IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 13, April 2025
Impact Factor: 7.67

Thinking with Machines: How AI Solves Math Puzzles and What Educators Can Learn

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Abstract: *This paper explores how large language models (LLMs) like ChatGPT can act as "thinking partners" in mathematics education. Using a two-stage, case-study design, we first examine the model's seven attempts to solve a classic age-and-product puzzle, six flawed and one correct, highlighting errors in ambiguity identification, domain constraint enforcement, and the twin-versus-eldest test. We then ask AI to generate and solve its own puzzle using the same logical template. Our analysis shows that LLMs can systematically enumerate cases, apply explicit bounds, and offer expert-style feedback. However, they remain brittle when tasked with inferring unstated constraints or abstracting beyond surface patterns. We argue that, with precise prompts and clear specifications, LLMs can enrich educators' diagnostic and design practices by providing transparent reasoning steps, even as the relational and cultural dimensions of teaching remain uniquely human.*

Keywords: Large language models; Mathematical reasoning; Logic puzzles; AI in education

DOI: 10.48175/IJARSCT-26055