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Characterizing STEM Education in Latin America: A Literature Review on Active Learning and Competencies

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Abstract

STEM (Science, Technology, Engineering, and Mathematics) is an interdisciplinary educational approach developed by the U.S. National Science Foundation to foster research, innovation, and learning. By integrating these fields, STEM education aims to develop theoretical understanding and practical application in real-world contexts. Despite its widespread adoption in developed countries, some initiatives lack a true STEM focus. In Latin America, STEM adoption is increasing, but challenges persist, including confusion between technology and computer science and limited engineering content in curricula. A specific concern is the declining interest in engineering disciplines, particularly in Colombia. This research examines STEM experiences in educational institutions through a literature review of 31 publications from 2018, focusing on Colombian and Latin American engineering institutions. Of these, five are based on practical educational experiences, while 26 are research-based studies. The types of studies reviewed include interventions, diagnoses, and social studies related to STEM education. The analysis shows a notable increase in STEM-related publications, especially during and after the COVID-19 pandemic, with most studies focusing on secondary and primary education. These findings reflect the growing momentum of STEM in educational settings across Latin America. The research categorizes the key findings from the reviewed publications into five primary dimensions: active learning methodology, competence development, individual conditions, context, and the teacher's role. Active learning methodologies such as inquiry-based learning, problem-based learning, and robotics are prominent in STEM education, promoting skills like critical thinking, creativity, and problem-solving. The research also highlights how contextual factors, such as the student's social and cultural environment, play a significant role in shaping STEM experiences. Gender gaps and motivational factors further influence student participation in STEM activities, emphasizing the need to address these issues early on to foster a more inclusive STEM culture. Moreover, the study underscores the importance of the teacher's role in the successful implementation of STEM education. Teachers are required to facilitate active learning, guide students through real-world problem-solving tasks, and continuously develop professionally to stay updated on new methodologies. Proper teacher training is critical for ensuring that STEM approaches are applied effectively in classrooms and that they are adapted to meet the specific needs of the local context. In conclusion, this research characterizes STEM education through five essential aspects: the use of active learning strategies, the influence of contextual factors, the development of student competencies, the impact of individual conditions such as gender and motivation, and the critical role of teachers in guiding and shaping STEM experiences. These findings highlight the shift from traditional educational models to more dynamic, problem-solving-based approaches, which foster meaningful learning and engagement in STEM fields. The study calls for early exposure to STEM for all students, with an emphasis on addressing gender disparities and ensuring proper teacher training to support the growing STEM initiatives in Latin America. © American Society for Engineering Education, 2025.

Author keywords

Active Learning; Competence Development; Gender Disparities; STEM education; teacher training

Indexed keywords

Engineering controlled terms

Curricula; Education computing; Engineering education; Engineering research; Learning systems; Problem solving; Publishing; STEM (science, technology, engineering and mathematics); Students; Teaching

Engineering uncontrolled terms

Active Learning; Competence development; Engineering and mathematics; Gender disparity; Latin America; Mathematics education; Science education; Science technologies; Teacher training; Technology education

Engineering main heading

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