

Strengthening scientific skills from the STEM approach in primary school students

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Abstract. This article shows the results of a Challenge-Based Learning (CBL) strategy articulated with the STEM approach. It was developed with primary school students from an educational institution in Chía-Colombia, carried out in four phases: observation, application, characterization, and evaluation, from a qualitative approach. The results show that 22% of the students were at a "no category" level in STEM skills. The processes of observation, questioning, and hypothesizing were also strengthened. Additionally, an institutional characterization of the STEM approach was performed, demonstrating that the institution scored 2.3 on this approach.

Introduction

Pedagogical practices in teacher training are a relevant space for their professional practice. In this sense, the Pedagogical Practice II of the Bachelor's Degree in Natural Sciences at the University of La Sabana, took place at Colegio Jorbalán, Chía campus. In this space, it is necessary to recognize the situational context in which this institution is framed, inquire what are the key aspects within the planning from the STEM approach (science, technology, engineering and mathematics). This campus is located at kilometer 22, Northern Highway - Chía, Cundinamarca, being part of the municipalities that make up the so-called Sabana Centro. The educational institution is a private country school, founded in 1952 by the Holy Catholic Santa María Micaela, of the order of Adoratrices nuns of Colombia, starting as a female institution with emphasis on commerce and intensive English which had the main objective of helping women from disadvantaged populations. Since 2020, it is recognized as a mixed institution with a single full-day schedule A, which serves students at the educational levels of preschool, elementary, secondary and high school with emphasis on commercial development and business management, recognized by the Ministry of National Education.

Theoretical

The Jobalanistas students' training emphasizes scientific skills, creativity, and curiosity in problem-solving. The teaching practice adopts a STEM approach, integrating science, technology, engineering, and mathematics in lesson plans. This approach aims to develop 21st-century skills, promote women's participation, and prepare students for future careers [1]. STEM encourages active learning through curricular flexibility, mainstreaming, and inclusion.

To support this, the Ministry of National Education established six guiding principles for STEM lesson plans and pedagogical practices: active, contextual, inclusive, expanded, integrated, and collaborative. These principles are crucial in maintaining the fundamental purpose of the STEM+ educational approach while developing resources, lesson plans, and projects.

Challenge Based Learning

The active principle of the STEM approach emphasizes the need for active methodologies that enable students to participate in their learning and connect it to real-life situations. [2] defines active methodologies as a sequence of classes that allow students to identify problems and begin establishing possible solutions through reflection on their learning and results. In this approach, the student takes a leading role, where depending on the implemented methodology (such as gamification, challenge-based learning, project-based learning, etc.), they develop life skills. Meanwhile, the teacher acts as a knowledge facilitator and process guide. To align with active methodologies, the teaching practice will focus on challenge-based learning (CBL), providing an opportunity for students to develop skills, competencies, and creativity while encouraging them to be active and autonomous learners.

Methods and findings

This qualitative, exploratory research, framed within an interpretive paradigm, investigated the impact of STEM-focused institutional factors on the scientific skills development of primary school students in a private Colombian institution. The study, conducted over 6 months, involved 35 primary students (58% of the institution's primary enrollment). Data collection included initial and final systematizations, with results classified using a STEM-focused skill level rubric adapted from [3][4]. The institution's STEM approach was assessed using [5]'s test, evaluating six categories on a 1-5 scale. This assessment, based on document analysis and community interviews, yielded a score of 2.3, indicating early development. The research hypothesis posited that STEM-focused education combined with challenge-based learning strengthens scientific skills in basic primary students at Jorbalán school in Chía, Cundinamarca.

Results demonstrated that the challenge-based learning strategy with a STEM approach contributed significantly to students' scientific competency development. Notably, 22% of initially "uncategorized" students improved their skills, resulting in 100% reaching a "Developing" level in hypothesis formulation, 66% in questioning, and 55% in observation. Furthermore, this strategy revealed students' interest in solving small challenges where they could test their knowledge and arrive at possible solutions as a group, fostering a perspective that doing science means investigating concepts rather than merely knowing them. These findings support the hypothesis and highlight the effectiveness of STEM-based pathway design in enhancing primary students' scientific skills. The study concludes that this approach equips students with valuable skills applicable to learning, problem-solving, and decision-making in various life situations, emphasizing the importance of integrating STEM methodologies in primary education and changing the view of what constitutes scientific research.

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