

The Revision of a Database Course: The Process and the Result

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Abstract

Practical database skills such as a working knowledge of SQL, data analysis and database design are recognised as important and useful skills. However a traditional database course that is assessed using a theory-based exam, a research assignment, and two practical assignments still allows many students to pass who subsequently show that they have minimal practical skills.

This paper describes the redesign of a database course in the Bachelor of Information and Communication Technologies (BICT) at Christchurch Polytechnic Institute of Technology (CPIT) that emphasises practical skills and assessments that require students to demonstrate that they have gained these skills.

The processes used were a literature review that covered what other writers have identified as being important skills, a review of student comments regarding the application of the content of the course to their capstone projects and a review of the database needs of other second and third year courses in the degree.

The result of this process saw the introduction of a revised course where there was little change to the content that was covered, but a change in emphasis to ensure that students who pass the course had at least mastered the basic skills of SQL and had greater exposure to the

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design and implementation of relational databases.

1 Introduction

Athauda (2007) described the revision of a database paper that aimed to emphasise the teaching of practical skills by using a real-world project. A member of the Business Computing Local Advisory Committee at CPIT commented “If a student had passed a database course I would expect them to have basic SQL skills”. Anecdotal evidence from lecturers teaching papers that rely on a working knowledge of SQL and database design suggests that many students have failed to gain even basic SQL and database design skills whilst having passed the database course. Many students discover that these skills are required for their capstone project particularly when it is database related.

Based on feedback from a recent external moderation of the course and on feedback from students who have complete the course it was decided to review the content and assessment of the course to ensure that students who passed the course have the SQL and database design skills necessary for industry, future courses that require them, and for their capstone projects where they are database related.

2 Background

The database course (BCPR203) is a 15 credit level 6 course that is compulsory for the BICT degree. It has been a traditional course based on a textbook and delivered via 2x 1 hour lectures and a 2 hour lab each week for a semester. It covered a wide range of topics and was assessed as shown in Table 1.

Assessment	Weighting	Minimum Requirement
Research Assignment	15%	-
Database Design Assignment	15%	-
SQL Practical Test	20%	-
Exam	50%	50%

Table 1 – The Original Assessment Structure for BCPR203 – Database Management Systems

The assessment grid (as shown in table 2) shows how each of the major areas of the course is assessed in the various assessments and the total weighting given to each of the areas as a whole.

This assessment structure would allow for a student to get a very low mark in either the database design assignment or the SQL practical test and still get enough marks overall to pass the course. In an extreme example, a student could get zero marks for the 26% of the course assessments that cover SQL, manage to get 50% from the other 74% of the course, and still gain a pass for the course.

BCPR203 is a compulsory course in the BICT degree, and has typically been completed by students in the Graduate Diploma in ICT as a prerequisite for a PHP-based server side programming course. Students completing the

Graduate Diploma in ICT are also able to use a course from the Diploma in ICT (Level 5) from the National Advisory Committee on Computing Qualifications (NACCCQ) family of courses as an alternative prerequisite with this course being DB500 – Database Management Systems (DBMS). The assessment regime for DB500 is mastery based as opposed to the achievement based assessment used in BCPR203, and requires all assessments to be passed, with resits available should students not pass at the first attempt. The perceptions of the two authors who have both taught BCPR203, DB500 and the server side programming course are that the students who only “just pass” DB500 will tend to be better prepared for the SQL and database design aspects of the server side programming course than those who only “just pass” BCPR203. (Kennedy & Ross, 2000) argue that while the 80% pass mark required for Diploma modules can lead to simplified assessment of theory components it has resulted in assessments for practical sections that are specified in terms of minimum criteria that must be met for a pass. Students who have passed DB500 have at least demonstrated some SQL and database design skills.

The intention therefore of the redesign of the course was to (a) determine whether the correct content was being covered in the course and (b) ensure the assessment structure used resulted in students having the required skills that would be expected of students completing such a course as BCPR203.

3 The Redesign Process

The approach that was adopted to redesign the course included a literature review that covered a number of pieces of work that analysed what should be included in database courses at similar levels including Robbert and Ricardo (2003), Conklin and Heinrichs (2005), Abdullat

(2001) and Athauda (2007). These writers helped in identifying what content was important in such a course.

Students completing their capstone project in the BICT degree are required to analyse the content of the 2nd and 3rd year courses in their project reports in terms of their applicability to their capstone project and to make recommendations about any changes that could be made to the courses as a result. These aspects of the final reports were used in an earlier study by Nesbit and Raizis (2004) to analyse whether the content of another course should be altered. This process was followed again by analysing a number of project reports completed by students whose project involved a database component.

A review of other 2nd and 3rd year courses in BICT that required database knowledge was conducted to determine which specific database content was required.

3.1 Literature Review

Robbert and Ricardo (2003) conducted a three year study in which they identified trends in the content of database courses. In the surveys that were conducted in this study the top choices for content were the relational data model, SQL, the entity relational model and database design (including normalisation).

Athauda (2007) described the revision of a similar database course in which the course was revised to include objectives of providing:

- A sound foundation in relational database theory
- Expertise in SQL

- Experience in designing, developing and implementing a relational database for an application
- Experience in the use of a commercial Relational Database Management System

The resulting course also included a real life project where the students were required to design a database for a real-world, but controlled, example and test the design by implementing it.

Conklin and Heinrichs (2005) compared the content of a number of database textbooks with a view to helping those choosing textbooks for database courses make more appropriate choices. In doing so they needed to answer the question of “what should be taught in the database courses?” Some of this work was based on the model curricula for Information Systems and Computer Science programmes. The more recent recommendations coming out of these programmes pointed to the need for information systems related programmes to spend less time on theory and more on practice relative to computer science programmes. The topics that were identified as being of most importance were relational databases, SQL, the E-R model and normalization.

Abdullat (2001) described the challenges of finding the right mix of theory and application in database courses, and stated that the purpose of such a course should be to provide a solid foundation for the design and implementation of database systems. As part of this work the Information Management (IM) knowledge area of the ACM/IEEE-CS Joint Curriculum Task Force was reviewed. The IM area of knowledge was identified as having fourteen components of which three are seen as being core and the remaining eleven being elective or optional. The three core components were:

- Information Models and Systems
- Database Systems
- Data Modeling

In a similar way to Athauda (2007) Abdullat included a real life project that involved the design and implementation of a real-world database and to an extent placed even more emphasis on this part of the course.

From the literature that was looked at, a number of trends begin to emerge regarding the content that should be included in such a course as BCPR203, with the most important aspects being the design of relational databases and the relational data model, along with the use of SQL.

3.2 Analysis of Students’ Capstone Project Reports

Forty (40) project reports from the BICT Capstone Project were reviewed, with special attention being paid to the section of the report where students analyse the content of the 2nd and 3rd year courses that they completed as part of the degree, and make recommendations as to other content that could be included in them. Of these forty capstone projects, twenty made direct reference to BCPR203 in this section of their reports. An analysis of the specific comments made by these students is shown in Table 3, and is consistent with the outcomes in the literature review about the importance of SQL and database design.

Relevant comment (grouped by theme)	Number	Percent
SQL is important, more SQL, joins and Group By commands	17	85%

Database design, ERD, keys, normalisation	9	45%
A level 300 database course is required	6	30%
Database and the Web, MySQL, php	3	15%

Table 3 – Relevant Comments Made Regarding BCPR203 in Capstone Project Reports

A number of other specific pertinent comments were also made, with these being shown in Table 4 and supporting the importance of students passing BCPR203 needing to have skills in SQL and database design.

A pass in this course should require at least adequate ability in using SQL
More instruction on SQL would have been beneficial
Since my project was to design and develop a database, I constantly had my notes out from this paper
The SQL module of the course was extremely helpful
I believe that SQL should be taught more thoroughly
The content presented on normalisation, primary and foreign keys, and database modelling were very useful
I recommend that we cover more SQL in this course
I suggest that at least one more assignment be dedicated to SQL
More emphasis should be given to the practical side of generating data models

It would have been useful to gain a good understanding of object-relational mapping

Table 4 – Specific Comments Made in Capstone Project Reports Regarding BCPR203 Content

3.3 Review of 2nd and 3rd Year Courses Requiring Database Knowledge

A number of 2nd and 3rd year courses from within the BICT degree were identified as building on the database knowledge gained from this course:

- BCPR212 – Introduction to Programming in Java
- BCPR213 – Introduction to Programming in vb.net
- BCPR222 – Best Practice Programming in Java
- BCPR223 – Best Practice Programming in vb.net
- BCPR301 – Advanced Programming
- BCPR342 – Server Side Programming in PHP

In the case of BCPR342, Nesbit (2003) surveyed a group of students about the most important skills that they perceived as needing to complete a major assignment. The results showed that the two most important skills needed were entity relationship diagram modelling and SQL. In the cases of BCPR212, BCPR213, BCPR222, BCPR223 and BCPR301 the students are expected to have a working knowledge of SQL in order to complete some of the assignment work in the course.

3.4 Summary of Findings

Through the literature review that was conducted, the analysis of capstone project reports and a review of other 2nd and 3rd year courses in the degree, the most important emphases in BCPR203 should be to develop significant skills in SQL that must be gained in order to pass the course and to develop skills in the design and implementation of relational databases that are based on real-world requirements. Of secondary importance is the need to develop an understanding of the issues surrounding the use of database management systems.

4 The New Course

The new version of BCPR203 that was developed through this process is not significantly different from the previous version when it comes to the content that is covered, but there are some significant changes to how the course is assessed in some aspects, particularly when it comes to the design and implementation of relational databases and the use of SQL.

The changes in content are minor with the most significant addition being some explicit coverage of the concepts of object-relational mapping as a result of feedback from students completing capstone projects.

The changes to assessment are summarised in the following sections:

4.1 SQL

As described earlier in this paper, in the original version of the course the SQL practical test was worth 20% of the marks for the course, but there was no requirement to gain any particular mark in this assessment, provided the average for all assessments was at least 50%. Based on the importance of SQL skills in the literature, the feedback from students in their capstone

project reports, the skills needed in related programming courses as well as the comment from a member of the institution's computing advisory committee that they would expect someone that has passed a 2nd year database course to have SQL skills, it was decided to split the SQL practical test into two SQL tests.

The first SQL test is worth 10% of the marks for the course, and students must gain at least 50% in this test to be able to pass the course as a whole. This test covers the basics of SQL, including SELECT (a range of questions that require the use of multiple tables, the WHERE clause, GROUP BY, HAVING and ORDER BY), CREATE TABLE, INSERT, UPDATE, DELETE. Three different versions of this test will be used in each semester, and students will be given the opportunity to sit all three versions and count the highest mark that they achieve for the course. The reason for doing this is to (a) ensure that students have mastered the basic skills of SQL and (b) to in essence allow for the equivalent of a resit for an assessment in a programme of study where resitting of assessments is not part of the assessment regulations. This aspect of allowing students to sit an assessment three times and choose the highest mark was described in Nesbit (2007) in a similar case where it was also seen as being desirable to have an assessment based on a mastery-type philosophy within a programme of study where the predominant assessment mode is achievement based.

The second SQL test is worth 5% but there is no requirement for a minimum mark in this test. This test covers some of the more advanced features of SQL, including views, constraints, triggers and stored procedures.

While the two SQL tests together are worth 15% of the new version of the course (see Table 5) as compared with 20% for the only SQL test

in the original version (see Table 1), the students now have to master the basics of SQL in order to pass the first test, which must be passed to pass the course overall. This will mean that students who “just pass” BCPR203 will now have a base level of skills in SQL for use in other courses in a similar way to students who “just pass” DB500. This now reflects the importance of SQL that was identified in the literature review and the review of capstone project reports, as well as the comment from the member of the Business Computing Local Advisory Committee at CPIT that “If a student had passed a database course I would expect them to have basic SQL skills”.

4.2 Design and Implementation of Relational Databases

The database design assignment has been based on an exercise generated by the lecturer. The students are provided with a set of reports from which they design the database and write a report on the design issues and decisions involved. The new design assessment follows that of Abdullat, (2001) and is similar to an assessment used with DA600 from DipICT (Level 6). The students choose a small company, school, club, family member's place of work, friend's business, somewhere they work etc as the basis for this assignment. It is a three phase assignment that involves requirements analysis, database design, and implementation. Early in the first phase a discussion with the lecturer is used to adjust the scope of the project. The aim is for about 12 tables. Phase two involves designing the database and writing a report as before. The design is implemented in MS-Access and the tables populated with sample real-life data. It is certainly a good learning experience- and real-world. As mentioned this type of assignment has been used with DA600 from DipICT (Level

6). The students learn that real world data is not as straightforward as textbook examples and implementing their design often exposes problems.

The weighting of this assessment has been increased to 25% (see Table 5) as opposed to 15% in the original version of the courses (see Table 1). This increase reflects the importance of database design that was identified in the literature review and in the review of capstone project reports. It also reflects the greater range of outcomes assessed by this assignment.

4.3 Issues surrounding the use of Database Management Systems

It is one thing to teach about database administration and the issues involved, it is another for students to fully appreciate the significance of these issues. It is one thing to create SQL scripts that include constraints, selects, triggers etc for a textbook database, it is another to realise what is involved in a real world database environment. For a number of years students doing DB600 in DipICT (Level 6) have been completing a group assignment, in groups of 4-5, where they are allocated a pre-arranged local Database Administrator (DBA) who they interview at the work place about a range of DBMS issues and then write a group report and an individual report. The feedback from students in DB600 indicates that this is a valuable learning experience that highlights the reality of database design, the size of a real world database, the use of SQL, and issues such as security and backup.

The research assignment will now be based on an interview with a local DBA and is worth 10% of the new version of the course (see Table 5) which is a reduction from the 15% weighting of the research assignment in the original version of the course (see Table 1). The change

with this assessment is that it will provide the students with a greater appreciation of the practical issues that are faced in a real-world DBMS environment.

4.4 The Assessment Structure in the Revised Course

The new assessment structure for the course is shown in Table 5 and shows that there are now two assessments that must be passed for students to pass the course overall (the Exam and SQL Practical Test 1), as well as the requirement to gain a 50% average across all of the assessments.

Assessment	Weighting	Minimum Requirement
Research Assignment	10%	-
Database Design Assignment	25%	-
SQL Practical Test 1	10%	50%
SQL Practical Test 2	5%	
Exam	50%	50%

Table 5 – The Revised Assessment Structure for BCPR203 – Database Management Systems

The new assessment grid shown in Table 6 shows that the total weighting (including the exam) given to SQL has dropped from 26% (see Table 2) to 21%. However, the students must now master the basic SQL tests covered in the first SQL test to pass the course. The importance of database design in the course overall is reflected in the increase from 25% in the original version of the course (see Table 2) to 35% in the revised version (see Table 6).

5. Review of the Process

The process that was followed in completing the review of the course was successful and is worth replicating in the review of future courses. The most useful aspects of the process were:

- Some discussion with members of the Business Computing Local Advisory Committee.
- The literature review that covered the a number of pieces of work that related to either the design of other database courses or to the importance of different topics within the database curriculum.
- The review of capstone project reports as this was able to provide both feedback from students about the course and how the course relates to their industry based experiences, thereby providing further industry feedback.
- The review of other courses where SQL knowledge is required.

6. Conclusions

The revised version of the course did not significantly change the content that is delivered in the course, but did change the emphasis by placing more importance on the skills that are needed for real-world database contexts. The most significant changes in emphasis are:

- The inclusion of an SQL practical test that must be passed for the students to pass the course overall
- The inclusion of a database design assignment that is based on a real-world example that not only includes the design of

the database, but its implementation in Microsoft Access and the population of the tables so that the design of the database is tested.

- An increased weighting on database design in the course
- The interview of a DBA as part of a research assignment that requires the students to explore the DBMS issues that they face as part of their ongoing work.

These changes in emphasis will ensure that the overall goals of the re-design of the course are met, with these being that the students completing the course have the SQL and database design skills needed for industry, future courses and database related capstone projects.

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	Research Assignment	Database Design Assignment	SQL Practical Test	Exam	Total
Database Mgt Issues & Concepts	15%			34%	49%
Database Design		15%		10%	25%
SQL			20%	6%	26%
Total	15%	15%	20%	50%	100%

Table 2 – The Original Assessment Grid for BCPR203 – Database Management Systems

	Research Assignment	Database Design Assignment	SQL Practical Test 1	SQL Practical Test 2	Exam	Total
Database Mgt Issues & Concepts	10%				34%	44%
Database Design		25%			10%	35%
SQL			10%	5%	6%	21%
Total	10%	25%	10%	5%	50%	100%

Table 6 – The Revised Assessment Grid for BCPR203 – Database Management Systems