

Chapter 4

Strengths and Opportunities of Artificial Intelligence in Modeling, Argumentation, and Inquiry in the Experimental Science Classroom

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ABSTRACT

This chapter explores the integration of Artificial Intelligence (AI) in the teaching of Experimental Sciences, marking a significant change in pedagogical approaches. Through processes such as Modeling, Argumentation and Inquiry, AI personalizes learning experiences according to the individual rhythms of each student, promoting innovation and adaptability. AI enhances educational personalization, allowing

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students to explore complex simulations and deepen their understanding of scientific phenomena. Tools such as AI-enriched learning environments provide immediate and adaptive feedback, essential for deeper learning, thus renewing traditional methods and introducing cutting-edge pedagogical practices. This chapter relies on a Strengths and Opportunities analysis to demonstrate how AI can transform science education. The goal is to propose AI tools that, with up-to-date practical examples, will enrich primary and secondary education by incorporating emerging technologies. In addition, guidelines for effective classroom implementation will be adapted and provided.

1. INTRODUCTION

The integration of Artificial Intelligence (AI) in the teaching of experimental sciences represents a significant change in pedagogical methods, facilitating innovations and adaptations to the individual learning rhythms of students through processes such as Modeling, Argumentation and Inquiry (Mosquera et al., 2024). Given the results of the recent research by Labañino, Lorca-Marín and de las Heras (2024), it was established, through the analysis of Strengths and Opportunities, how AI can radically transform science education, not only by improving traditional teaching methods but also by introducing innovative educational practices adapted to the individual needs and learning rhythms of students, in this case, through the processes of Modeling, Argumentation and Inquiry.

Previous research, such as that of Sahin (2021) and Timms (2016), highlights the ability of AI to personalize learning and enable students to explore complex simulations, thus improving understanding of scientific phenomena. Roll and Wylie (2016) and Holmes, Bialik, and Fadel (2019) emphasize the support of AI in scientific inquiry and modeling, offering immediate and adaptive feedback that is vital for deep learning. Sergis, Sampson, and Pelliccione's (2018) research highlights how AI can create immersive and meaningful learning environments, while Wenger's (1987) theories of communities of practice and situated learning, along with Papert's (1980) constructionism theory, provide a sound theoretical framework for the effective integration of AI in education. This approach not only promotes an enriched environment but also makes modeling and scientific argumentation central elements of the educational process.

Moreover, according to the SWOT Matrix by Labañino, Lorca- Marín and de las Heras (2024), research such as Gombert et al. (2022) and Kanti Mishra (2022) underline the effectiveness of AI tools for accurate and efficient assessments and their availability in educational environments, highlighted also by Lombardo and Pizzo (2016) in terms of pedagogical innovation and teaching efficiency using

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