

Support in mathematics and statistics for science students

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PowerPoint available as pdf from:

<http://calcscience.uwe.ac.uk> > Resources

Development of learning resources in UWE

Overview of presentation:

Resource requirements in UWE for maths in science

Development of a study text and website

Subsequent evolution of on-line resources

Student feedback

Current developments

Resource requirements in UWE

Range of scientific disciplines:

- biological, forensic, chemical and environmental sciences

Diversity in students' abilities and approaches to study:

- GCSE grade C, A-level, mature students

Resources required for staff as well as students:

- support tutors who have little experience teaching mathematics at the required level and in the required context.

Re-establish the relevance of maths/stats in science:

- decline in maths skills has fostered a gradual development of a more non-mathematical approach to science, which needs to be reversed

Study text + web site - Rationale

Textbook evolved from the printed notes to support 1st and 2nd year students and final year projects:

Essential Mathematics and Statistics for Science, G Currell & A A Dowman

Mathematics: Scientific data, Equations in science, Linear relationships, Logs and exponentials, Rates of change

Statistics: Statistics for science, Distributions and uncertainty, Scientific investigation, Statistical tests, Linear regression, Experimental design

Aim is to develop skills directly relevant to needs of the basic science courses:

- e.g. teaching logs only to base 10 and e
- e.g. introducing differentiation as an experimental rate of change
- e.g. linking standard deviation closely with experimental uncertainty

Study text + web site - Style

Each topic has explanatory text +

Worked examples (> 200)

Questions with video answers (QVAs) on website (< 200)

[Worked answers on website](#)

Additional material on website – open access

[Excel tutorials](#)

[On-line self-assessments](#)

[Data analysis tutorials](#)

Study text + web site – Question of statistics

Physical sciences v biological sciences

Main sources of variation are different: measurement or system

Basic statistics are the same

Tutors' perceptions are very different, based on own experience

Teaching approach for statistics

Some students find the basic concepts very difficult

Use of contexts very important

Reviewed extensively in 2nd edition of textbook

Study text + web site – Basic skills

Basic GCSE skills, e.g. BODMAS, fractions, percentages, not included in printed text, but available on website

Tutors from all disciplines reporting that a lack of these skills causes real problems

On-going developments on website to address this problem

Specific issues in re-teaching basic skills to undergraduates

Requirements vary widely between students from revision to re-learning

Basic skills must be mastered quickly to progress with other skills

Printed resources not effective in this situation

e.g. [Basic maths for science](#)

Study text + web site – Evolution of 2nd edition

Reviewed the ‘teaching’ of some maths topics in the printed text:
e.g. rearranging equations, exponential growth and decay

Re-structured the use of statistics in science:
e.g. analysing test results from a p -value perspective

Greater integration of the website with the book:

Basic maths skills available via interactive tutorials on the website

Expanded tutorials on the use of Excel and Minitab for data analysis

On-going development of new resources, case studies and study guides

[UWE – Calculations in Science ‘home page’](#)

Evolution of on-line resources - Structure

Must be suitable for both advanced and struggling students

Advanced students work through self-test very quickly to confirm skills

Weaker students can re-run tutorials and use self-test to access relevant support

Each resource has separate units for easy navigation

Essential that the student feels 'in control' of own study

Each unit typically includes

Short introductory video or 'video tip'

On-line self test ~ 5-10 questions

Video answers to each of the self test questions

e.g. [Units in Science](#)

On-line resources – Case studies + study guides

Case studies address a specific problem in particular discipline

Includes self-testing and links to supporting areas of study

e.g. [Beer's Law](#)

Study guides address a specific topic,

- in science (e.g. [moles, grams & concentration](#)) or

- in the use of maths in science (e.g. [linear regression](#))

Much of this work has received funding from the Royal Society of Chemistry in association with:

['Discover Maths for Chemists' website](#)

Feedback from students

Survey in Blackboard designed to assess preferred methods of learning of 40 students

Analysis via Blackboard was more limited than expected

- unable to extract raw data to enable cross referencing of individual results

Responses are given for 3 questions

Responses to question 1

How/where do you learn best?

Ranked preferences:

- 1 In a class tutorial
- 2 On your own using on-line resources (e.g. video answers)
- 3 On your own, working through your notes
- 4 In a standard lecture
- 5 With other students using on-line resources (e.g. video answers)
- 6 With other students, working through your notes

Responses to question 2

Which of the following would be the best ways for you to learn a new maths/stats topic? (QVAs = questions plus video answers)

Ranked preferences:

1. **Study Programme + on-line QVAs, before a 1 hour tutorial with paper-based questions**
2. Combined 2 hour **lecture+tutorial** with **paper-based** questions
3. Standard 1 hour **lecture, before a 1 hour tutorial** class with **paper-based** questions
4. Standard 1 hour **lecture + on-line QVAs**
5. No formal classes, but a **Study Programme + on-line QVAs, plus** the availability of drop-in tutorial support at specific times in the week.

Responses to question 3

If you had to learn a new maths/stats topic **by yourself** how useful would the following resources be in your study?

Ranked preferences:

- 1 Study programme, e.g. a detailed list of topics / questions
- 2 Access to drop-in help (provided by UWE staff)
- =3 Additional on-line questions with video answers - QVAs
- =3 Video answers to questions in the textbook
- 5 Printed tutorial sheets of questions (as issued in tutorials)
- 6 Access to help via peer learning from other students

Conclusions from survey

Contact with staff via tutorial classes was seen as a key factor in learning

On-line video materials were widely welcomed and considered relevant and easy to use

Traditional lectures were not considered to be very useful in this subject (UWE has already moved to a combined lecture/tutorial class as a preferred method of delivery)

Study programmes plus QVAs (on-line questions and video answers) could replace the lecture, provided that they were supported by a tutorial

Option of self study with no formal classes had very little support

Current developments

Development of Study Programmes

- **word document with hyperlinks** for specific modules or individual groups to outline a recommended and customised programme of study
- provides a detailed sequence of self-assessment and study, together with explanations and commentary.

e.g. [Example study programme](#)

Further development of on-line Case Studies and Study Guides

- in partnership with other tutors to develop new resources for

Case studies, e.g. [Gas laws](#)

Study guides, e.g. [Using proportion in simple science calculations](#)

Acknowledgements

- University of the West of England
- Royal Society of Chemistry
- Dr Antony Dowman – co-author of textbook
- Ideas and help on case studies and study guides:
 - David Read – University of Southampton
 - Rossana Wright – University of Nottingham
 - Christine Owens – University of Birmingham

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