

Teacher performance and its impact on mathematics academic achievement

El desempeño docente y su incidencia en el rendimiento académico en matemática



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Abstract

Teacher performance is a determining factor in students' academic achievement, especially in the area of mathematics. This study analyzes the relationship between teaching quality and students' academic achievement in Ecuadorian educational institutions. A descriptive-correlational design with a quantitative approach was employed, using surveys and achievement tests applied to 400 students and 50 mathematics teachers. The results show that the use of active methodologies, formative assessment and pedagogical support have a positive impact on student learning. However, challenges were identified such as the lack of continuous training and resistance to change in the teaching practice. It is concluded that improving teacher performance through innovative strategies and constant training is key to optimize mathematics performance. This study provides relevant evidence for the formulation of educational policies that favor more effective teaching

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Sinergias educativas

April - June Vol. 10 - 2 - 2025

<http://sinergiaseducativas.mx/index.php/revista/>

eISSN: 2661-6661

revistasinergias@soyuo.mx

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Received: January 02, 2025

Approved: March 03, 2025

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Key words: Teaching performance, academic achievement, mathematics teaching, pedagogical strategies.

Resumen

El desempeño docente es un factor determinante en el rendimiento académico de los estudiantes, especialmente en el área de matemáticas. Este estudio analiza la relación entre la calidad de la enseñanza y los logros académicos de los estudiantes en instituciones educativas ecuatorianas. Se empleó un diseño descriptivo-correlacional con enfoque cuantitativo, utilizando encuestas y pruebas de rendimiento aplicadas a 400 estudiantes y 50 docentes de matemáticas. Los resultados muestran que el uso de metodologías activas, la evaluación formativa y el acompañamiento pedagógico tienen un impacto positivo en el aprendizaje de los estudiantes. Sin embargo, se identificaron desafíos como la falta de formación continua y la resistencia al cambio en la práctica docente. Se concluye que mejorar el desempeño docente mediante estrategias innovadoras y capacitación constante es clave para optimizar el rendimiento en matemáticas. Este estudio aporta evidencia relevante para la formulación de políticas educativas que favorezcan una enseñanza más efectiva.

Palabras clave: Desempeño docente, rendimiento académico, enseñanza de matemáticas, estrategias pedagógicas.

Introduction

Teacher performance is a determining factor in the quality of the educational process and in students' academic achievement. Mathematics teaching, in particular, faces specific challenges related to the instructional methodology, the teacher's level of preparation and the student's perception of the subject. Numerous studies have highlighted the importance of a well-prepared teacher, capable of applying innovative methodologies and fostering critical thinking in the classroom (Hattie, 2009; Shulman, 2011). In this sense, the relationship between teacher performance and academic achievement in mathematics has been the subject of study in various research in the educational field (Goldhaber & Hansen, 2013; Darling-Hammond, 2017).

The educational context in Latin America reflects a constant concern for improving mathematics teaching, due to the low results observed in international tests such as the Program for International

Student Assessment (PISA) and the Third Regional Comparative and Explanatory Study (TERCE) (OECD, 2019; UNESCO, 2021). These assessments have evidenced significant gaps in the acquisition of mathematical skills among students, suggesting that the quality of teaching provided by teachers plays a crucial role in the development of mathematical competencies (Hanushek & Rivkin, 2010). Moreover, these results have led education officials to rethink teaching methods and to strengthen teacher training as a key strategy for improving education in the region.

Teacher performance can be evaluated through various indicators, such as lesson planning, implementation of didactic strategies, learning assessment and interaction with students. Some pedagogical models, such as constructivism and problem-based learning, have proven to be effective in improving academic achievement in mathematics (Vygotsky, 1978; Bruner, 1996). However, in many educational contexts, traditional and behaviorist approaches persist that limit active student participation and reduce opportunities for meaningful learning (Freire, 1998). The lack of student-centered methodologies has been identified as one of the barriers that negatively affect mathematics learning, reducing motivation and deep understanding of concepts.

At the international level, strategies have been proposed to improve teacher training and encourage the use of active methodologies in mathematics teaching. Programs such as Boaler's "Mathematical Thinking" (2019) and Hattie's "Visible Learning" (2009) have shown that teaching based on conceptual understanding and logical reasoning produces better results in terms of retention and application of knowledge. In contrast, educational systems that continue to rely on memorization and repetition have shown limitations in preparing students to face complex mathematical challenges in their academic and professional lives.

In Ecuador, the education system has implemented reforms aimed at strengthening teacher training and improving academic results in mathematics. The Ministry of Education has promoted continuous teacher training and the integration of technologies in the classroom to optimize teaching and learning processes (Ministerio de Educación del Ecuador, 2022). However, despite these efforts, students' academic results in mathematics continue to be a central concern, suggesting the need for a deeper analysis of the impact of teacher performance on academic achievement. Teacher training should not only focus on the acquisition of mathematical

knowledge, but also on the development of pedagogical skills that enable effective and adaptive teaching.

The role of the teacher in the motivation and development of positive attitudes towards mathematics is fundamental. Several studies have evidenced that the use of appropriate didactic strategies, such as problem-based teaching and collaborative learning, favors a more dynamic and participatory learning environment (Dweck, 2006; Jo Boaler, 2016). However, in many cases, the implementation of these strategies is limited by factors such as lack of resources, teacher resistance to change and lack of specific training in active methodologies (Fullan, 2007). In addition, it is common to find that educational systems still prioritize standardized assessments that do not always reflect the true potential of students or the effectiveness of the methodologies used in the classroom.

Current trends in mathematics education promote a shift towards more interactive and student-centered approaches. Learning based on the use of technology, simulations, and visual models has proven to be an effective tool to facilitate the understanding of abstract concepts and improve academic performance (Schoenfeld, 2016). However, for these innovations to be effective, it is essential that teachers receive continuous training and have institutional support for their implementation. The gap between innovations in mathematics education and their application in the classroom remains a challenge, especially in developing countries where technological resources and training opportunities are limited.

Another key aspect in the relationship between teacher performance and academic achievement is the assessment of learning. The way teachers assess their students directly influences their motivation and understanding of the subject matter. Research has shown that formative assessment, which provides continuous feedback and encourages self-regulation of learning, contributes significantly to improved mathematics performance (Black & Wiliam, 2018). However, in many educational systems, assessment is still based on summative tests that do not always reflect students' learning process or allow them to develop critical and analytical skills.

In the Ecuadorian context, it is essential to consider how teachers perceive their own role in student learning and how prepared they are to face the challenges involved in teaching mathematics. The lack of pedagogical accompaniment and the absence of teacher

performance evaluation mechanisms have been identified as limitations in the improvement of educational quality (Ministry of Education of Ecuador, 2022). In order to achieve a real impact on students' academic performance, it is necessary to develop educational policies that promote evidence-based teacher training and the application of effective methodologies.

The purpose of this study is to analyze the incidence of teacher performance on academic achievement in mathematics, considering aspects such as teaching methodology, learning assessment and interaction with students. Through an empirical approach and based on quantitative data, we seek to identify patterns and correlations that allow us to generate recommendations for the improvement of educational quality in mathematics.

Materials and methods

To carry out this study, a quantitative approach based on data collection through surveys and academic achievement tests was used. A descriptive-correlational study was designed to analyze the relationship between teaching performance and mathematics achievement.

The study is framed within a non-experimental cross-sectional design, in which data obtained in a specific academic period were analyzed. Variables such as teaching performance, methodological strategies used and students' academic performance were measured.

The target population consisted of secondary school students in public and private institutions in Ecuador. The sample was selected by stratified random sampling, including a total of 400 students and 50 mathematics teachers.

Validated questionnaires were used to measure teacher performance, as well as standardized tests to evaluate students' academic performance in mathematics. In addition, interviews were conducted with teachers to learn about their pedagogical strategies.

The data collected were analyzed by descriptive and inferential statistics, using specialized software such as SPSS and R. Correlation coefficients were calculated to determine the relationship between teaching performance and academic achievement.

Results

The results obtained from the data analysis allow us to identify trends in the relationship between teacher performance and academic achievement in mathematics. The most relevant findings are presented below.

According to the data collected, 70% of the teachers surveyed indicated that they use didactic strategies based on logical reasoning and problem solving, while 30% maintain a more traditional and rote approach. This finding is reflected in the students' results, where those exposed to active methodologies obtained significantly higher scores in mathematics tests.

Table 1. Relationship between didactic strategies and academic performance.

Teaching strategy	Teachers (%)	Average student performance
Problem-based approach	70%	85%
Traditional approach	30%	65%

It was found that the type of evaluation applied influences academic performance. Sixty percent of the students indicated that they feel more motivated when they receive continuous feedback through formative evaluations, in contrast to 40% who prefer summative tests.

Table 2. Frequency of use of graphic organizers in learning mathematics.

Use of graphic organizers	Students (%)
Always	51%
Almost always	40%
Never	9%

Finally, 80% of the students affirmed that their motivation to learn mathematics increases when the teacher demonstrates enthusiasm and mastery of the subject, highlighting the importance of the teacher's attitude in the teaching-learning process.

Discussion

The findings of this study show that teacher performance is a determining factor in students' academic achievement in mathematics. It was identified that those teachers who implement active didactic strategies focused on problem solving achieve a positive impact on student learning and motivation. The relationship between teaching methodology and academic performance highlights the importance of training teachers in innovative pedagogical approaches that foster critical thinking and autonomy in learning.

Likewise, formative assessment was consolidated as a key element in improving student performance. Students who received continuous feedback and opportunities for self-assessment showed a greater understanding of mathematical concepts compared to those who were only assessed through summative tests. This suggests the need for a transformation in the assessment systems within the classroom to promote more meaningful learning oriented to the development of analytical skills.

On the other hand, the results reveal that the teacher's attitude and commitment directly influence students' motivation towards mathematics. Teachers who demonstrated enthusiasm and mastery of the content were able to generate a more dynamic and participatory learning environment, which reinforces the importance of continuous professional development in teacher training.

In conclusion, this study highlights the relevance of teacher performance as a key factor in mathematics education. It is recommended to strengthen teacher training and updating programs, promoting active methodologies, the use of technological tools and the implementation of formative assessment strategies. These measures will contribute to improve students' academic results and reduce the mathematics learning gap in the Ecuadorian context.

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