



## ALeA: Advancing Personalized Learning with Adaptive Assistance and Semantic Annotation

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The Adaptive Learning Assistant (ALeA) [Be23] is designed to address the needs of an increasingly diverse student population by providing personalized learning resources. Learning Objects (LOs) in ALeA are semantically annotated following the Y-model framework [Lo23], focusing on key questions such as: What concepts does the LO cover? In which cognitive dimension must these concepts be mastered? And what is the intended learning objective? Learner interactions with these LOs generate data that can be used to update the learner model, simulating progress. A didactic model utilizes articulation schemata to make rule-based decisions on the selection and timing of LOs, ensuring a transparent, traceable, and deterministic system.

### Implications for Learners

- *Guided tours:* Learners can create personalized mini-courses, focusing on mastering specific concepts within a targeted cognitive dimension. ALeA presents prerequisite definitions learners need to understand—excluding those already mastered—leading to the concept to be learned.
- *Flashcards:* LOs can be transformed into flashcards. Using the learner model, ALeA dynamically adjusts flashcard frequency, showing them only to learners who have a firm grasp of the required concepts.
- *Quizzes:* A variety of question types, including multiple-choice and fill-in-the-blank, can be organized into tests. These quizzes assess learners' understanding and provide real-time feedback to teachers. Quizzes also prime the learner model, tailoring future activities to individual needs.
- *Collaborative Learning Spaces:* ALeA offers forums where learners can discuss material, ask questions, and receive responses from peers, moderators, or instructors. A matchmaking system helps learners form study groups based on shared preferences and learner model data, promoting collaboration.

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## Implications for Educators

- *Enhanced Instructional Strategies:* ALeA automates routine administrative tasks, allowing educators to focus on higher-impact teaching activities such as discussions and personalized support.
- *Data-Driven Insights:* Dashboards offer instructors a clear overview of class performance, helping to identify areas that need additional focus and enabling more effective instruction.
- *Scalable Solutions:* ALeA adapts to various educational environments, from K-12 to higher education.

**Conclusion and Future Work** Modeling the domain, learner, and didactic behaviors of educators allows ALeA to be versatile and scalable, meeting the needs of both learners and educators while ensuring system actions are traceable. Future developments include integrating programming tasks with automatic feedback, expanding to fields beyond computer science, and enhancing exam preparation with flexible drill cards and exam-like questions. Additional administrative functionalities, such as dashboards and access management, are also being developed.

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