

# **Agent4Edu:** Generating Learner Response Data by Generative Agents for Intelligent Education Systems





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## The first exploration of simulating human learning with LLMs













Collecting real response data from learners

Training a simulator Generating new response data

**Educational** Applications

Personalized

Learning

Existing methods rely on real response data, limiting zero-shot simulation in cold-start scenarios

Existing methods lack explainability and reliability, as they only generate response results (i.e., the answer correctness), not the problem-solving process

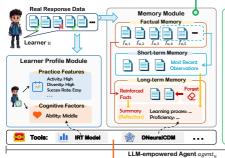
Action Module

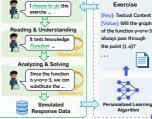
Cognitive-driven Action

### Our Solution: Agent4Edu

#### A personalized learning simulator powered by LLMs

Explainability: Detailed simulation of human behaviors in understanding, analyzing, and answering exercises, as well as the implicit cognitive mechanisms of learning and forgetting





Reliability: Accurate capture of learning abilities using LLMs (e.g., GPT-4) and human ability measurement tools, where LLMs improve generalizability for zero-shot simulations

Interactivity: Interaction with personalized learning environments

# Experiments

Model			ROUGE-3↑
KES	50.11	58.32	25.77
DKVMN	64.39	76.70	37.24
EERNN	65.72	76.06	43.55
SAKT	65.52	78.33	31.09
DAISIM	65.63	78.25	31.72
Agent4Edu (GPT-3.5-turbo)	66.70	79.84	<u>37.97</u>
Agent4Edu (GPT-3.5-turbo) <sub>100</sub>	65.40	78.72	35.14
Agent4Edu (GPT-4)100	66.51	79.53	34.86

#### **Accurate Question-Answering Response Simulation**



Simulated Data Distribution by Agent4Edu Similar to Real Data (Ground-truth)



**Zero-shot Simulation** vs. Human

FSI 80.11 82.39 +2.	_	5			
	p.	Imp.	F1-score+	F1-score	Model
VII 70.45 01.04 12	28	+2.28	82.39	80.11	FSI
KLI /9.43 01.04 +2	39	+2.39	81.84	79.45	KLI
MAAT 81.77 81.97 +0.	20	+0.20	81.97	81.77	MAAT

**Enhancing Personalized** Learning Algorithms



We have developed a website for interactive learner simulation, integrated with Agent4Edu.

Conclusion: Agent4Edu can simulate human learning reliably, explainably, and interactively

Weibo Gao is currently on the job market in the research area of LLM-based Agent and User Modeling. Please contact him if you are interested. Email: weibogao@mail.ustc.edu.cn X: @webbobpaco WeChat: gaoweibo1997

Ground-truth



