A SYSTEMATIC REVIEW OF THE EFFECTS OF MODELING IN SCIENCE EDUCATION

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ABSTRACT

This systematic review explores the role of modeling in science education, synthesizing findings from 31 research articles published between 2010 and 2022 and indexed in the Web of Science database. The selection process adhered to PRISMA guidelines, employing a comprehensive search strategy focused on modeling, science education, learning outcomes, and systems thinking. Thematic analysis of the selected studies revealed three principal dimensions: the direct impact of modeling on students' conceptual understanding and critical thinking; the socio-cultural factors influencing the effectiveness of modeling practices; and theoretical considerations regarding the integration of modeling into science curricula. Results indicate that modeling significantly enhances students' academic performance, promotes deeper engagement with scientific concepts, and fosters higher-order cognitive skills. Moreover, cultural and social contexts were found to play a vital role in shaping the success of modeling-based learning. These findings align with the broader educational reforms in Europe, emphasizing competency-based and active learning approaches.

Keywords: Model-based learning, systematic review, systems thinking, educational modeling, modeling strategies.