

Mastery Grids for SQL

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Mastery Grids for SQL is a practice system for SQL programming that offers students a personalized access to several kinds of smart learning content and allows them to monitor their learning progress and knowledge in comparison with pairs or groups, and allows teachers to create such smart learning contents with our authoring tools and design a course curriculum with desired topics and matching learning materials. Our past research has successfully deployed Mastery Grids in various learning domains (Java, Python, SQL) in different universities. SQL programming language is one of the already-covered learning domains in Mastery Grids. The SQL programming course in Mastery Grids has been used for undergraduate and graduate level course since 2013. Although the course material covers an extensive range of SQL programming topics, it can be extended using the authoring tools that come along with Mastery Grids. Our research shows that Mastery Grids effectively increases learners' performance, motivation, engagement and retention.

❑ Mastery Grids Interface Features

- ❑ **Knowledge and Progress Visualization:** Presenting student learning progress and knowledge by colored grids from four perspectives as shown in Figure 1: students' perspectives ("Me" or "Group") and comparison perspectives.
- ❑ **Social Comparison:** Implemented by "Me vs Group" and "Me vs other learners" in the visualization in various granularities including by topics or by learning content type (Figure 1, Figure 2).
- ❑ **Adaptive Navigation Support:** Recommendation of learning resources are provided based on student activities and learner knowledge in a centralized user modeling server. (see red stars in Figure 1)



Figure 1: Mastery Grids' knowledge and progress visualization of Me, Me vs Group, Group, other learners embedding open learner model of oneself and social comparisons of a student with the group or other learners.

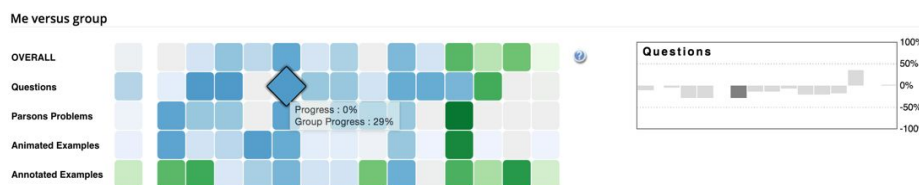


Figure 2: Mastery Grids' social comparison by learning content (resource) type.

SQL Learning Smart Content and Flexible Course Design

Mastery Grids provides multiple types of interactive, smart learning contents including parameterized SQL quizzes, and annotated examples. Learning material in SQL course are organized in topics. Topics are aligned in accordance with learning timeline as is represented in Figure 1.

❑ **SQL Problems:** Students are asked to write a complete query to achieve a task in each problem. Tables and attributes are provided to allow students to explore. (Left figure)

❑ **Annotated Examples:** Short snippets of code with explanation of key lines in them. (Right figure)

Task:

Find the first names that both an actor and a customer use.

Enter your answer here.

Submit Answer
Go to SQL-Lab

Table Name	Schema & Sample Data (click +/- to show/hide sample data)
accident(+)	report_number date location
actor(+)	actor_id first_name last_name last_update
address(+)	address_id address district city_id postal_code phone last_update

Topic: Derived Relations and Views • Activity: Derived Relations

```
SELECT branch_name, avg_balance
FROM
(SELECT branch_name, AVG(balance)
FROM account
GROUP BY branch_name)
AS branch_avg(branch_name, avg_balance)
WHERE avg_balance > 1200;
```

The derived subquery and the two columns are renamed using tuple variables, AS. Hence, the whole subquery is 'branch_avg', the first column is 'branch_name' and the second column is 'avg_balance'.

❑ **Animated Examples:** Code examples that include graphics representing the variables and output screen. The student can run line by line and observe outputs in an animated fashion.

Topic: Group - By and Having Activity: Grouping and Aggregating (1)

```
1 SELECT b.bid,COUNT(*) AS account
   FROM boats B, reserves R
2 WHERE R.bid = B.bid AND b.color = red
3 GROUP BY B.bid;
```

Stack Frame
This condition tests two parts. Firstly, it tests whether the boats have been reserved by match the boat's bid with the bid in the 'reserves'. Secondly, the boat's color is limited to red.

Table: boats	Alias: B	Table: reserves	Alias: R
bid	color	bid	date
✓ 101	✓ Red	✓ 101	03.20.2016
✓ 102	✓ Red	✓ 102	03.05.2016
✓ 103	✗ Blue	✓ 103	03.10.2016
✗ 104	✗ Green	✗ 106	03.11.2016
✗ 105	✓ Red	✗ 107	03.07.2016

Values were matched.

❑ **Authoring Tools:** We have developed a set of authoring tools enabling the above content creation and a complete course design using these content. Tools include Content Authoring, Course Authoring, Group Authoring and 4) Authoring Portal to access different authoring tools.

Learning Analytics Enabled

Mastery Grids with its architecture provides following major advantages for conducting learning analytics: 1) it allows flexibly experimenting different learner models, recommendation/personalization techniques, 2) its fine-grained logging mechanism for user activities allows for behavior analysis such as sequential pattern mining. 3) it allows easily incorporating new smart content on which one can conduct experiments to study the effect.

Resources and Documentations

Our project website with detailed information can be accessed here bit.ly/OSLM_MG All related code can be downloaded from Github: <https://github.com/PAWSLabUniversityOfPittsburgh>, <https://github.com/acos-server/>.