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A Framework for DBMS Course Tool Selection

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ABSTRACT

Database courses have long been a core dimension of Information Systems programs. As database tools and resources continue to evolve, educators are faced with changing options for supporting database education, including enterprise systems such as Oracle, DB2, and Teradata, open source alternatives such as MySQL and PostGreSQL, and commonly available PC-focused products such as Access and SQLServer. Based on a pilot survey of database educators worldwide, this paper presents an overview of the tool options within a context of the varied criteria used by educators to make their choices: cost, accessibility for students, ease of installation and use, support, industry relevance, and pedagogical goals. The purpose of this discussion is not to argue for a particular choice, but to provide a framework for selection based in individual database course or IS program needs and constraints.

Keywords

Database, RDBMS, IS Education.

INTRODUCTION

Database design and management have long been one of the core dimensions of Information Systems programs (Gorgone, Davis, Valacich, Tpi, Feinstein and Longenecker, 2002). Most educators and practitioners agree on the continuing and even increasing importance of data analysis, design, development, implementation, and management knowledge and skills in today's and tomorrow's global organizations, despite the offshore sourcing of other types of IS jobs. Periodic IS skills surveys continue to point to the importance of database, e.g., (Van Slyke, Kittner and Cheney, 1998).

What is less clear, however, is the optimal choice for Database Management System (DBMS) resources to support learning these skills and knowledge. Certainly, most educators agree that it is the DBMS-independent concepts that are most important and can be taught using many different platforms. However, active learning proponents suggest that hands-on experience with DMBS tools can enhance students' understanding and retention of concepts (Ramakrishna, 2000), as well as provide them with practical skills that can help jumpstart their entry-level job placements.

The issue of what are the best tools to use for instructional purposes is not new, but as the tools keep changing and evolving, options may also change. The purpose of this paper is to revisit and update shared knowledge about currently available resources, and to map their features and differences within a framework of varied pedagogical contexts.

BACKGROUND

Some IS programs have only one database course, some have several. Large universities may be able to provide more institutional support for installed tools, while smaller schools may need to operate within more limited budgetary and human resource constraints. Some faculty and/or programs focus more on early life cycle phases of analysis and design, while others seek in-depth implementation experience for their students. Often a different set of tools is needed and used for early phases of data analysis and modeling, such as Visio or Smartdraw. However, the focus of this paper will be on the DBMS tools used to support the later phases of the development cycle.

In an effort to provide their students with sophisticated tools with enough functionality to address multiple course objectives, faculty frequently face the prospect of becoming system administrators, in installing, configuring, and maintaining software, as well as setting up and managing student accounts and troubleshooting technology problems. Many faculty find that, although they may enjoy the learning involved, the time and effort required may interfere with other responsibilities. Thus the choice of tools, that balances pedagogical goals with faculty time, is an important one.

Little previous literature provides comparative studies of multiple tools within an educational context. A few educators have provided case examples and pedagogical arguments for using specific tools such as Oracle (Mata-Toledo and Reyes-Garcia, 2002), MySQL (Denton and Peace, 2004), and even HTML (Moore, Binkard and Fant, 2002) in database courses.

One of the respondents in this pilot study sums up the issues that many instructors and programs are dealing with in choosing tools to support database education:

> *"I have struggled with this for several years. Oracle is widely used in industry, particularly large organizations and it is the powerhouse of databases. ... The downside is the lack of support, adequate Oracle documentation and the resulting reliance on third party resources. ... some excellent books ... have been released in the recent years...MySQL is free (always a plus in an academic environment) and is rapidly gaining market share. Its similarity to Access makes the transition to Access fairly easy. It is not as rich in features as either Oracle or Access but with the open source nature of the software that will likely change. Access ... is acceptable and widely used by non-IS professionals because of its ease and pre-packaged wizards."*

This quote demonstrates a number of criteria that determine the choice of software: cost, technical support, supporting resources, industry relevance, and accessibility. Denton and Peace (2004) identified a set of criteria in analyzing their own particular pedagogical needs with respect to a database tool: cost, ease of use, security, functionality, job market appeal, compatibility. The results that emerged from the analysis in this paper are consistent with their list.

METHODOLOGY

In order to gain a broader perspective on these issues, the author posted a query to the AISWorld listserv (lyris.isworld.org), which is viewed by approximately 1000 Information Systems (IS) academics worldwide. The posting was aimed at database educators and simply asked what tools they used to teach database and why. Although it is not known how many of the list members teach database, thirty-two list members responded to the query. They came from sixteen U.S. states and ten countries, in North America, Europe, Asia, the Middle East, and Africa. The responses were analyzed and the remainder of the paper presents and discusses this pilot analysis.

ANALYSIS AND DISCUSSION

Respondents in all cases stated their preferred tools and in most cases provided some justification for their choice of tools. In addition, some respondents offered additional valuable insights from their own experiences in experimenting with different tools. The discussion in this paper synthesizes the respondents' choices and comments, intending to provide the reader with a summary of current options and a useful framework for making a decision about which tools are most appropriate for his/her specific situation.

Criteria	Times Mentioned
Pedagogy	17
Cost	15
Industry Relevance	14
Accessibility for students	13
Ease of Use/Learning Curve	9
Institutional Support Needed/Available	9
Ease of Support	9
Supporting Materials	5
Table 1 – Selection Criteria	

Selection Criteria

Each e-mail response was reviewed and in most cases criteria were easily discerned. The criteria were categorized into the list summarized in Table 1 above. (Note that the total is greater than the total of respondents, since many respondents mentioned more than one criteria.)

It is perhaps heartening that pedagogy is the most frequently mentioned reason for tool choice. Pedagogy as a factor means that people chose particular tools because of the specific functions and features that supported the concepts they wanted students to learn in the course. For many instructors, there is a major focus on modeling and design early in the course, but the most important goal of using the available DBMS tool(s) is, for many instructors, for their students to learn SQL. Other pedagogical goals mentioned included user interface and application design and development, Web-database interface, and client-server database interface. For example:

> *"We then use Oracle SQL*Plus (local installation) for me to teach the CREATE, UPDATE, etc. commands in SQL, as well as queries. Then I also show them how to use MS Access ODBC as front-end to Oracle backend database. I also demonstrate how to do SQL from SQL View within MS Access."*

> *"We use Access for our first database course and Oracle for the second. We want students to have QBE, form design, and Windows programming, as well as an in-depth exposure to SQL."*

Not surprisingly, cost was an important consideration for most respondents. In this list, cost is primarily the cost to the institution. The cost to the student is encompassed in the category "Accessibility for Students." (See below). Cost was one of the primary reasons for choosing open source options such as MySQL and PostGreSQL. IBM's Academic Initiative providing free DB2 installation and training was also mentioned by a couple of respondents. Interestingly, some people viewed the cost of Oracle as an obstacle, while others stated the $500 annual fee for the Oracle Academic Initiative made it a relatively inexpensive option. The Teradata University Network (TUN) provides a Web SQL interface to many databases that is free of charge to faculty and students, although it is apparently much less well-known.

The main reason for Oracle's popularity (see Table 2) is its widespread use in industry, probably due to become even larger due to its merger with Peoplesoft. The sophisticated, powerful toolset that it includes offers a lot of functionality, but may be better suited to programs that can offer multiple database courses, since the learning curve for many is too steep to take advantage of it in the basic database course.

> *"The reasons of using Oracle can be outlined as follows:*
> *1. Companies and institutions in my country use Oracle (around 80%)*
> *2. Security issues (assigning/removing privileges) can be demonstrated.*
> *3. Transaction processing concepts can be demonstrated.*
> *4. System is reliable."*

Accessibility for students, both on and off campus, is another important consideration. This includes the ease and cost for students of acquiring and installing the software on their own computers, if needed, in order to use it away from campus.

Some DBMS packages require institutional technical support, especially if installed on a campus server linked to a campus network and subject to security constraints, which can limit or prevent access from off-campus, and potentially conflict with the DBMS configuration. Or, supporting the platform can require extra time and effort on the part of the individual instructor, as described above. Finally, the availability of teaching and learning materials can also factor into the choice of DBMS.

DBMS TOOLS

Table 2 below shows the number of times that respondents mentioned using a particular tool. As with the table above, the total is greater than the number of respondents since a number of respondents use multiple tools.

Oracle™

The most frequently mentioned reason for using Oracle was its widespread use in industry and the edge it gives students when looking for entry-level jobs. Also, many supporting materials (textbooks, SQL workbooks) are available. However, other things mentioned were the need for institutional support, that is, someone to set up accounts and administer the server, and the steep learning curve for the developer tools for which most schools with only one database course do not have time. There were conflicting views of the ease or difficulty of installing and running the personal version on a student computer.

"In the past, I had students use Oracle. But, we found it too much work to manage / administer. Also, I never had time to really go beyond the core SQL language, so the resume builder of using Oracle did not really go beyond saying 'I used Oracle'."

"Oracle is a fine, if expensive, enterprise-class data management tool, but difficult to administer (heck, it's difficult to install) and maintain."

Tool	Users
Oracle	17
Access	16
MySQL	8
SQLServer	6
DB2	4
Postgresql	3
Teradata/TUN	2
Table 2 – Tool Choice	

MS Access™ and SQLServer™

Microsoft tools such as Access are commonly, easily, and cheaply available on most campuses and for most students on their own computers, which was the main reason mentioned for those who chose Access. A number of respondents used a combination of Access and some other more powerful tool such as SQLServer, Oracle, or Teradata. Some objected to the approach that Access uses for SQL as interfering with pedagogical objectives.

"Access - it is on all campus machines, the students have it on their machines, and it is not difficult to learn, the object of the course should not be learning software, but learning the theory and implementing it."

"As a learning environment, I think MS-Access is horrid. I don't want my students using the query builder; I don't like the bundling of a (weak) programming environment with the data management environment; I don't like the fact that access to actual SQL DML and DDL is obscured in MS-Access... there's a lot I don't like about it, especially as a teaching tool."

"Access is of no interest - the SQL has been 'Microsofted' "

These comments demonstrate alternative pedagogical goals that are not inconsistent but imply different tool fits.

MySQL and PostGreSQL

Coming in third, MySQL (and the more powerful PostGreSQL) have the open source advantage of being free, and their supporters exhibit strong enthusiasm. There were conflicting views of ease of use, some stating it was easy for students to install their own versions, and others stating that installation was difficult, but once installed, worked well.

"Once you get it [MySQL] all up and running (which can be difficult), it is very stable and works well."

"My students interface via phpmyadmin or the mysql browser. It is easy to install and the interfaces work well for a class setting. I encourage students to install MySQL on their personal machines."

MySQL's third place spot in the ranking suggests the consistently growing interest, in both industry and academia, in the open source movement. As the software interfaces continue to improve, and the use of open source software in industry matures, MySQL may provide an increasingly attractive option for database educators.

IBM DB2™

Although DB2 is free and training is provided for faculty as part of IBM's Academic Initiative, it does require institutional support and system administration, which may be an obstacle for smaller institutions with limited resources.

> *"I use DB2. It's free; it's easy and it comes with tech support. I have my own server on which I create all the student accounts. I have a script file that performs this automatically each semester by cleaning out the old ones and creating new ones. It has all the GUI tools that you need, including one for creating stored procedures (if you teach that, as I do); and you can either give the students a copy of the client software so that they can access their database from home, or they can download DB2 Express-C, which is a new (totally free) copy of the DB2 software for their own use."*

Teradata™

Teradata is probably more widely known for its Data Warehouse, Data Mining, and Business Intelligence functions and features. Its market share is growing (Graham, 2005).   However, it may be that many instructors do not consider it as an option for teaching the basic database course. They may not realize that the Teradata University Network (TUN) provides a simple, easy to use Web interface to SQL that permits access to numerous databases associated with a dozen different basic database textbooks. An obstacle for many in the past was that the query capabilities were read-only. However, TUN recently has added write-access, which may make it much more attractive to potential users.

> *"I use SQL Server because the students can get it free through Microsoft …. Now that Teradata allows students to create tables, I will be looking at it as an alternative."*

SELECTION FRAMEWORK

Table 3 displays the list of tools and indicates the most frequent reasons cited by respondents for making their choices. This framework is far from comprehensive or complete, but can give readers a structure for evaluating their own needs and situation, for exploring the options and for mapping the solution that best fits.

Tool	Peda-gogy	Cost	Industry Relevance	Accessibility for students	Ease of Use/ Learning Curve	Institional Support Needed/ Available	Ease of Support	Supporting Materials
Oracle	x		x			x		x
Access				x	x	x		x
MySQL	x	x		x	x			
SQLServer						x		
PostGreSQL	x	x						
Teradata		x		x	x		x	
DB2		x				x		
Table 3 – Decision Framework								

An example of using the framework is as follows. A program that offers multiple database courses, where students can extend their learning curve for the tools over multiple semesters, and which can get institutional support, may find that Oracle or DB2 is an appropriate choice, with the benefit of industry-relevant skills at the job starting gate. On the other hand, a typical MIS program within an AACSB accredited business school may only offer a single database course, and might choose a combination of Teradata for learning SQL in an enterprise environment and Access for implementation of applications within the time constraint of a single semester. The combination is low-cost, little need for support or instructor database administration, and low learning curve. Most instructors and practitioners would agree that SQL skills are highly portable across platforms, as was mentioned by several respondents in this brief survey.

CONCLUSION

The data used as the basis for this paper is clearly a convenience sample with attendant limitations: small sample size, little evidence that it is representative or generalizable, and simplistic quantitative and qualitative analysis. It is intended to provide an initial summary of the issues, but also to set the stage for the next step in the research. Phase II would focus on

developing a more rigorous, more comprehensive survey of worldwide database education resource usage. However, even the results of this initial survey provide a useful framework for educators seeking help in making the decision of what tools to use to support their courses. Further, database educators may appreciate that many of their colleagues are facing similar issues, and may learn from their collective wisdom and experience as synthesized in this paper. The Appendix provides web sites for more information about the major tools and software academic programs discussed in the paper.

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APPENDIX: RESOURCES

IBM/DB2 Academic Initiative - www.ibm.com/university/data

Oracle Academic Initiative - https://oai.oracle.com/en/index.html

Teradata University Network - www.teradatauniversitynetwork.com

MySQL - www.mysql.com

PostGreSQL - www.postgresql.org

Comparison of different SQL implementations - http://troels.arvin.dk/db/rdbms/

Comparison of relational database management systems - http://en.wikipedia.org/wiki/Comparison_of_relational_database_management_systems

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