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AI for Adaptive Tutoring and Transfer Student Success

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Recent education-related policies enacted in California, such as AB 1187, which expands access to tutoring at community colleges, and AB 1705, which effectively eliminates remedial English and math classes, may increase demand for college-level tutoring in our state. However, no open-source adaptive tutoring system has been developed for use in higher education. Open Adaptive Tutor (OATutor) is the first open-source adaptive tutoring system that applies artificial intelligence to tutoring in higher education. This policy brief explores OATutor's development process, as well as other applications of AI in higher education for course articulation and transfer planning across institutions.

Introducing OATutor

OATutor (1) operates based on the principles of **Intelligent Tutoring Systems** (2), which include representing student competence as a production set, communicating goals and providing instruction in the context of problem solving, promoting an abstract knowledge of problem solving, and facilitating successive approximations to the intended skill to be learned. OATutor's current library of curated content features 31 chapters and 199 lessons of college algebra courses, with additional content from statistics and physics courses currently in development.

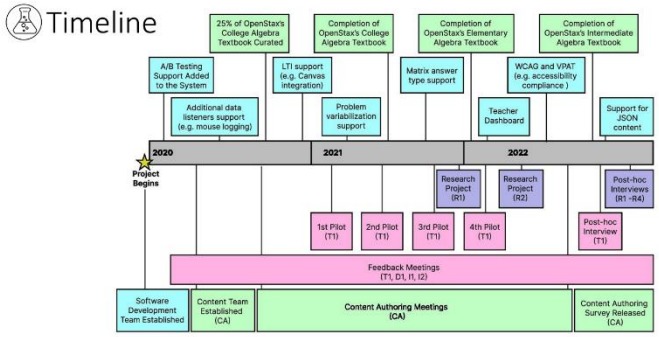

Figure 1: OATutor Research and Development Timeline

Research, Data, and Development

Figure 1 provides an overview of the development timeline for OATutor. Data collection on the use of AI for adaptive tutoring has been a central part of designing and developing the program. To that end, the software research team has worked closely with OATutor's undergraduate content creators, as well as professors who have participated in **four pilots over seven course offerings** by implementing the software in their classrooms. The research team uses several methods to collect student and teacher feedback, including **surveys** and **semi-structured interviews with additional follow up.**

Researchers also use learning analytics from the software itself to provide data-driven insights about how well OATutor helps students achieve given learning objectives. **Table 1** displays **gains in student learning** for learning objectives across two elementary and intermediate algebra topics (3).

Textbook Level	Condition	N	Avg. Time	Hints Requested	Learning Gain	Avg. Pre-test	Avg. Post-test
Elementary	Control	19	08:16	132	24.63%	59.68%	84.32%
Intermediate	Control	17	12:53	150	23.65%	50.94%	74.59%

Table 1: OATutor learning gain results based on 77 crowdsourced learners

AI for Course Articulation and Transfer Planning

Course articulation in higher education refers to identifying which courses at a given institution are academically equivalent to those at another college or university. Course articulation is especially important for transfer students, who must satisfy course requirements at a community college (or other institution) to transfer to their target university. It is also relevant in the larger California policy context, as the state legislature has recently undertaken efforts to better streamline the course articulation process. **AB 1111** requires the creation of a common course numbering system across California's community colleges and **AB 928** requires CSUs and UCs to agree on a set of shared general education requirements.

The sheer number of possible course combinations between California community colleges, UCs, and CSUs make comprehensive course articulation virtually impossible to establish and maintain purely by hand. However, **AI course articulation** may be beneficial to accomplishing these objectives (4). AI systems, such as the **Equivalency Engine** program, developed by Pardos's lab, can be trained to do this by corroborating information from students' course enrollment histories, which helps identify which courses across institutions may be equivalent to one another (5).

Algorithmic aversion suggests that human decisionmakers may often discount algorithmic recommendations more heavily than similar recommendations made by humans. However, campus advisors at UC Berkeley generally viewed pilot trials of AI for transfer planning and major recommendations favorably (6). This is a promising sign for AI-assisted course articulation and planning initiatives going forward.

The Importance of Human-AI Collaboration in Education

As in other educational contexts, the use of AI in OATutor is primed to efficiently personalize content based on individual student needs. It is also well-equipped to support student and administrator decision-making, such as in scenarios related to course articulation and planning for transfer students. However, it is important to note that OATutor is not intended to take the place of human educators, including teachers, tutors, and graduate TAs. Going forward, **there is both human desire and empirical justification for the necessity of human-AI collaboration,** rather than full automation of teaching and tutoring systems.