

The use of computer aided teaching for problem solving in SQL.

John Peppiatt

Manukau Institute of Technology,
Auckland, New Zealand
john.peppiatt@manukau.ac.nz

In July 2003, MIT introduced a new paper into their BIS degree programme that introduced the SQL-DML to students along with the principles of HTML and XML. The paper was delivered from a programming perspective and emphasis was given to interpreting a business based question and extracting the appropriate data. To facilitate this, a teaching tool (computer application) was developed for creating exercises to provide immediate feedback to students when used in a tutorial or at home. The tool is also capable of being used to assess students in exam conditions and was applied for this purpose

1. INTRODUCTION

In 2003, my colleagues and I set out to design a new degree paper called Data Management Technology. Amongst the learning objectives is the development of knowledge of SQL-DML syntax, together with the ability to apply SQL to extract the correct information from a database given a statement of the requirement. The department has delivered courses involving SQL over many years but it has been evident that, although the grammar of SQL is not that difficult, students often find it very difficult to apply SQL techniques to solve real-world type problems. To address the issue the natural response from the teachers is to say that students simply need to practice and gain experience. We came to the same conclusion and decided that we needed an environment that gave the opportunity to practice and get informative feedback.

As very busy teachers, we also wanted to create a reusable set of teaching resources and to be able to assess our students' competence in a controlled and efficient manner. The initiative we ended up following was to develop an SQL exerciser program – a decision that was strongly influenced by the fact that the teaching team involved programmers.

This exerciser has now been used for two semesters of students (40 – 50) and this paper briefly describes the features of the exerciser and then reflects on the anecdotal experiences of the staff who have been involved.

2. The Features of the SQL Exerciser

- The SQL Tester utility was developed in VB.NET using ADO.NET technology and is capable of manipulating any OLEDB database.

- The SQL Tester can be used to author a bank of questions. A question involves

- a statement of the requirement
- a model answer
- restrictions on any SQL clauses that may or may not be used
- the marks for a completely correct answer
- deductions for using techniques other than those being targeted

- The bank of questions and answers is stored in a serial file (xml) and is saved in encrypted form for use by the students

- The utility and the question files may be copied and taken home if required

- Connection to a database is made by the student through a standard menu feature

- Students enter their SQL text and this is executed by the utility. The model answer SQL text is also executed, the results compared and the feedback is provided.

- Hints can be provided by the utility analysing the model answer and detailing the keywords involved in the model answer.

- Icons (smiley faces) are used to indicate success or not as is a numeric mark.

- The model SQL text is never seen (unless in the context of review lectures)

- Auto-save and recovery features are included.

- SELECT, INSERT, DELETE and UPDATE statements are all supported through transaction roll-back methods

- Printing features are included.

3. THE EXERCISER IN USE

In any commercial environment, developers have to become familiar with the structure of the corporate database and in keeping with this idea teaching modules (tester exercises) were constructed around a single database. The database selected was that used by the textbook required for this course (Van der Lans, R. F., (2000), **Introduction to SQL**), which is about a tennis club where the results of players tennis matches are recorded, as are their fines and the details of committee members.

Initially, a total of six modules were developed as was a summative test. The modules would include 10 to 20 questions set against an MS-ACCESS implementation of the tennis database. The database was also made available on SQL server.

The questions were graduated to illustrate the use of the concepts being explored in increasingly complex ways. Some SQL would stretch to around ten clauses involving sub-queries and unions.

The students would work on these exercises in supervised tutorials of two hour duration or in their own time (at the institute or at home).

The summative tests were 90 minutes duration, and marking was through a combination of the computer marks and a mark given after a lecturer review of the students' answers.

The segment of the paper on SQL was about 80-90 learning hours (expected) over seven weeks.

4. LECTURER AND STUDENT EXPERIENCE

This information is informal and anecdotal as we have not as yet formally surveyed and analysed the strengths and weaknesses of this approach. The points are:-

- The students are totally engaged in the activity and remain so for the two hour duration of a tutorial

- The students find the exerciser easy to use and become used to it very quickly.

- Mentally agile students do very well, find it challenging and rise to the challenge. There was one 17 year old who with no prior knowledge of SQL except through lectures and textbook reading who finished a module faster than most lecturing staff could do!

- Weak students can slide into 'trial and error' modes and may eventually get a correct answer. These students did poorly in the 90 minute test.

- Students who made use of the course text book to complement their practice reported that the reading and the exercises went well together.

- The summative assessment gave a good spread of marks – good for grading. The first summative test was regarded as hard (our most gifted only achieving 80%). The difficulty level on the second test was adjusted and the results were in accordance with our 'feel' for the group.

- The vast majority of students reported that the tool provided a fair assessment mechanism.

The teaching staff agreed on a number of points

- Students entering extensive trial and error modes need to be detected and counselled to formulate strategies and devise layered test strategies. It would be nice to build in some detection algorithm into the tool

- Shadow modules need to be available containing repetitions of questions requiring same style answers for some weaker students

- Students should be encouraged to buy and use the text book (even resistant students reported positive outcomes when they did)

- The strategy is better than others we have tried. Like all strategies, some students may benefit by exposing them to alternative approaches.

■ The resource is very re-usable and if the shelf life of the paper is six or seven deliveries the investment in time was worth it.

■ The manual review of summative tests is still valuable but as far as a summative mark is concerned it is more likely to be relevant for weaker students.

5. CONCLUSION

The overall exercise was in part a programming project using the technology covered in the paper, which includes VB,.NET,ADO.NET. HTML, XML as well as SQL. It's prime objective was to provide a rich and relevant learning experience for the students. Formal course evaluations indicate that the course as a whole is valued and is seen as relevant to industry. The students appear to be at least as comfortable with this environment than with alternatives such as the MS-ACCESS query wizard, or the ORACLE and INTERBASE SQL clients.

There is scope to improve the product to detect problem learning behaviour and provided richer diagnostic feedback. There is also scope to investigate complementary teaching strategies to meet the needs of some students and to formally survey student reaction to progress some of the issues. Due to other calls on our time we are more likely just to refine our use of the product in the normal course of reflection than to develop the product further. We will continue to use the tool in teaching.

Participants and Acknowledgements

Dobрила Lopez – for the SQL lectures, preparing assessment material, and using the tool in tutorials as well as providing support and advice.

Mike Lopez - preparing assessment material, and using the tool in tutorials as well as providing support and advice.

The students who enjoyed or suffered 562.676 Data Management Technology in 2003 and 2004 and provided almost always constructive suggestions.

REFERENCES

Van der Lans, R. F., (2000), **Introduction to SQL**, Third Edition, Addison-Wesley, Harlow, England

