Unit 18: Database Design

Unit code: J/601/6617
QCF Level 3: BTEC Nationals
Credit value: 10
Guided learning hours: 60

Aim and purpose

The aim of this unit is to enable learners to understand the features of relational databases and to develop the skills necessary to design, create, populate and test a relational database incorporating advanced features.

Unit introduction

Database software is one of the most commonly used application packages in business. Many jobs involve the use of databases and for this reason employees with database skills are valued. The advantages of using a relational database are extensive, including significantly reduced data storage requirements, improved record manipulation and faster access to records. As with spreadsheets, data mining software can make use of database files to interrogate records and look for trends or unusual events.

Most organisations use databases in some way to store records, for example customer information, supplier information, employee details and financial information. These records can be searched, sorted, ordered, and cross-referenced using relational databases. Using a simplified chart tool, graphs and charts can also be created and embedded in reports. Importing and exporting data to and from databases will be practised in this unit.

To ensure that relational databases have integrity, validity and efficiency, designing the database prior to implementation is important. Failure to do this may result in a poor product. Learners will consider the validation and verification methods that can be implemented to ensure that the data stored in a database is as accurate as possible. Efficient relational database design is managed through the process of normalisation and learners will be using normalisation techniques to develop efficient and effective relationships between entities.

In this unit learners will come to understand the features and functions of database software and use advanced features to design and implement fully-functioning relational databases to specified user requirements. This unit links well with *Unit 11: Systems Analysis and Design*.

Learning outcomes

On completion of this unit a learner should:

1 Understand the features of relational databases

2 Be able to design, create and populate a relational database

3 Be able to test a relational database.

Unit content

1 Understand the features of relational databases

Features: entities; attributes; relationships; benefits

Entities: key fields eg primary keys, foreign keys; referential integrity; auto incremented keys; field attributes; data redundancy

Attributes: field properties eg data types, size, validation rules

Relationships: one-to-many; one-to-one; many-to-many; normalisation

Benefits: reduced data redundancy; other eg reduced data storage, faster access, efficient updating, searching, sorting, reporting

2 Be able to design, create and populate a relational database

Design: relationships; tables; queries; data entry forms; reports; design documentation eg DFds, ERDs, data dictionaries, structured English

Creating relationships: normalisation (first, second and third normal forms); modifying; cascading updates; cascading deletes

Query design: selection of data types; use of logical operators eg AND, NOR, NOT

Data entry forms: verification routines; validation routines eg input masking, checks for completeness, data consistency; data redundancy; visual prompts; dropdown; combo boxes

Populate: data entry; importing data from external sources eg other databases, spreadsheets, text files

Exporting data: query results; report results; destination eg spreadsheet, database

Advanced features: creating styles for fields, tables, forms, reports; creating styles to match user need; consistency eg using tool box; customising: menus and toolbars eg use show/hide functionality, add buttons; automated functions eg macros, scripts, program code

Errors: reasons eg different data types, poor design, inconsistent normalisation; rectification

3 Be able to test a relational database

Testing: test plan; functionality; against user requirements; customer acceptance

Evaluation criteria: fit for purpose; justification of features used; suggestions for improvements

Assessment and grading criteria

In order to pass this unit, the evidence that learners presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 explain the features of a relational database	**M1** explain referential integrity and the purpose of primary keys in building the relationships between tables	**D1** discuss how potential errors in the design and construction of a database can be avoided [IE1]
P2 design a relational database for a specified user need [CT1]		
P3 create and populate a database [SM2]	**M2** import data from an external source	
P4 create features in data entry forms to ensure validity and integrity of data		
P5 perform queries using multiple tables and multiple criteria	**M3** export data to an external source	
P6 include an advanced feature in a database design	**M4** implement an automated function.	
P7 test a relational database. [SM4, RL4]		**D2** evaluate a database against the specified user need.

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key			
	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

This unit assumes that learners have a basic understanding of databases and database terminology and focuses on the design and implementation of a relational database. Learners need good access to computers which should be supported by theory and practical activities and by examples from industry and commerce. If learners have completed *Unit 11: Systems Analysis and Design* or are studying it in parallel with this unit, the elements of design and the associated design documentation will be familiar to them. In fact the two units work well together if that delivery structure is possible.

Much of the unit is given over to practical work, and it is expected that learners will spend the majority of their time practising working on either databases that have been created by the tutor, or databases the tutor has instructed them to produce. This will mean that all learners will need individual access to PCs for nearly all of the unit.

Exercises should be realistic in content and, ideally, will be designed with a practical business in mind. For example, one database could be a list of a company's clients, as would be used by a sales team to keep a track on what has been said to different people about different products. Another example might be a marketing database, which contains a list of potential clients, whose details must be tracked and kept up to date. This database could be used for running queries that would generate an email-list spreadsheet file for a mass mailing.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Introduction to the unit
The purpose and features of relational databases: • whole-class exercise – tutor presentation on database relationships • whole-class exercise – use tutor-provided materials to learn about field properties • whole-class exercise – class practical to learn how to create and modify databases • directed research – learners work from tutor-provided materials to understand key fields • whole-class exercise – tutor presentation on how to identify and remedy database errors.
Assignment 1 – Why Relational Databases?
Learning to create, populate and test a multiple database: • whole-class exercise – design documentation and designing database structures • whole-class exercise – practical lesson on creating correct and functional data entry forms • whole-class exercise – practical on importing and exporting data • whole-class exercise – practical lesson on how to run good database queries.

Topic and suggested assignments/activities and/assessment
Assignment 2 – Designing
Use advanced features of a database and test functionality: • directed research – using tutor-provided materials to understand what data integrity is, and how is it protected • individual exercise – learning how to style a database • individual exercise – customising a database and automating it to make it more user friendly • individual exercise – learn to test and evaluate using a tutor-provided database.
Assignment 3 – Implementing
Assignment 4 – Checking it Works

Assessment

This unit can be assessed through either a single project-style assignment, or through a number of smaller assignments. Whichever route is preferred, linking assessment to good business practice will help learners contextualise the subject matter.

To achieve a pass grade, learners must achieve the pass criteria listed in the assessment and grading criteria grid.

For P1, they must explain the features of a relational database. Evidence for this could be, for example, a written report, a presentation or a written discussion. Note that the features include benefits and learners need to be able to quote aspects that relate to the efficiency of storage of information with a minimum of data redundancy and also the ease by which information can be extracted from the database as required.

For P2, learners must design a relational database containing at least five tables for a specified user need. Learners must provide evidence of appropriate normalisation and database design. Documentation such as ERDs, data dictionaries, DFDs, structured English etc will provide the evidence.

For P3, learners will have implemented their design and populated the tables. Relationships should have been established and referential integrity enforced, this will allow cascaded updating and deletion of linked records. Evidence will come from annotated screen prints.

P4 should be evidenced through the creation of forms to the primary tables and through the implementation of at least three of the suggested strategies for ensuring the validity and integrity of data.

For P5, queries should be created using a minimum of two tables and a minimum of two criteria and be thoroughly tested.

For P6, learners should have included at least one of the advanced features from the unit content in their database design.

P7 requires full testing of the database, including functionality and user testing. Learners should have a test plan and evidence will come from this and user feedback.

To achieve a merit grade, learners must achieve all of the pass and the merit criteria.

For M1, learners should show evidence that they understand the concept of referential integrity and the mechanisms that exist to support the enforcement of referential integrity within a database package. They should also be able to explain the purpose of primary keys and how they are used to build the relationships between tables. Reference should also be made to foreign keys.

M2 requires learners to import data from an external source (this could be from a text file, spreadsheet, word-processed table or another database package). The data could, for example, be used to form one of the tables required in the database.

M3 requires learners to export the results of either a query or report to another application. To evidence this, learners could provide a screen print of a directory containing the exported data in a suitable file format or a print of the data in its new format. Alternatively, for M2 and M3, an appropriately documented demonstration of learners exporting and importing data would be appropriate. The tutor could ask for a particular set of data to be exported to a particular application.

For M4, learners are required to implement one of the automated functions suggested in the unit content.

To achieve a distinction grade, learners must achieve all the pass and merit criteria and the two distinction criteria.

D1 is an opportunity for users to identify and explain a range of common errors in database design and construction, explaining how these types of errors can be avoided. As an example, learners could discuss the impact of errors such as the accidental deletion of a field in a query or report, the renaming of a field, changing data types etc.

D2 requires learners to evaluate their databases' success in meeting user need. Learners should not only discuss strengths and weaknesses, but justify the features and functions they have used and make suggestions for improvements.

Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the assessment and grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, M1, D1	Why Relational Databases?	An organisation has asked you to design a relational database, and to start with they want a short guide to explain how relational databases work.	Poster or leaflet
P2	Designing	The organisation wants a database to coordinate their sales, suppliers, warehouse and despatch areas. You are to design a fully normalised database structure.	Design documentation
P3–P6, M2–M4	Implementing	Now implement your design.	Screenshots Printouts Outputs Witness statement
P7, D2	Checking it Works	Test and evaluate your database fully.	Test plans Test results User feedback Evaluation

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC in IT sector suite. This unit has particular links with the following unit titles in the IT suite:

Level 1	Level 2	Level 3
	Unit 16: Database Systems	Unit 11: Systems Analysis and Design

Essential resources

Learners will need access to appropriate hardware and software, for example Microsoft Access, that can handle relational databases. Learners will also require manuals and help sheets related to the actual software used.

Learners will require access to computer equipment to enable them to gain a practical awareness and enable them to apply their knowledge and understanding in a practical situation.

Employer engagement and vocational contexts

The use of vocational context is essential in the delivery and assessment of this unit.

There is a range of organisations that may be able to help to centres engage and involve local employers in the delivery of this unit, for example:

- Learning and Skills Network – www.vocationallearning.org.uk
- Local, regional business links – www.businesslink.gov.uk
- National Education and Business Partnership Network – www.nebpn.org
- Network for Science, Technology, Engineering and Maths Network Ambassadors Scheme – www.stemnet.org.uk
- Work-based learning guidance – www.aimhighersw.ac.uk/wbl.htm
- Work Experience/Workplace learning frameworks – Centre for Education and Industry (CEI University of Warwick) – www.warwick.ac.uk/wie/cei.

Indicative reading for learners

Textbooks

Hernandez M – *Database Design for Mere Mortals: A Hands-on Guide to Relational Database Design, 2nd Edition* (Addison Wesley, 2003) ISBN 0201752840

Kroenke D – *Database Concepts, 2nd Edition* (Prentice Hall, 2004) ISBN 0131451413

Ponniah P – *Database Design and Development: An Essential Guide for IT Professionals: Visible Analyst Set* (John Wiley & Sons Inc, 2006) ISBN 0471760943

Ritchie C – *Relational Database Principles* (Thomson Learning, 2002) ISBN 0826457134

Website

www.databasedev.co.uk

Delivery of personal, learning and thinking skills

The table below identifies the opportunities for personal, learning and thinking skills (PLTS) that have been included within the pass assessment criteria of this unit.

Skill	When learners are ...
Creative thinkers	generating ideas and exploring possibilities when designing a relational database for a specified purpose
Reflective learners	inviting feedback from users when testing a database
Self-managers	working towards goals to complete a functioning database anticipating, taking and managing risks when testing a relational database.

Although PLTS are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are ...
Independent enquirers	identifying questions to answer and problems to solve when discussing potential errors and how they can be avoided.

Functional Skills – Level 2

Skill	When learners are ...
ICT – Using ICT	
Plan solutions to complex tasks by analysing the necessary stages	testing and correcting errors
Select, interact with and use ICT systems safely and securely for a complex task in non-routine and unfamiliar contexts	creating a database
Manage information storage to enable efficient retrieval	designing a database
ICT – Finding and selecting information	
Select information from a variety of sources to meet requirements of a complex task	importing data
ICT – Developing, presenting and communicating information	
Enter, develop and refine information using appropriate software to meet requirements of a complex task	performing queries on the database
Mathematics – Analysing	
Use appropriate checking procedures and evaluate their effectiveness at each stage	testing a relational database
Mathematics – Interpreting	
Interpret and communicate solutions to multistage practical problems in familiar and unfamiliar contexts and situations	designing a relational database for a specified user need.