Loughborough University

This item was submitted to Loughborough's Research Repository by the author.
Items in Figshare are protected by copyright, with all rights reserved, unless otherwise indicated.

Getting more out of spreadsheets - using Microsoft Excel to facilitate CAA

PLEASE CITE THE PUBLISHED VERSION

PUBLISHER

© Loughborough University

LICENCE

CC BY-NC-ND 4.0

REPOSITORY RECORD

Grebenik, Peter. 2019. “Getting More Out of Spreadsheets - Using Microsoft Excel to Facilitate CAA”. figshare. https://hdl.handle.net/2134/1811.

GETTING MORE OUT OF SPREADSHEETS – USING MICROSOFT EXCEL TO FACILITATE CAA

Peter Grebenik

Getting more out of spreadsheets - Using Microsoft Excel to facilitate CAA

Peter Grebenik
School of Biological and Molecular Sciences
Oxford Brookes University
Headington
Oxford
OX3 0BP
Email: pgrebenik@brookes.ac.uk

Abstract

Spreadsheets provide a single programming environment in which many CAA tasks can be accomplished. The first part of this paper contains suggestions of ways in which spreadsheets can be used to manage most of the common administrative tasks which fall on lecturers in charge of running modules. The remainder of the paper contains details of ways in which spreadsheets have been used to set individualized student assessments and to give students both formative and summative feedback.

Introduction

Microsoft Excel is a readily available spreadsheet programme with powerful data handling, formatting and graphic capabilities. Despite its widespread use, many staff know of and use only a very limited set of its features and remain unaware of many of the capabilities built into the programme, particularly those associated with data manipulation and visual basic (VB) macros. Although all the descriptions included in this paper refer to Excel, many of the ideas could be implemented on other spreadsheet packages.

Administration of a module/unit

Most institutions now have centralized student information systems. Module leaders planning to use spreadsheets to administer their modules need to arrange procedures for downloading lists of student names and student numbers from these systems in spreadsheet readable formats. At Oxford Brookes University, it is easy to download 'csv' files from the University's student management system in a standard format:

"M08127 - The Health of Man"
"DR SA BROOKS 3285"
"29-JUN-2001"

"25","75"

"Module No","Number","Names","Fields","Codes"
"M08127","98011111","ABRANA, EUGENE","HB","MC10B1"
"M08127","99022222","AIKIN, SARAH","NU","MC10A"
…

The first four lines contain detail about the module, line 5 is blank, line 6 is a set of headers for the main area of student data which makes up the rest of the file. Five further columns are reserved for recording information about medical certificates, coursework, exam and total marks, and special mark grades concerned with resits and other exceptional situations. This standard format has been agreed with the student system's administrator to facilitate the return of marks from spreadsheets into the central student management system.

Module leaders can use the remaining 245 columns in the spreadsheet to record such aspects as allocation into groups for practical/seminar/tutorial work, attendance at practicals/seminars/tutorials, marks associated with individual pieces of coursework, marks associated with exam questions, notes about specific students, emails received from specific students and any other student information which is germane to the efficient running of the module.

Two features of Excel make it particularly useful for module administration. The first one, introduced in Excel5, is the autofilter. This enables the user to view and work with subsets of the whole class list on the basis of simply chosen criteria e.g. to view all the students allocated to a practical session running on a particular morning, or all the students who have missed a particular practical. Although autofilters are relatively easy to use, they become even more user friendly when they are supported by VB macros which are triggered by a simple user action on the spreadsheet (e.g. entering a day code in a particular cell). The second feature of Excel, introduced in Excel97, which has greatly increased its usefulness for module administration is the fact that individual cells can contain large amounts of text (up to 32000 characters). Unfortunately, the standard programme does not make it easy to manipulate such text within a cell, but a VB add-in has been written to give a more user-friendly no-frills text-editing interface for dealing with long text entries in a single cell.

The following paragraphs give more detail of some of the ways in which a spreadsheet can be used to simplify tasks associated with module administration.

Production and use of lists for practicals and seminars

It is often necessary to produce lists of well-defined subsets of the whole class. To do this, columns of the spreadsheet used for filtering must contain identifiers such as We1, We2, We3, Th1, Th2 to indicate different seminar groups running on a Wednesdays and Thursdays.

- Autofilters and column hiding, either done manually or programmatically by VB macros allows the printing of attendance registers for each of the subsets.
- Block email lists can be produced for each of the subsets.
- If they are available as graphic files, student photographs can be added into the printed registers (Excel can handle images files programmatically).
- Autofiltering to display a single subset makes it much easier for staff to enter such information as attendance data and marks. This is particularly true if the overall number of students on the module is large.
- Making the spreadsheet shareable and locating it on a network drive means that all staff involved in the assessment of a module can enter information at the same time. It also means that the task of entering such information can rest directly with the staff or demonstrator involved, rather than with the module leader.

Recording of individual student information

Since the introduction of Excel97, it has been possible to keep large amounts of text in a single cell. Thus it is now easy to keep such information as emails from students or notes from other members of staff in the module administration spreadsheet. One of the reasons why spreadsheets are so useful in module administration is that they allow the module leader to keep all student based data for the module in one file.

Dealing with MCQs

MCQs are a widely used assessment method. Using an optical reader to just produce a raw data file, and using Excel to process this data has a number of significant benefits in terms of module administration.

- It allows the lecturer to customize mark schemes (e.g. to use weighted negative marking).
- Plagiarism in MCQ exams can be a significant problem. Evidence for this can be found by pairwise comparison of actual student responses, a process which can be easily programmed in VB so that the analysis can run within a spreadsheet.
- At Oxford Brookes when MCQs are used with large classes, two different question papers are used and distributed so that students in adjacent columns in the exam room have exam papers in which the questions are in a different order. This discourages 'lateral copying'. Using Excel to process the raw data makes the marking from such exams a simple matter.
- Giving lecturers access to the raw data allows for improved quality assurance procedures. For example, it is easy to highlight those answer sheets in which the optical mark reader has detected more than one response to a question so that the lecturer can recheck them. Lecturers can also check those papers in which there are an unexpected number of unanswered questions where there maybe problems with the way in which the student has filled in the answer sheet.
- The raw data from the optical mark reader should contain the student number as well as the individuals' responses. It is then possible to transfer the examination

marks directly into the module administration spreadsheet using the student number as a unique identifier and Excel's 'VLOOKUP' function.

Improved quality assurance

Many modules now run with large enrolments. Spreadsheet administration can minimize errors and inconsistencies which can easily arise when dealing with large numbers of student results, particularly with time pressures at the end of term. It is good practise to:

- Use formulas to scale and sum coursework and exam marks.
- Use formulas to allocate resit grades (e.g. whether to offer resit coursework and/or resit examinations).
- Use autofilters to view only those students in borderline ranges (e.g. those who are within 4 marks of passing the module).
- Use autofilters to view only those students for whom medical certificates have been received.
- Record moderated marks and reasons why the moderation has been applied.

Transfers of marks and printing marksheets and module statistics

In institutions where a centralized system records all module marks, electronic transfer of marks from spreadsheets should be easy to arrange. For example, at Oxford Brookes, a protocol has been agreed and marks are returned in simple 'csv' format from the module administration spreadsheet. The whole process has been automated and is controlled by a VB macro. Running this macro

- checks that there are no duplicate student numbers in the spreadsheet
- checks that that the total mark is an integer in the range 0-100
- informs the module leader of those cases in which the total mark does not equal the sum of the coursework and exam marks
- generates a standardized format 'csv' file on a floppy disk
- prints a standardized marksheet which can be signed-off by the module leader and external examiner
- generates some simple statistical information about student performance on the module
- generates individual resit coursework forms where appropriate

Summary

The major benefits of using spreadsheets to administer modules are:

- information is easily exchanged with central administrative systems
- module leaders decide on what information to store
- all student related information is stored in a single file
- information is readily manipulated using spreadsheet formulas

- autofiltering allows module leaders to review particular groups of students

Individualised numerical questions

In a number of technical subjects it is important for student learning that they practise numerical exercises. For example, in introductory chemistry courses, students need to attempt different types of problems in the general area of chemical stoichiometry. At Oxford Brookes, numerical problems in chemical stoichiometry are set using spreadsheets as the electronic medium. The methodology is described in more detail in the following paragraphs.

A template spreadsheet is written containing between 20 and 40 questions. Some examples are given

- What is the chemical amount of $Ca(OH)_2$ present in 140.5 kg?
- What is the mass of 0.1072 mol of ozone, O_3?
- What mass of sodium bicarbonate is in 0.026 mL of 0.86 M solution?
- The pH of a solution of $Ca(OH)_2$ is 10.17. What is the concentration of calcium ions?
- Carbon dioxide is a product of the reaction
  $Na_2CO_3 + 2HCl = 2NaCl + CO_2 + H_2O$
  What mass of CO_2 is produced when 45.03 g Na_2CO_3 react with 12.52 g HCl?
- Hydrated magnesium sulfate has the formula $MgSO_4.7H_2O$. What mass of water is contained in 0.592 g of solid?

Note that each question contains both text and numeric information. In the template, the numeric values are generated using Excel's random number generator.

A VB macro in the template is used which creates individualized spreadsheets for all the students doing the module so that each person has problems with different randomly generated numeric values in the questions. These spreadsheets are then distributed to the students on the module. At Brookes, this distribution is itself controlled by a single spreadsheet which students simply load; alternatively, the individual spreadsheets could be emailed to students as attached files.

Students using the problem spreadsheets can see all the questions on the sheet in cells in column A. Cells in column C show a text-prompt telling the student to enter their answers in the cells in column B, adjacent to the questions. After a value has been entered in a cell in column B, a formula in the cell in column C compares the 'student answer' with the correct answer and reports to the students whether their answers are 'correct', 'wrong' or 'not understood' (for those cases where students have entered non-numeric characters by accident). There are no limitations on the number of attempts that students can make to get correct answers.

When students close the problem spreadsheets, a VB macro runs which detects whether they are using the University PC network, and if they are, writes information

to a 'results file' including the student number, the date, and which questions have been answered correctly. If the macro decides that the student is not logged onto the University PC network, it displays a message box as a reminder that the spreadsheet must be opened and closed on the University network in order to get marks for completing the work.

The lecturer uses a separate spreadsheet for examining the results file and for allocating marks to students. These can then be transferred into a module administration spreadsheet using the Excel 'VLOOKUP' function as previously described.

Some of the features of using this method of delivering numerical problems to students are listed:

- Each student has different problems to attempt and so there can be no simple sharing of numerical answers.
- Students can work on the spreadsheet whenever and wherever they have access to Excel.
- Students get immediate feedback on whether they are getting the correct answers and are able to make repeated efforts to get work right in an anonymous risk-free environment where initial wrong answers will not show them up in front of their peers or teachers.
- By allowing students an unlimited number of attempts and by giving them immediate feedback on their answers, the spreadsheet method gives students more confidence to engage with numerical problems.
- Lecturers working with large classes can assign marks to student work with minimal time input.

Guiding students through calculations

The individualized problem sheets described only give students feedback on whether their answers are correct or incorrect - they offer no additional help to students who cannot answer the questions. A different approach has been tried in certain cases to give students more help with complex calculations. One such example is described.

A chemistry practical session is used to generate some analytical data on the amounts of calcium and magnesium present in a mineral sample. The majority of the students who complete the practical work are unable to carry through unaided the chain of calculations necessary to work out the percentages of calcium and magnesium present.

To overcome this problem and to provide help to students without using large amounts of staff time, a spreadsheet is made available to them. On opening it, the student is prompted to enter the mass of one of the reagents used and its molecular weight. If the mass entered is outside the expected range, a formula in the spreadsheet shows the text "check entry, value around 1.5 g expected". If the molecular weight entered is incorrect, the spreadsheet indicates this to the student

using the text "wrong, try again", but it also indicates if the value is very close to the actual value by showing a message box with the text "nearly correct, check your arithmetic and the number of significant figures". Once these first two entries have been successfully made, the next question becomes visible. This process of asking a simple question, and only making the next question visible once the student has correctly answered the previous question is repeated to lead the student through a complex calculation. When the student has successfully answered all the questions, a printout of the spreadsheet acts as a permanent record which can be handed in with their practical report.

The following points summarize the advantages of this approach.

- Spreadsheets like this can be easily constructed using standard Excel formulas and require very little in the way of VB macros to make them run.
- Values of experimental observations entered by students can be checked against reasonable/expected values.
- Complex calculations can be broken down into a series of simple steps which students can be guided through.
- A print-out of a fully completed spreadsheet shows someone marking the work that the calculation has been carried out without mistakes in it.
- The print-out of the fully completed spreadsheet acts as a properly set-out worked example for the student to review.
- It enables the majority of students to complete a complex calculation without direct staff input.

Summary

- Spreadsheets are widely available and most staff and students have some familiarity with them.
- Their flexibility and power makes them one of the most useful programmes available on PCs.
- The different ways in which they can be adapted and used in CAA are largely limited by the imagination of the user.
- Investing the time to become familiar with this software can lead to large savings of time on mundane module administration as well as improved quality control. The more students who are registered on a module, the greater these time savings become.
- Students can be given immediate individualized feedback which enhances their learning.