be addressed through institutional educational policies and a sustained commitment to teacher training and support.

## 5. Discussion

The results presented in this study support, with clear quantitative evidence, the positive impact of implementing Project-Based Learning (PBL) on the teaching-learning process of mathematics. Although fellow teachers may have applied other methodologies more effectively, the application of pre- and post-tests allowed us to observe substantial changes in three relevant pedagogical dimensions: the use of active methodologies in the classroom, the optimization of time for the treatment of key content, and the connection of learning with everyday life.

From a scientific perspective, the findings align with social constructivism and the postulates of Vygotsky (1978), who explained that "every function in a child's cultural development appears first at the social level and then at the individual level; first between people and then within the child" (p. 57). By placing the student at the center of the educational process, through the resolution of contextualized and meaningful problems, not only is the acquisition of knowledge facilitated, but also the development of higher cognitive skills such as critical thinking, autonomy, and the ability to transfer what they have learned to real-life situations.

In the dimension of the use of active methodologies, the increase from 20% to 60% in the "Always" category reflects a transition from traditional practices focused on transmission to active, participatory, and reflective models. This change is essential to fostering meaningful learning, as it allows students to construct knowledge through exploration, collaboration, and the practical application of abstract concepts. It should be noted that students were constantly encouraged to carry out this research, which could have caused some bias in the posttest results.

On the other hand, the positive perception regarding the optimization of time to address priority content (from 43.33% to 63.33%) reinforces the idea that PBL does not entail a loss of efficiency in curricular coverage. As Bell's (2010) study demonstrates, "project-based learning, when well-structured, can cover up to 28% more curricular content than traditional methods in the same amount of time" (p. 147). On the contrary, it organizes knowledge in an integrated and contextualized manner, which facilitates deeper and more lasting understanding, reducing the need for rote repetition or fragmented teaching.

The third dimension, related to connecting learning to everyday life, also showed significant improvements (from 50% to 66.67%). This result is didactically relevant, as it demonstrates how PBL goes beyond the traditional view of knowledge, helping students recognize the applicability of mathematical knowledge in their environment. Contextualizing mathematical content through PBL increases students' perception of usefulness. This connection enhances motivation, interest, and a sense of belonging, factors closely linked to academic performance and school retention.

From a research perspective, these results must be considered within the specific context of the sample analyzed; however, they offer a solid basis for future research that delves into the long-term effects of PBL, its impact on other educational levels, as well as on initial and continuing teacher training.

## 6. Conclusions

The results obtained from surveys conducted with teachers and students at various educational institutions in the city of Quito show that, despite the recognition of its benefits, the implementation of PBL in mathematics teaching remains limited. Among the main factors restricting its systematic application are lack of time, a shortage of adequate teaching resources, and insufficient teacher training in the use of this methodology.

Despite these barriers, PBL is positively valued by the educational community, as it facilitates a more dynamic, contextualized teaching-learning process aligned with the national curriculum proposed by the Ministry of Education of Ecuador. It constitutes an active methodology with high potential for promoting meaningful learning and the development of mathematical skills in upper elementary and high school students. Its integration strengthens a deeper understanding of mathematical concepts and their application in real-life contexts, while promoting the development of transversal skills such as critical thinking, problem-solving, and collaboration.

The design of pedagogical activities based on disciplinary projects, supported by criteria of pedagogical relevance, adaptability, and the promotion of critical thinking, is essential to enriching the educational process in the area of Mathematics. These activities, in addition to promoting meaningful learning, integrate educational values such as equity and inclusion, contributing to the comprehensive development of students and strengthening the current curriculum. The implementation of PBL has proven to be a valid pedagogical methodology, empirically and theoretically supported, that improves the quality of the teaching-learning process in Mathematics. The consolidation of its benefits will depend on educational policies that promote its systematic incorporation, adequate teacher training, and the establishment of a school culture that values evidence-based methodological innovation.

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