Human-Pedagogy Inspired LLM Fine-Tuning Paradigm for Lifelong Learning and Continual Adaptation

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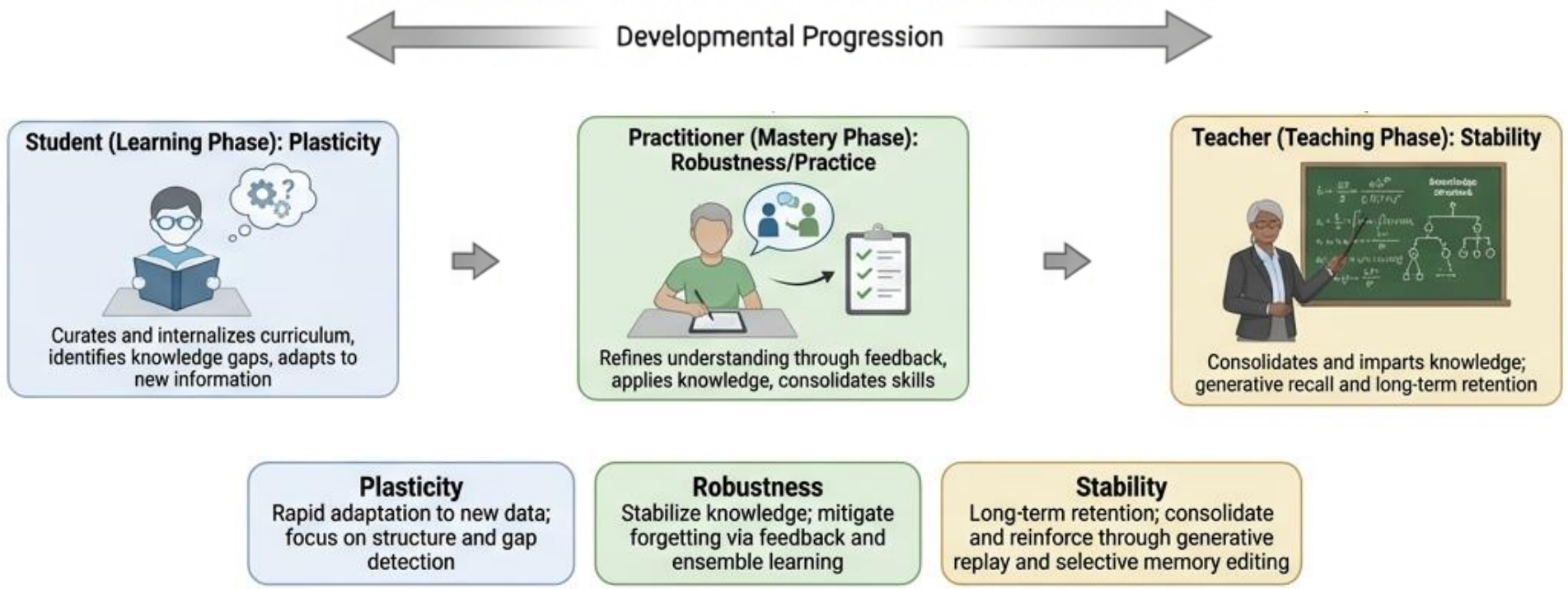
Streaming Continual Learning 2026

SOLUTION ?

"If we wish AI to continually learn and adapt to new domains seamlessly like humans, then they must learn and be taught to adapt the same way as humans do"



Kargupta, Priyanka, et al. "Cognitive foundations for reasoning and their manifestation in llms." *arXiv preprint arXiv:2511.16660* (2025).

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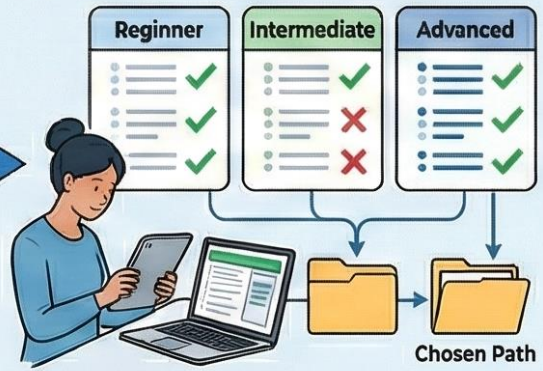
Learn-Master-Teach Tuning (LMT^2)

PHASE 1: LEARNING (THE STUDENT)

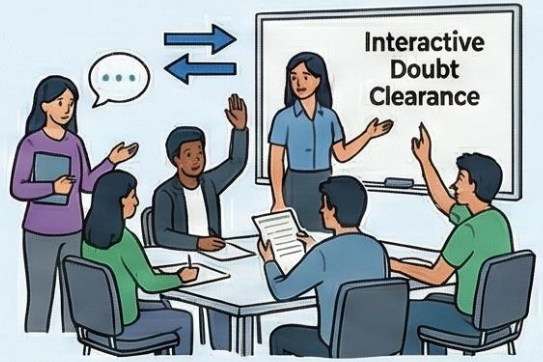
1 Knowledge Gap Assessment

2 Teaching Material Curation



3 Learning from Teacher

4 Interactive Concept Refinement



PHASE 2: MASTERY (THE PRACTITIONER)

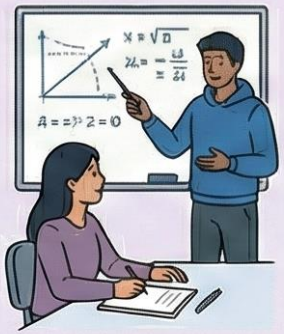
5 Feedback-Driven Practice

6 Multi-Teacher Knowledge Distillation

7 Post-Instructional Reflection

PHASE 3: TEACHING (THE TEACHER)

9 Learning by Teaching



10 Socratic Style Mentoring

11 Lifelong Learning

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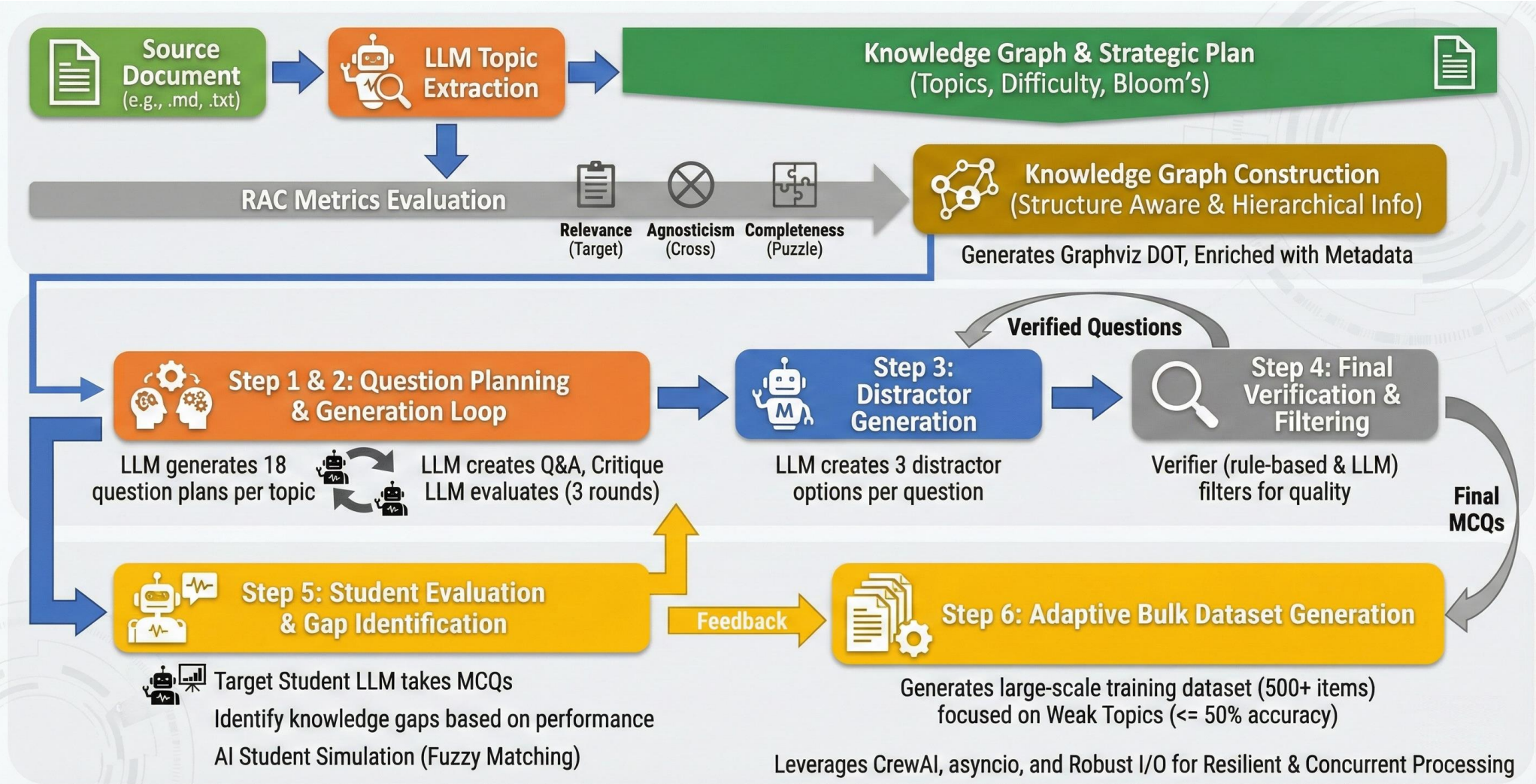
Student Phase I : Learning



Stage 1. Knowledge Gap Assessment (SciQAG, LEPA, MCQG-SRefine, StructTuning, KaFT)

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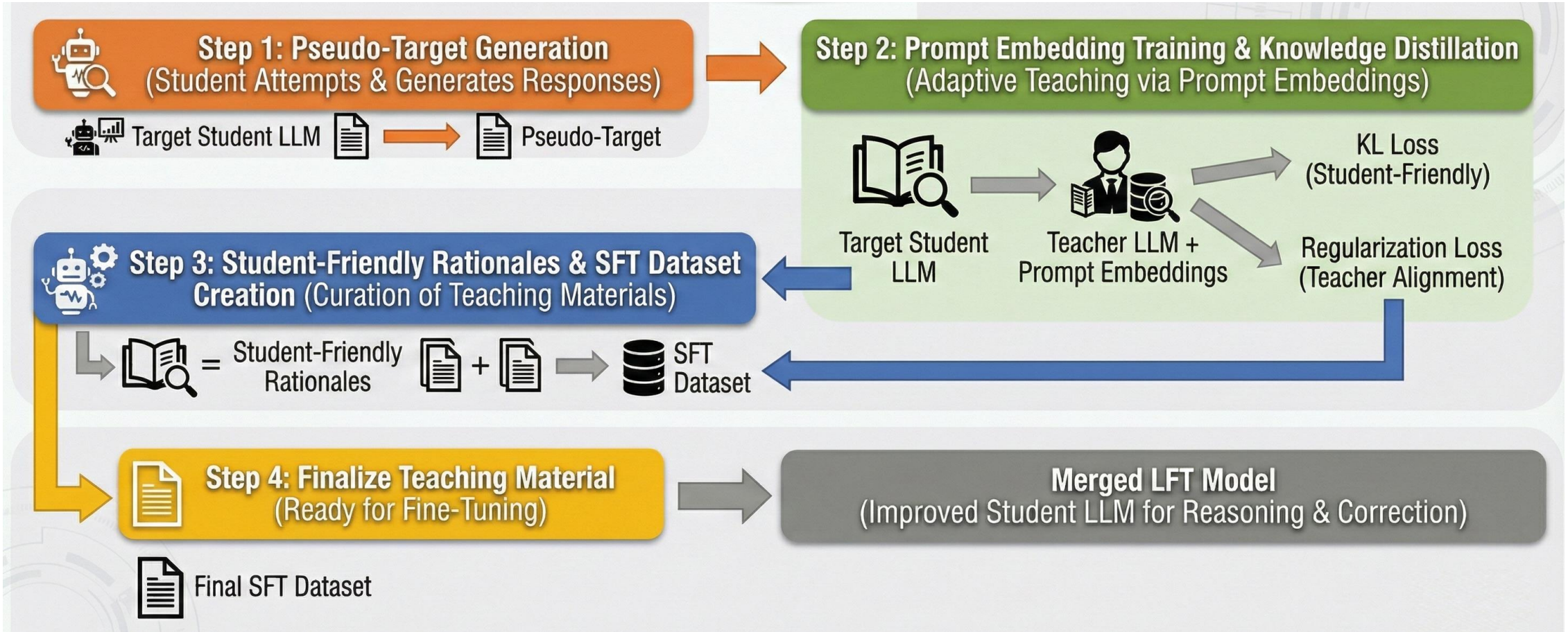
Student Phase I : Learning



Stage 2. Learning from Teacher (PromptKD, PromptDistillation, DA-KD)

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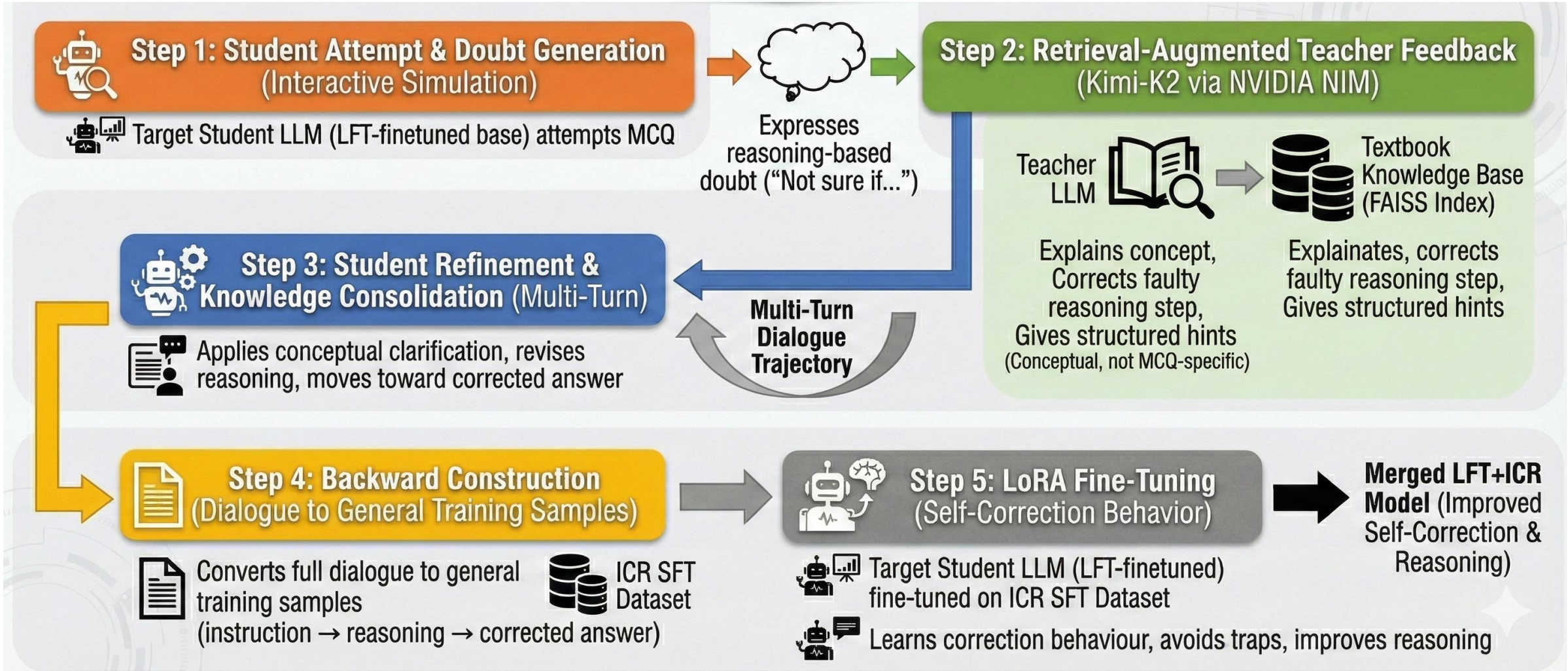
Student Phase I : Learning



Stage 3. Interactive Concept Refinement (INTERACT, Learn-by-interact)

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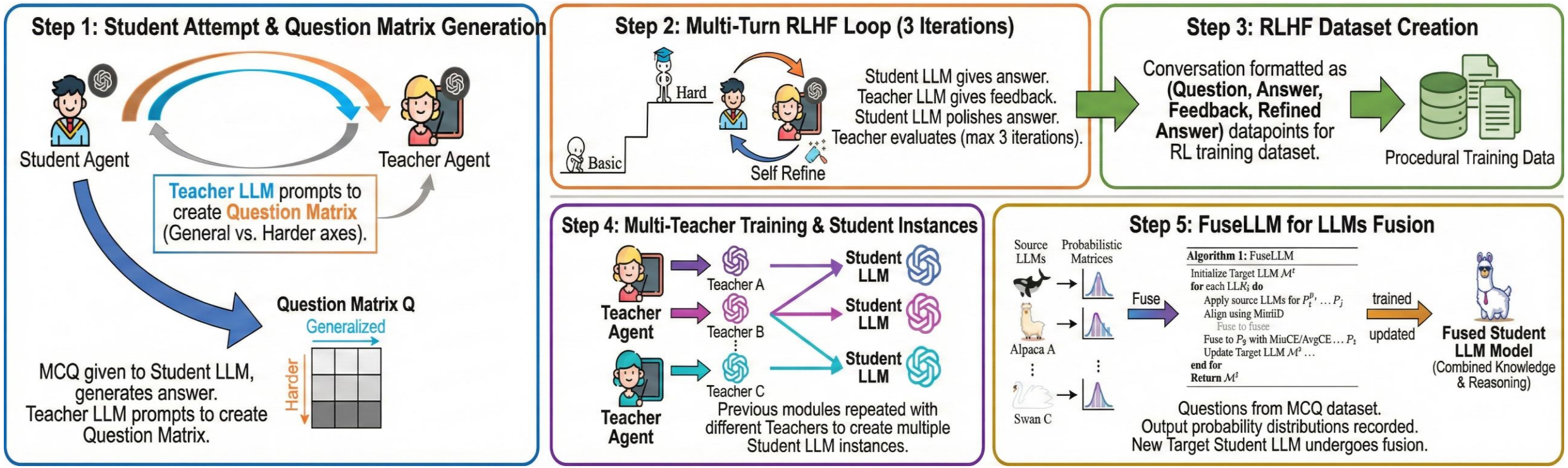
Practitioner Phase II : Mastery



Stage 1. Feedback Driven Practice (YODA, NutePrune)

Stage 2. Multi-Teacher Knowledge Distillation (FuseLLM)

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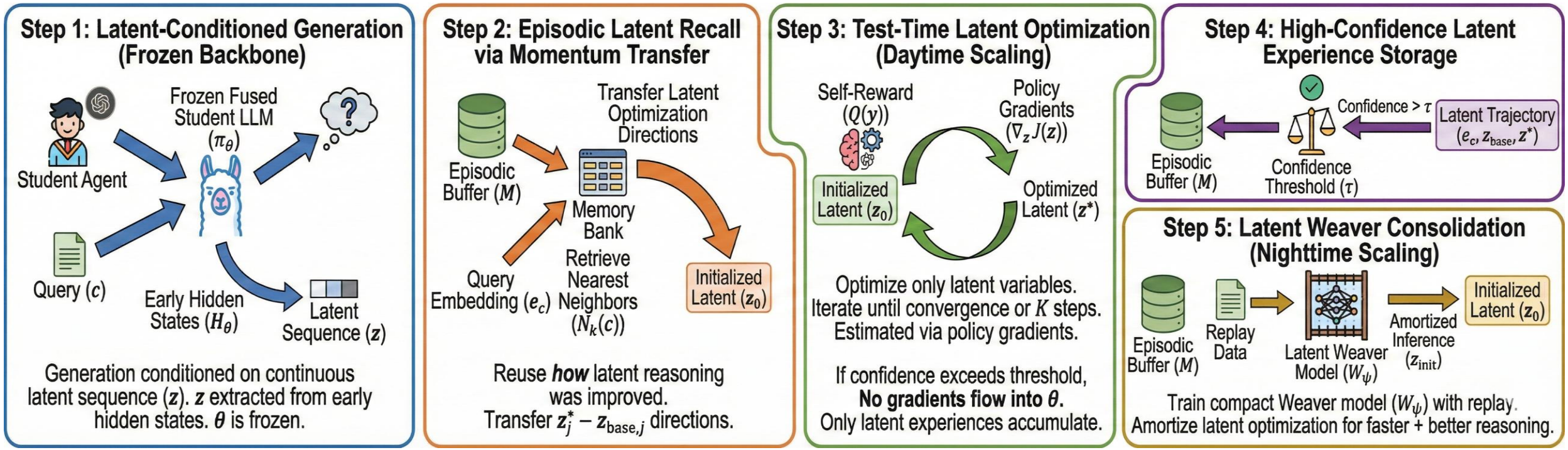
Practitioner Phase II : Mastery



Stage 3. Post-Instructional Reflection (LatentEvolve, ReflectEvo, EQT)

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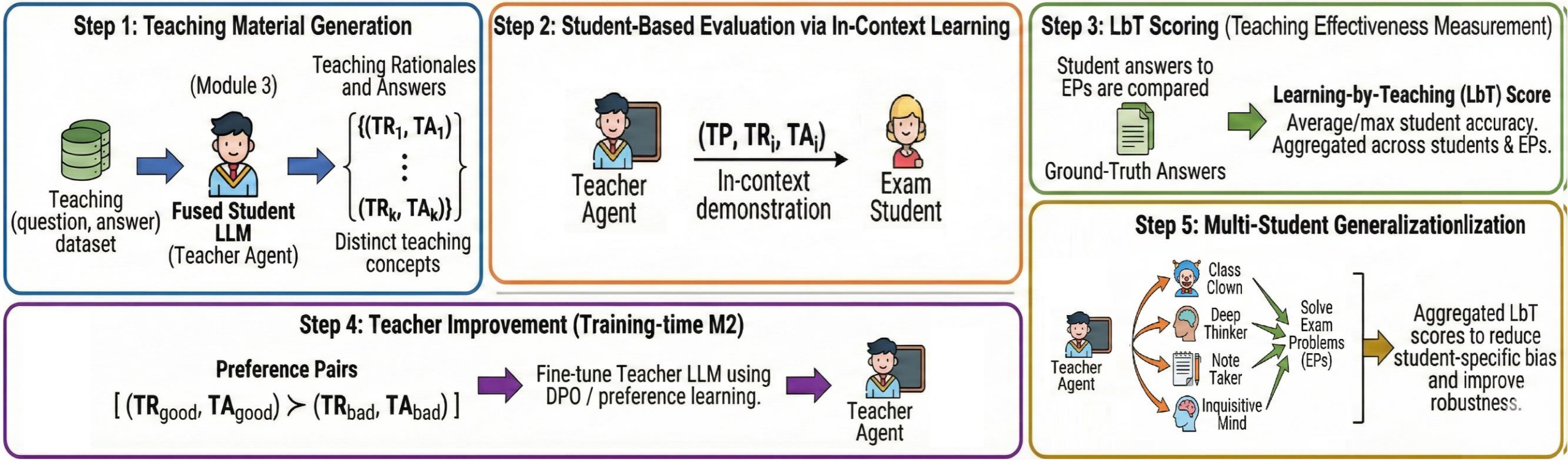
Phase III : Teaching



T – Teaching
P – Problem
R – Rationale
A – Answer

Stage 1. Learning by Teaching (LbT, SimClass, EducationQ)

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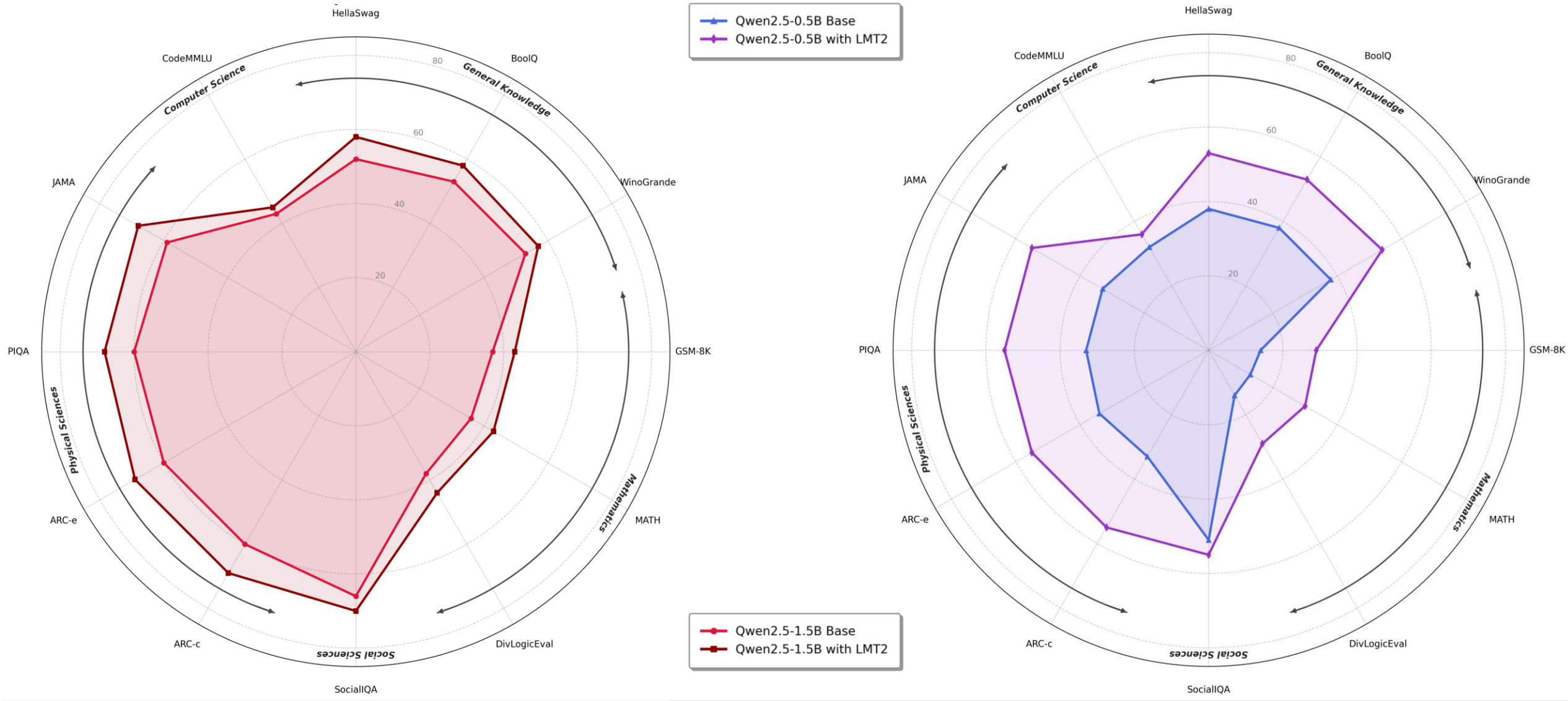
Results


Qwen2.5-0.5B Base
Qwen2.5-0.5B with LMT2
Qwen2.5-1.5B Base
Qwen2.5-1.5B with LMT2
HellaSwag
BoolQ
WinoGrande
GSM-8K
MATH
DivLogicEval
SocialIQA
ARC-c
ARC-e
PIQA
JAMA
CodeMMLU
General Knowledge
Mathematics
Social Sciences
Physical Sciences
Computer Science
20
40
60
80

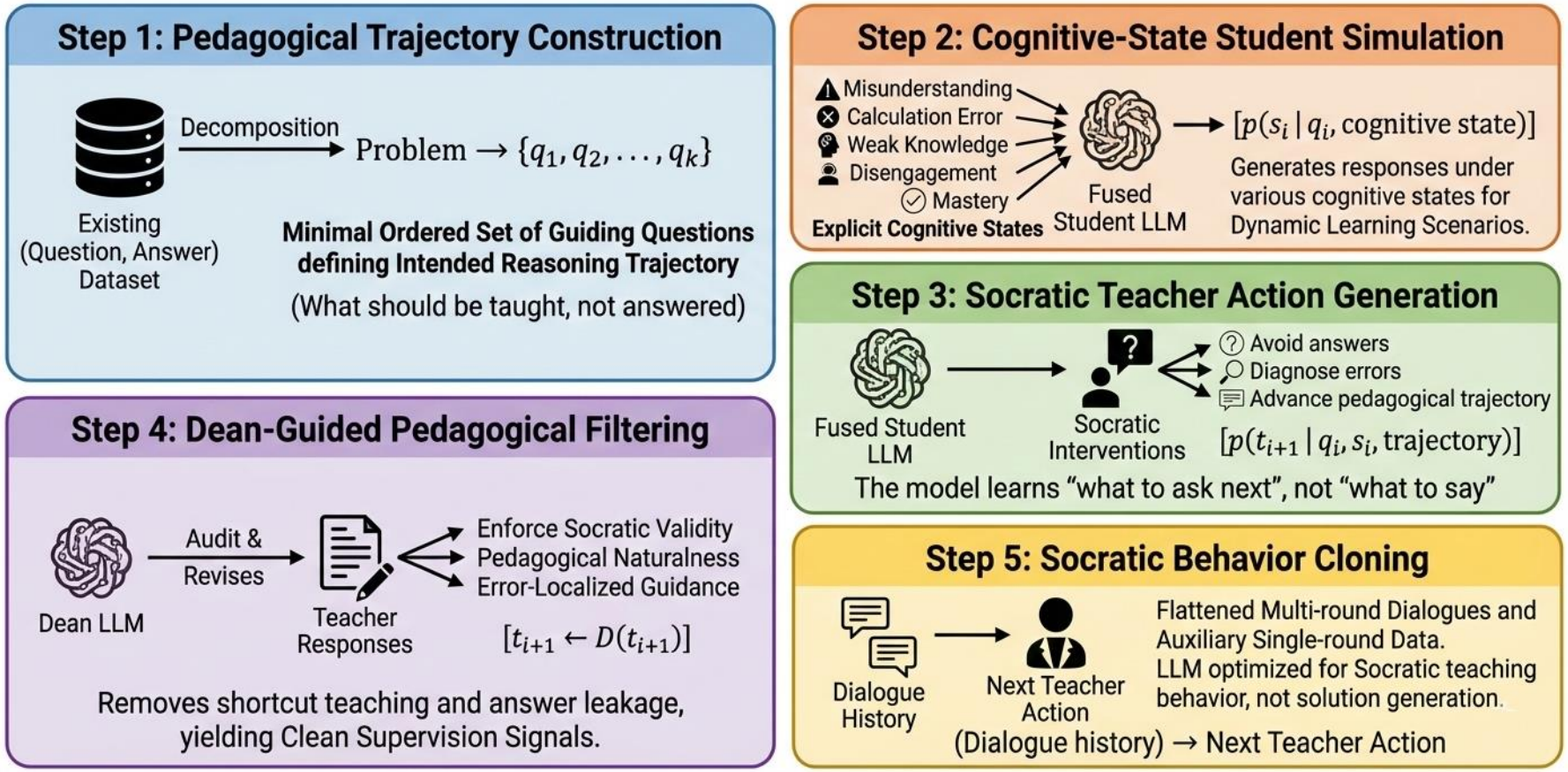
Future Directions

Personalized AI Educational Tutors :
In Phase III Teaching, after Learning by Teaching, we add a

(a) **Socratic Style Mentoring** to turn our now, Teacher LLM into a Mentor, capable of guiding students adaptively

(b) **Lifelong Learning –** When new information comes, we use knowledge updating or editing to account for it (*research labs*)

(c) **Hallucination Detection and Mitigation**



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THANK YOU

Any Questions ?

View the paper here and connect

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