

Chemical Education, Research, Practice, Innovation, Evaluation and Scholarship

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Overview

- An example of innovation
- Textbook authoring
- A chemical education research project
- Some other projects

Innovation + Evaluation = Research?

An Innovation Project

Support and Assessment of Laboratory Work in Chemistry

Assessment in Chemistry

- Examination
- Coursework
- Laboratory

Reassessment in Chemistry

- Resit
- Examination in own time
- Completion of coursework
- Completion of laboratory reports

Laboratory Reassessment Based on Simulation

- Web delivery allows remote access
- New material related to course
- No new experimental techniques
- Different routes for different students

Evaluation and Implementation

- Used with whole class during laboratory refurbishment
- Subsequently used for reassessment

Evaluation

- Clear structure allows calculations to be performed in steps
- Easy access
- Worked example hard to follow
- Doing the actual experiment would be tedious
- Students cannot be penalised for defective materials and other circumstances

Evaluation

- Individual results prevent plagiarism
- Experiment does lend itself to this approach
- Links to other sites would be helpful
- Run as paper based exercise

Use in Reassessment

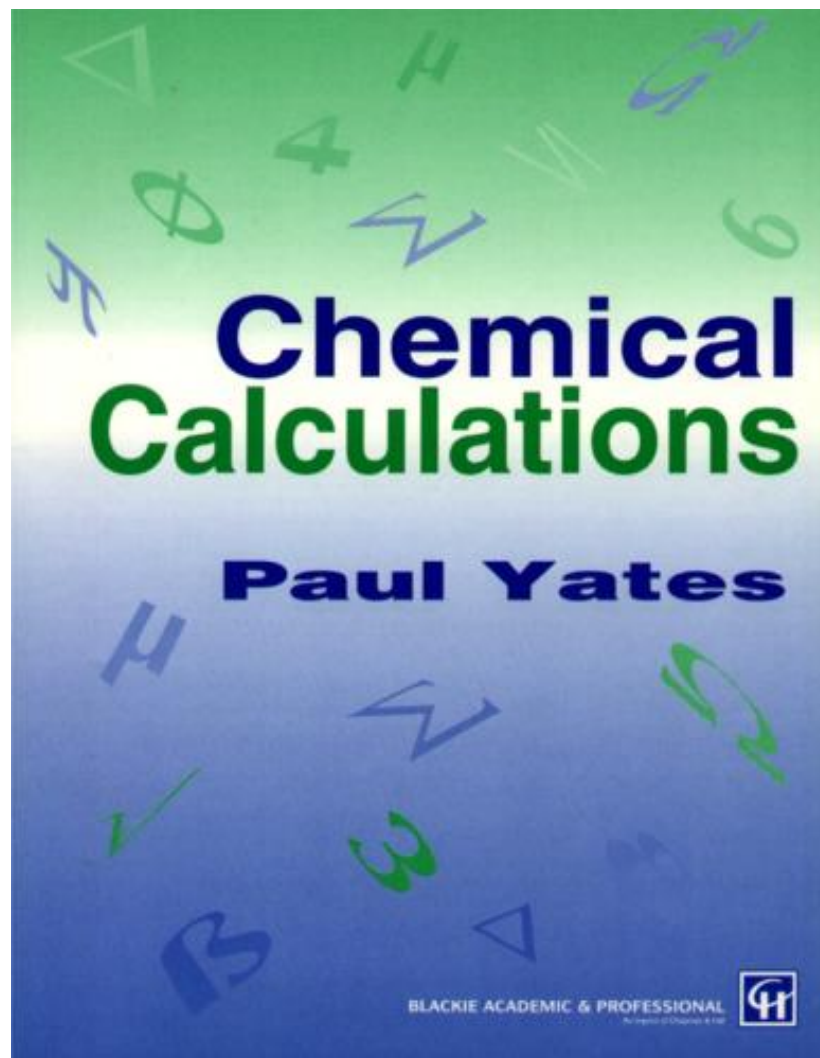
- Work submitted by three students
- Queries answered by e-mail

Innovation	✓
Evaluation	✓
Research	✗

More extensive evaluation needs to concentrate on *implementation* aspects.

A Textbook





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EMPLOYMENT
SUPPORT
&
TRAINING

Chemical Calculations

- Innovative structure
- Extensively evaluated
- The commercial face of scholarship

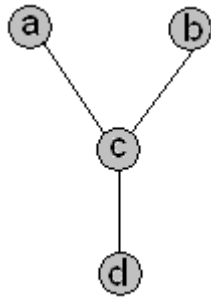
Innovation	✓
Evaluation	✓
Research	✗

Should textbooks have status equivalent to that of research output?

A Chemical Education Research Project

Learning Hierarchies: Mathematical Skills for Chemists

Name of problem type	Example of instance
(a) Given an equation in x and y , determine the gradient and intercept of a graph of y against x .	Determine the gradient and intercept of a graph of y against x if $y = 2x + 3$.
(b) Rearrange a given equation into the form $y = mx + c$.	Rearrange the first order equation $\ln c - \ln c_0 = -kt$ into the form $y = mx + c$.
(c) Given an equation with specified variables, identify the type of plot which will give a straight line.	What type of plot would give a straight line representing the relationship $\ln c - \ln c_0 = -kt$?
(d) Given an equation in the form $y = mx + c$ with specified variables, determine the gradient and intercept of a specified plot.	Determine the gradient and intercept of a plot of $\ln c$ against t if $\ln c = -kt + \ln c_0$.



$$\Pr(c|a) = 0.79$$

$$\Pr(c|b) = 1.00$$

$$\Pr(c|ab) = 1.00$$

$$\Pr(d|c) = 0.59$$

$$N = 31$$

Use seasoned teachers or
textbook writers to find the
knowledge states.

The Assessment of Knowledge in
Theory and in Practice

Jean-Claude Falmagne, Eric
Cosyn, Jean-Paul Doignon and
Nicolas Thiéry



Knowledge States

• \emptyset	2	• {a b c}	4
• {a}	6	• {a b d}	0
• {b}	0	• {a c d}	5
• {c}	0	• {b c d}	0
• {d}	1	• {a b c d}	8
• {a b}	0		
• {a c}	5		
• {a d}	0		
• {b c}	0		
• {b d}	0		

Is this an example of chemical education research?

- Externally funded
- Based on published literature
- Analyses student test results
- Could result in improved teaching and learning

Chemical	✓
Education	✓
Research	✓

How is this work related to everyday practice?

Another Type of Research Project

Is the Mathematics Problem
Recognised by the Chemical
Industry?

Methodology

- 110 out of 564 completed questionnaires
- Completed by personnel with a range of job titles

- Few companies expressed concern about the mathematical ability of the chemistry graduates they employ
- Arithmetic is an essential skill with statistics often required
- Calculus was regarded as useful by half of employers
- Application of mathematics is desirable

- Some employers require only basic mathematical skills
- Automated procedures reduce the need for mathematical skills
- Deficiencies in English and chemical knowledge are more important than those in mathematics

Is this an example of chemical education research?

- Externally funded
- Published
- Informs curriculum design
- Doesn't directly address methods of learning and teaching

Chemical	✓
Education	✓
Research	✓

Is this research *about* chemical education, rather than chemical education research?

Another Example

Are we winning the battle?



To what extent do job advertisements for chemistry lectureships reflect the supposed importance of teaching relative to research?

Methodology

- 41 advertisements in 2003
- Confined to lectureships in chemistry
- Confined to original short advert



Classifications

- 0 Teaching not mentioned
- 1 Explicit statement that teaching is less important
- 2 Teaching mentioned with no further expansion
- 3 Quality of teaching mentioned
- 4 Teaching explicitly given equal weighting to research
- 5 Only teaching required

Relationship to RAE Result

RAE score	No. of posts	Average score
0	2	3.5
1	0	-
2	1	5.0
3a	3	2.3
4	15	1.9
5	10	1.4
5*	10	2.2

Relationship to TQA Result

TQA Result	No. of posts	Average score
Satisfactory	19	2.1
Excellent	20	2.0

- Importance of teaching is not reflected in initial job advertisements
- No difference between departments rated as “satisfactory” or “excellent” for teaching
- RAE grades 3a and 5* give most prominence to teaching

Is this is an example of chemical education research?

- Publishable?
- Doesn't directly relate to learning and teaching of chemistry
- Could help to raise profile of teaching leading to improvements

Conclusions

- Range of scholarship activities with different amounts of research
- Research which is relevant to chemical education is not the same as chemical education research

Postscript

Department of Chemistry

Chair/Reader and Lecturer

We are seeking to appoint two new members of staff in the Department of Chemistry, providing the opportunity to be a part of a successful department during an exciting period of expansion and diversification. The Department is keen to enhance its links with the newly established Medical School and the School of Biological Sciences, and to capitalise on the new Centre for Biomolecular Analysis through Mass Spectrometry (BAMS Centre). Applications from outstanding candidates with research interests that would further these aims are particularly desirable, although those with research interests in other areas that complement and strengthen the research profile of the Department are also welcome.

The Department is very well equipped, has buoyant and expanding undergraduate recruitment, and expects to expand its research school, aided by a significant Doctoral Training Account.

The Department was rated 10th in the 2003 Times UK league table and successful applicants will be expected to assist in raising the Department's standing from Grade 4A rating.



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UNIVERSITY OF WALES SWANSEA

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