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Spatial Thinking in STEM Pedagogy-Scientometric Review of Innovations, Gaps and Implications

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ABSTRACT

Spatial thinking plays a pivotal role in STEM education, serving as a cognitive foundation for problem-solving, visualization, and conceptual understanding across disciplines. This scientometric review examines global research trends, innovations, and existing gaps in the integration of spatial thinking within STEM pedagogy. Drawing on a dataset, the study maps key publication patterns, influential authors, collaborative networks, and thematic clusters and visualized through alluvial charts using RAWgraphs, and summarized in tables. The analysis reveals a surge in interest over the past decade, particularly in the application of digital tools such as virtual reality, augmented reality, and educational technologies to enhance spatial reasoning. However, disparities remain in terms of geographic distribution, gender representation, and the translation of spatial thinking research into classroom practices. The review highlights the need for more inclusive, interdisciplinary approaches and calls for future studies that bridge theoretical advancements with pedagogical implementation. The findings offer valuable insights for educators, policymakers, and researchers aiming to strengthen spatial literacy within STEM curricula.

Keywords: dis-embedding, geometric transformation, spatial scaling, spatial thinking, STEM pedagogy