Chapter 3
GenAI and Ancient Greek Natural Philosophy:
Exploring the Foundations of Science Concepts Through Interactive Dialogues

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ABSTRACT

This chapter outlines a design framework for employing generative AI chatbots (GenAI) as Socratic dialogue partners to enhance students' engagement with fundamental scientific concepts through historically informed discourse. The proposed framework consists of four components: Initiation, Dialogue, Reflection, and Evaluation and Transfer. Feedback loops connect these parts to ensure that teachers' goals, AI prompts, classroom activities, and formative assessments are all aligned. This study concentrates on ancient Greek natural philosophy, particularly Presocratic and

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Aristotelian concepts regarding matter, change, and causality. The chapter argues that Socratic dialogues with GenAI, placed in historical contexts, can facilitate better understanding of core scientific concepts, foster critical and reflective thinking, as well as help students to locate modern scientific knowledge within a broader historical and cultural context. It also addresses the moral, legal, and management issues that arise when utilising GenAI to facilitate Socratic dialogue responsibly.

INTRODUCTION

In recent years, generative AI tools have started to reshape science education in higher education, not only as auxiliary technologies for producing content but increasingly as mediators of explanation, feedback and inquiry-oriented learning. Empirical work in university science courses and laboratories has shown that GenAI can support both teaching and learning by helping students generate hypotheses, clarify complex concepts and receive rapid, personalised feedback, especially when it is deliberately framed as "a learning partner rather than a mere support tool" (Kalogiannakis, Papakonstantinou, & Sotiropoulos, 2025; Sotiropoulos & Kalogiannakis, 2025).

The present chapter advances a more specific proposal: it conceptualizes GenAI not as a generic support tool, but as a Socratic dialogue partner situated within a historically and philosophically informed framework for engaging with "big ideas" in science

The traditional Socratic type of questions-and-answers – long valued for encouraging critical thinking – is gaining new relevance in the age of AI in education. Specifically, AI-powered tutors can be instructed with proper Socratic prompts, guiding students through scaffolding questioning that fosters reflection. Recent studies, conducted within classroom settings, show that this strategy confers actual cognitive benefits (Hu et al., 2025). For example, fine-tuning the process of a large language model (LLM) to behave like a Socratic tutor significantly improves students' reflective and critical thinking skills, than a generic AI tutor (Degen, 2025). Similarly, studies which involves GenAI – produced dialogues, in high school classes, note an active elevated student engagement in the dialogues process, including follow – up questions, indicative for increasing critical thinking and creativity. This clearly indicates that GenAI can be used to pose probing questions, rather than simply deliver answers, which in turn sharpens students' analytical thinking and deepen their conceptual clarity.

These results are consistent with the perceived educational benefits of Socratic dialogues. Students who are facilitated by AI to conduct Socratic inquiries rather than passively receiving information must articulate their reasoning, encounter

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