

Personalized Robot Tutoring using the Assistive Tutor POMDP (AT-POMDP)

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Assistive Tutor POMDP (AT-POMDP)

We formulate the robot tutor action selection problem as a POMDP called the Assistive Tutor POMDP (AT-POMDP). The state space has 3 dimensions: knowledge level, engagement level, and attempt number. There are 6 tutoring help actions, the 5 tutoring actions shown below and no-action. The observation consists of the attempt correctness and the attempt speed. The transition and observation models are shown to the right.

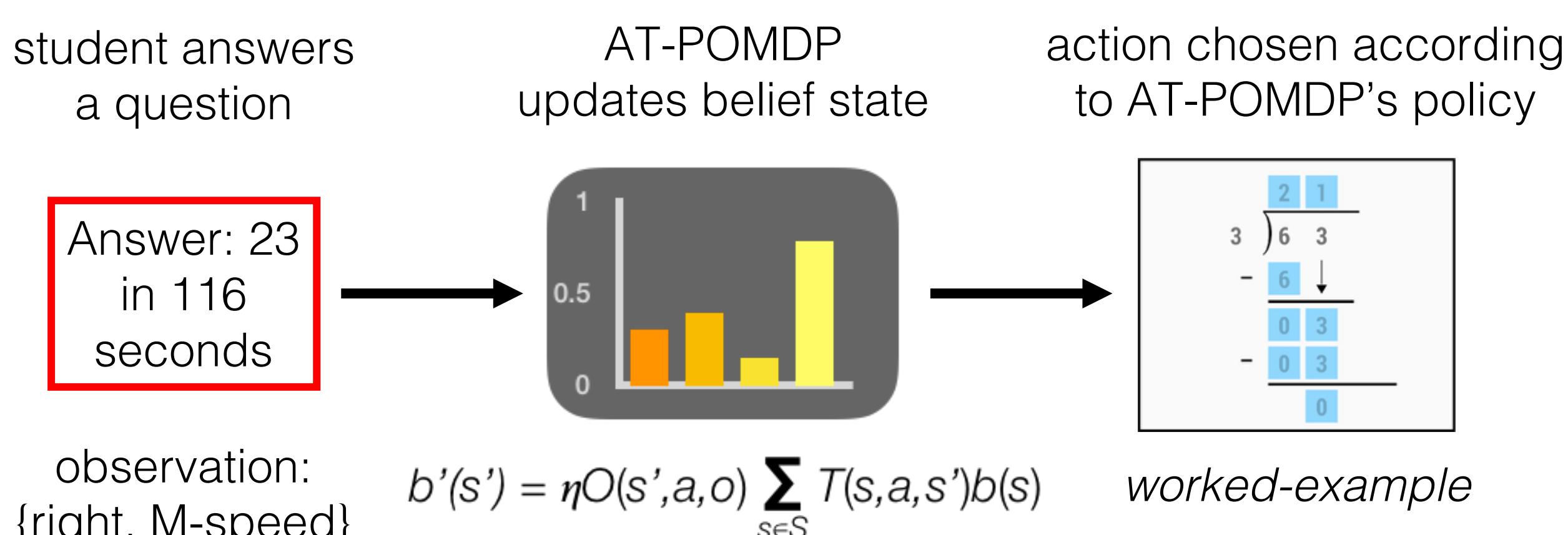
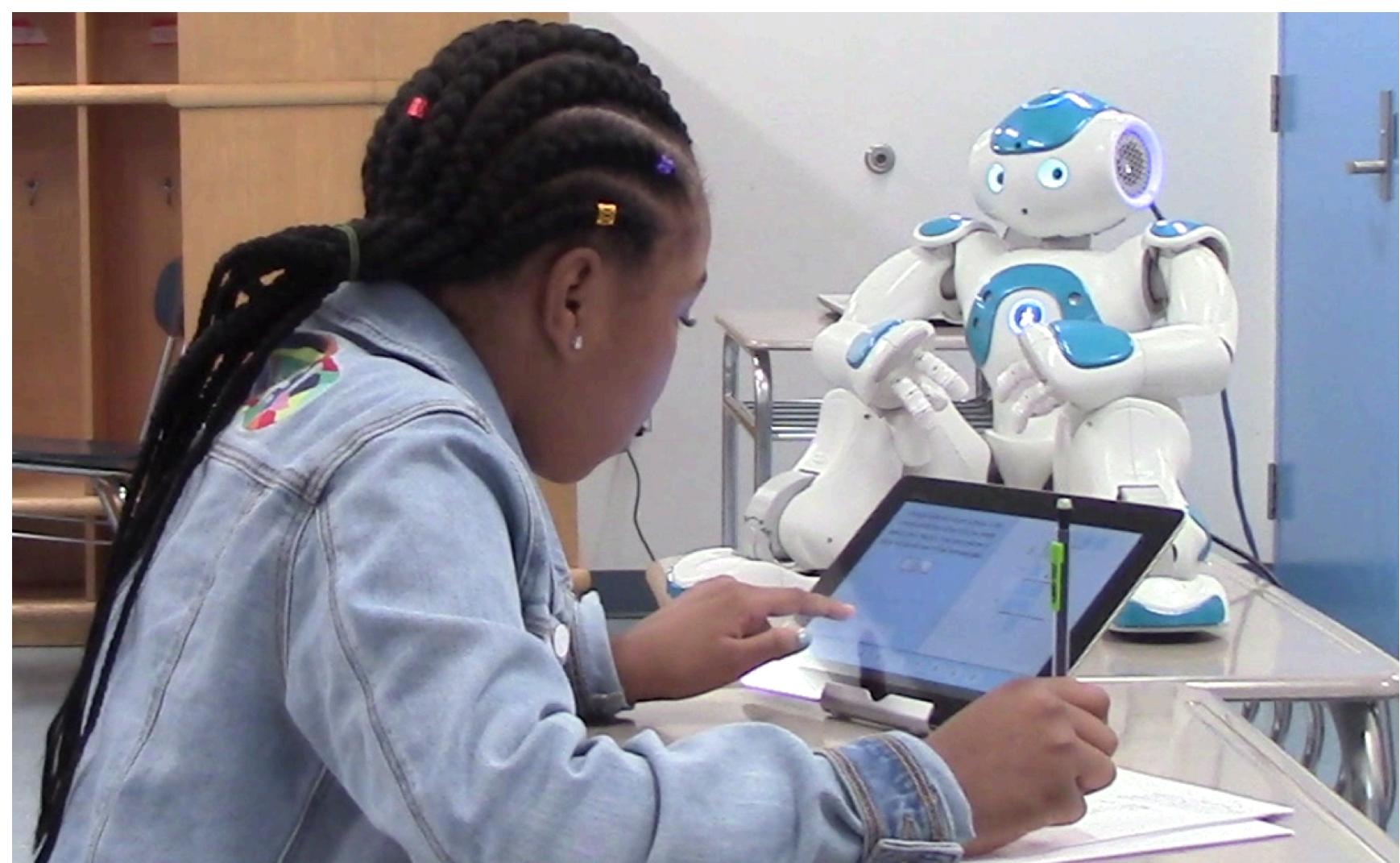
Transition Model:

$T(s, a, s') \equiv \Pr(s' | a, s) \equiv c_{action} \cdot \Pr(s_e' | a, s) \cdot \Pr(s_a' | a, s)$
 where s_k represents the knowledge, s_e represents the engagement, and s_a represents the attempt state components.

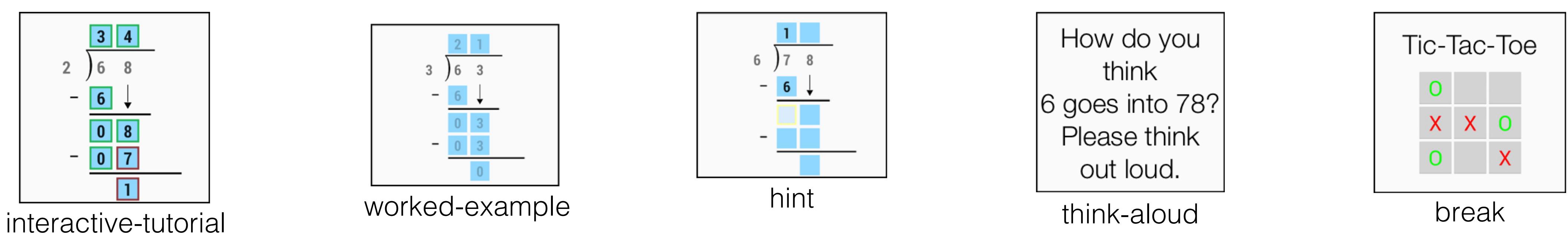
Observation Model:

$O(a, s', o) \equiv \Pr(o | a, s') \equiv \Pr(o_{acc} | a, s') \cdot \Pr(o_{speed} | a, s')$
 where o_{acc} represents the accuracy and o_{speed} represents the speed components of the observation.

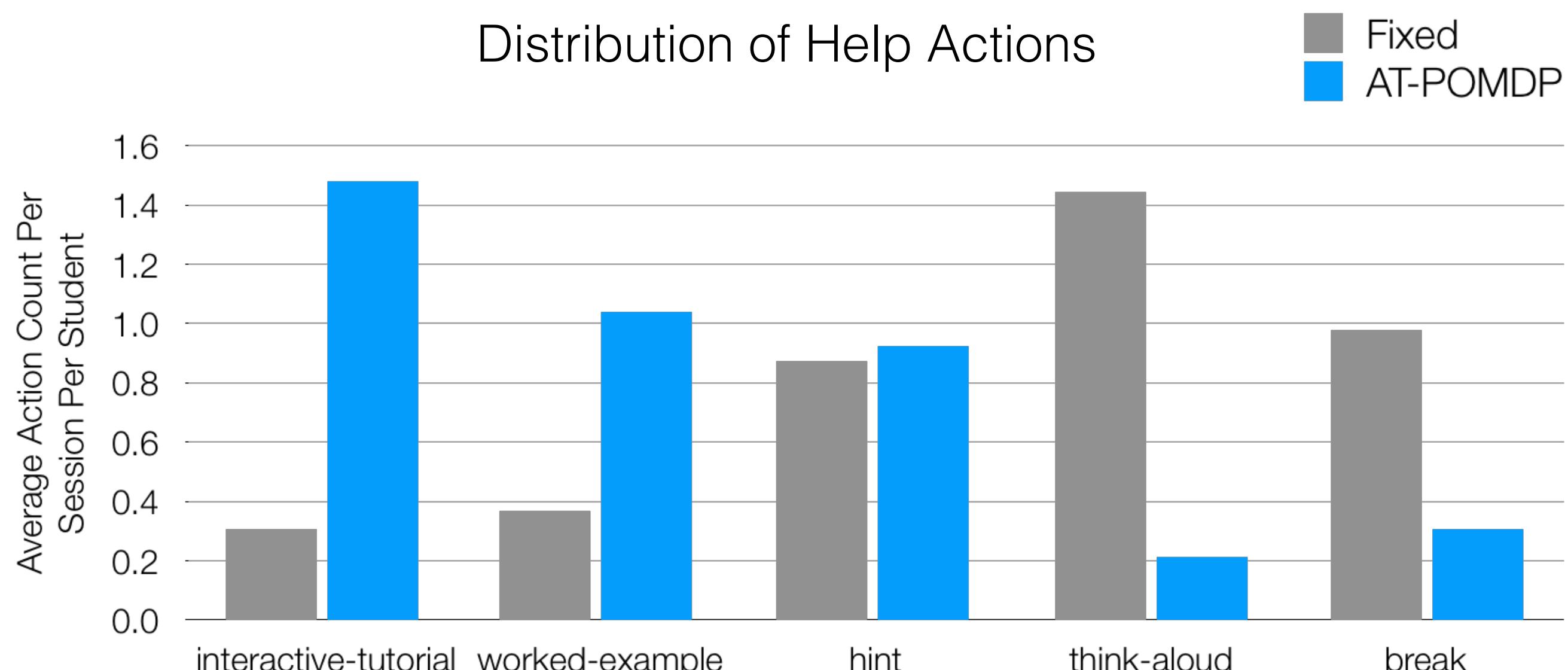
Robot Tutoring System



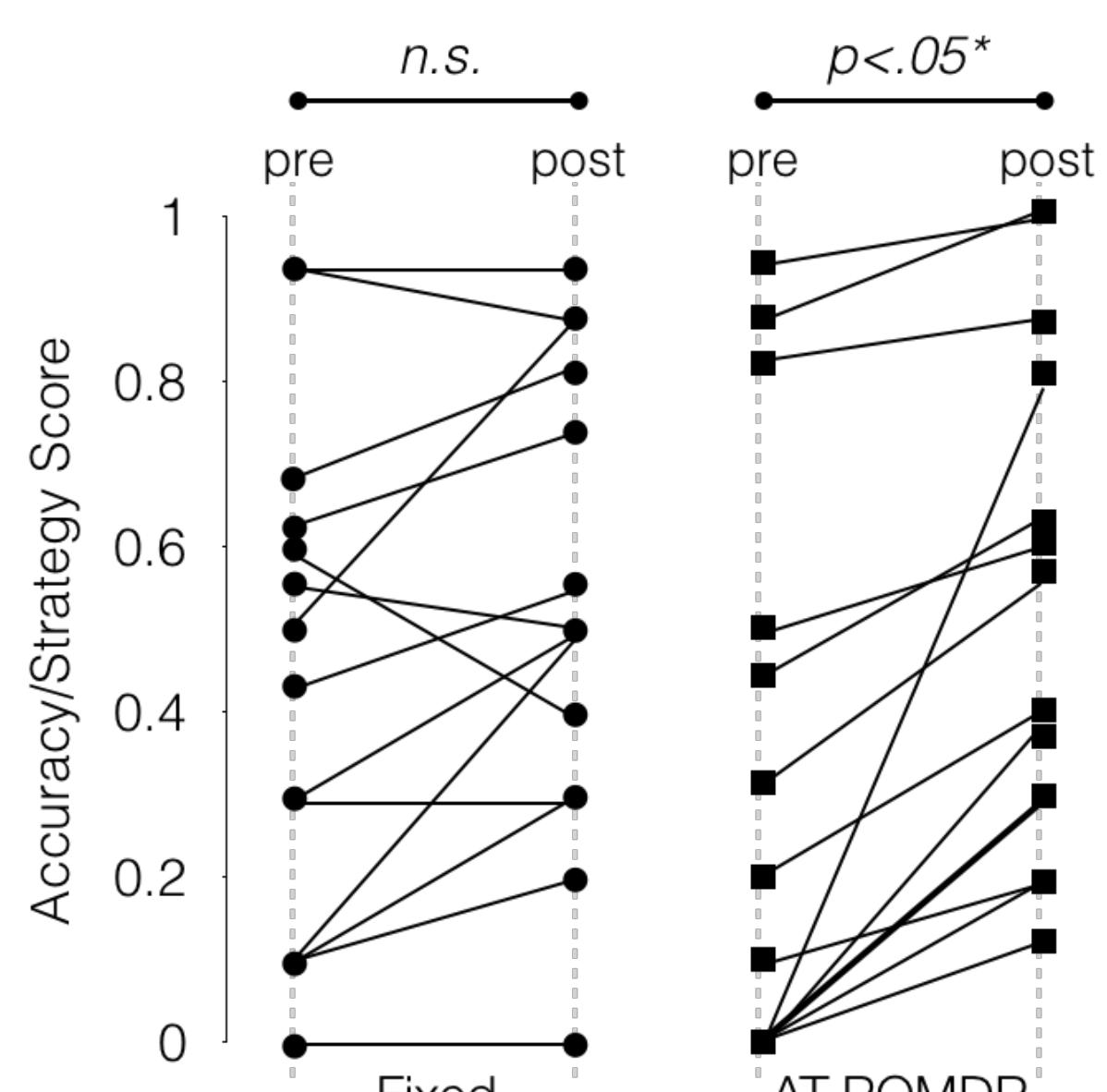
Help Actions



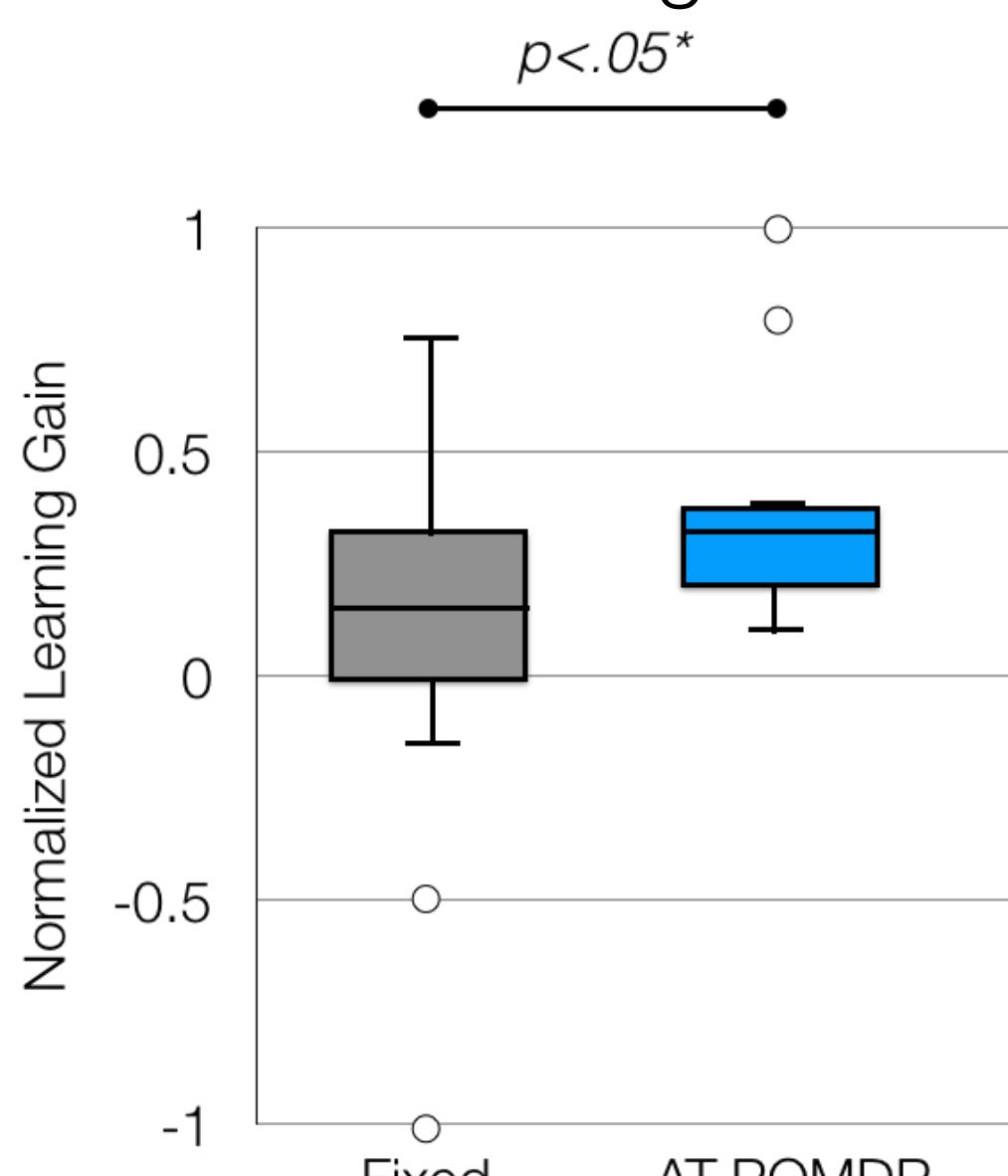
Results



Pre-Test to Post-Test Scores



Learning Gains



Case Studies

P11 was a high performer. AT-POMDP selected a majority of no-action help actions. She answered the next attempt correctly 3 out of 4 times this occurred.



P25 was a low performer. AT-POMDP selected mainly interactive-tutorials and worked-examples. She improved her long division strategy use on the posttest.



P12 was frequently disengaged and distracted. AT-POMDP selected 5 breaks over the 5 sessions. His accuracy on the next attempt was higher than his overall attempt accuracy.

