Title

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Abstract

Large language models (LLMs) demonstrate knowledge and linguistic capabilities, yet they are limited as educational tools because they cannot apply pedagogical strategies grounded in cognitive science. To address this gap, we propose Teaching Strategy Migration via Instance-based Training (TSMIT), a framework for instilling cognitive science theories-based pedagogical intelligence into LLMs. The TSMIT framework operationalizes cognitive principles of effective teaching by migrating them into a LLM through instance-based fine-tuning. We first conducted an empirical study with 150 university students to identify and rank preferred learning cognitive principles. We then curated a dataset of dialogues that encode these strategies into conversational examples. By fine-tuning GPT-3.5 Turbo on this dataset, we developed TSMIT's AI tutor model. NLP metrics evaluations, along with 500 LLM-as-judge and human evaluations, revealed that TSMIT outperformed its base model in key pedagogical dimensions. TSMIT offers a robust and replicable methodology for transforming general LLMs into specialized, cognitively-aligned educational tools.

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