SQL Valley: Interactive and Self-Directed SQL Learning Through Skill Trees

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Teaching database querying requires students to develop both a conceptual understanding of databases and the practical ability to formulate queries. Traditional teaching materials often present these topics in a fixed sequence, which can make it difficult for students to see how different competencies relate to one another, identify gaps in their understanding, or choose their own learning paths. At the same time, providing sufficient practice opportunities and individualized feedback can be challenging in large courses.

To address these challenges, we developed SQL Valley, an open-source web-based learning environment that combines interactive Skill Trees with automatically graded exercises and immediate feedback. The Skill Tree organizes educational content into two types of modules: concepts, which help students develop intuitive mental models, and skills, which represent practical competencies. Prerequisite relations connect these modules into a navigable structure, making the organization of the course explicitly visible. Students can freely explore this structure, revisit prerequisite knowledge, and monitor their progress as they complete modules.

Each skill is accompanied by interactive exercises with randomized parameters. Students can formulate SQL queries, immediately inspect their results on an in-browser database, and submit their answers for automated grading. Incorrect submissions receive targeted feedback to help students identify mistakes and improve their solutions. The application also provides theory and summary pages, while an optional planning mode helps students work toward selected learning goals. Beyond SQL, the same Skill Tree framework has been applied to relational algebra and Datalog, using static exercises where interactive execution is not available.

SQL Valley was deployed in two undergraduate database courses at Eindhoven University of Technology, involving approximately 600 students. An exploratory evaluation involving 13 student interviews and a survey with 30 respondents indicated positive student experiences. Participants particularly valued the visible course structure, interactive exercises, and progress tracking. Students reported improved study motivation and described using the Skill Tree to identify gaps in their understanding and navigate prerequisite knowledge.

The presentation will demonstrate SQL Valley's main features and discuss experiences from its deployment. Database educators can integrate SQL Valley into their own courses, selecting the modules and exercises relevant to their teaching. For other subjects, the reusable Skill Tree visualization, available as an NPM package, provides a foundation for developing similar learning environments.