

## Where will IT end? Using information technology in University education

Adrian V George  
University of Sydney

Peter Tregloan  
University of Melbourne



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## ICT & Education: This lecture will explore

Some general issues involved with using ICT in education at a

- University level
- Department level
- Student level



Sample quantitative and qualitative data collected from 'ChemCAL'

- How students use ChemCAL
- Does this indicate anything about study habits?

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## ICT & Education: Current Climate



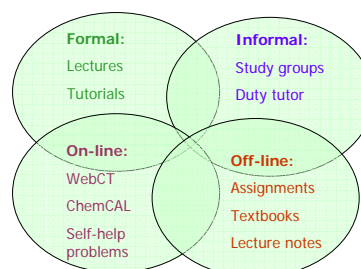
- Contracting resources
- Increasing pressure on academics
- Higher expectations of quality & efficiency
- Expanding student base

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## ICT & Education: Web of Learning



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## ICT & Education: University Issues

- Reputation of University
- Integration
- How to review progress
- Major cultural shift for staff and students
- Provision of central or local resources (hardware + personnel)
- Mission statement



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## ICT & Education: Department Issues

- Cost and efficiency – applications/staff
- Design of material - are the learning objectives changed?
- Who pays for continued support and development?
- Does it work?



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### ICT & Education: Student Issues

- Expectations of University – 'modern' learning
- Access to computer – home or University facility?
- Speed and time of access – are there issues at home for the students?
- Time management – can not use on-line material on the bus!



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### ICT & Education: Advantages to students

#### Flexible learning

- Multi layered program possible
- Comfortable environment
- Feedback at time of work
- Less time on campus (jobs)
- Self paced learning
- Access 24-7



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### ICT & Education: Educational benefits

- Learning styles
  - No single educational package for all
  - Keyboard skills
- Computer ability
  - Excellent for "drill and practice"
  - Not responsive to unexpected question
- Quality Assurance
  - 'External' review



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### ICT & Education: Evaluation

#### Method

- Request for on-line feedback
- Computer usage data
- Student surveys
- Word of mouth

#### Purpose

- Ensure educational benefit
- Improve programs/applications
- Justify current and future resources



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### ICT & Education: The big question

#### Does it work?

- Evaluate what we have
- Review what is new
- Keep this process going



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## ICT & Education: Applications in Chemistry

Replace "wet labs" – simulations

Communication

Support of content

- Presentations
- Asynchronous learning
- Formative and summative assessment



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## ICT & Education: ChemCAL

Aim of this study



- Benchmark USYD and UMELB
- Examine how students use this resource - log data
- Student perception of this resource – questionnaire (N = 737; 460)

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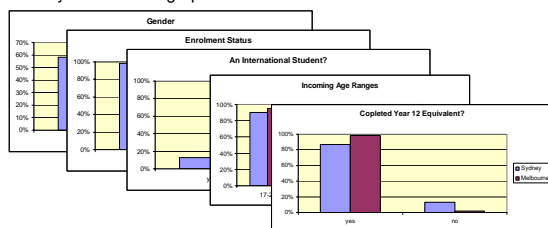
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## ICT & Education: Check of demographics

The population returning the surveys appeared representative of the wider student cohort

Very similar demographics at both Universities



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## ICT & Education: Use of ChemCAL

ChemCAL is used at both USYD and UMELB

- It is constructed of a series of modules with information, animations, questions, hints and explanations
- It is available to all first year chemistry students
- It forms part of a raft of resources
- It is not compulsory

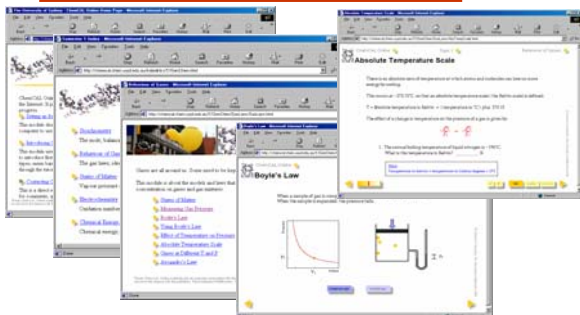


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## ICT & Education: ChemCAL program



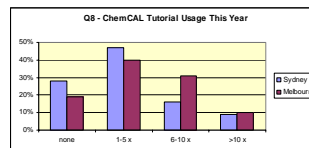
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## ICT & Education: Use of ChemCAL

Students were asked how often they used ChemCAL (N=737, 460)



The majority of students use ChemCAL at least a little

Log data indicates a mix of steady use during the semester and cramming at just before exams

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## ICT & Education: Stoichiometry - summary

Less than 50% get the equation balance correct at their first attempt.

Less than 50% calculate the number of mol of iron from 1 kg of iron oxide (based on an equation which is now correct)

About 60-70% can turn that number of mol into a mass of iron correctly

Hints and explanations were used, but only by ~10-20% of users

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## ICT & Education: Quantum numbers

ChemCAL Online Chemistry 610-141 Atomic Structure

### Quantum Numbers

There are three quantum numbers required to specify unambiguously an atomic orbital while an additional quantum number is needed to identify an electron uniquely.

The quantum number which identifies an orbital within a sub-shell is:  $m_l$

What are the allowed values of  $m_l$  for a given value of  $l$ ?

$m_l = -l, \dots, 0, \dots, l$

$m_l = 0$   
 $m_l = 1$   
 $m_l = 0, 1, \dots, (l-1)$   
 $m_l = 1, 2, \dots, l$   
 $m_l = -(l-1), \dots, 0, \dots, (l-1)$   
 $m_l = -1, \dots, 0, \dots, l$

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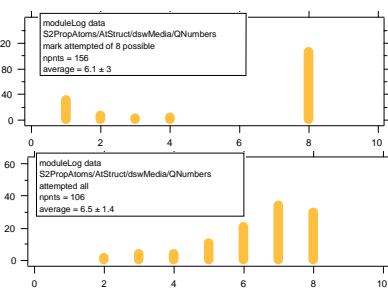
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## ICT & Education: Quantum numbers

How many marks do students attempt?

For students that attempted 8 marks, what was their score?



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## ICT & Education: Nucleophilic substitution

ChemCAL Online Nucleophilic Substitution Reactions Making New Compounds

The substrate shown below can be converted to the product by reaction with an appropriate nucleophile. Choose the required nucleophile from the list, and determine the leaving group that is released in the reaction.



$\text{CH}_3\text{CO}_2^-(\text{aq})$   $\text{OH}^-(\text{aq})$   $\text{NH}_3(\text{aq})$   $\text{CN}^-(\text{aq})$   
 $\text{OCH}_3^-(\text{methanol})$   $\text{OCH}_2\text{CH}_3^-(\text{ethanol})$   
 $\text{CH}_3\text{S}^-(\text{ethanol})$   $\text{C}^+ \text{C}^- \text{CH}_3^-(\text{benzene})$   
 $\text{Cl}^-$   $\text{Br}^-$   $\text{OTos}$

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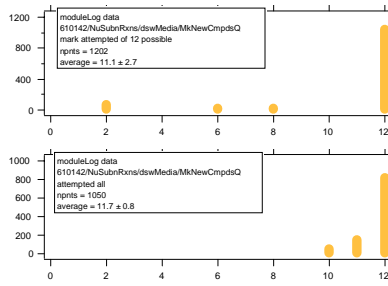
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## ICT & Education: Nucleophilic substitution

How many marks do students attempt?

For students that attempted all 12 marks, what was their score?



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## ICT & Education: Kinetics

ChemCAL Online Chemistry 610-141 Reaction Rates and Kinetics I

### Second Order Reactions

In a first order process, a graph of  $\ln[A]$  vs time is a straight line.

The rate law for a second order reaction,  $\text{rate} = \frac{-\Delta[A]}{\Delta t} = k[A]^2$ ,

can be integrated to give:  $\frac{1}{[A]} - \frac{1}{[A]_0} = kt$

The data shown is for the reaction:  $2\text{NO}_2(\text{g}) \rightarrow 2\text{NO}(\text{g}) + \text{O}_2(\text{g})$

To see a graph of  $[\text{NO}_2]$  vs time click:

[\[NO<sub>2</sub>\] vs time](#)

On paper, draw two graphs:

a)  $\ln[\text{NO}_2]$  vs time

b)  $1/[\text{NO}_2]$  vs time

Which graph is closest to linear?

$\ln[\text{NO}_2]$    $1/[\text{NO}_2]$

time (min)	$[\text{NO}_2]$	$\ln[\text{NO}_2]$	$1/[\text{NO}_2]$
0	0.780	-0.25	1.28
1	0.345	-1.06	2.90
2	0.221	-1.51	4.52
3	0.163	-1.81	6.13
4	0.129	-2.05	7.75
5	0.107	-2.23	9.35
6	0.091	-2.40	10.99
7	0.079	-2.54	12.66
8	0.070	-2.64	14.29
9	0.063	-2.76	15.87
10	0.057	-2.84	17.54

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### ICT & Education: Kinetics

UMELB 86%  
USYD 75%

UMELB 81%  
USYD 56%

UMELB 85%  
USYD 75%

Just show me: **UMELB 5%; USYD 3%**

The data shown is for the reaction:  
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### ICT & Education: Kinetics

Plot graphs; which is linear?:  
**UMELB 72%; USYD 68%**

First or second order?:  
**UMELB 88%; USYD 86%**

From slope determine  $k$   
correct first attempt: **UMELB 59%; USYD 57%**  
correct second attempt: **UMELB 9%; USYD 13%**  
guess & show me: **UMELB 22%; USYD 19%**

In a first order process, a graph of  $\ln[A]$  vs time is a straight line.  
The rate law for a second order reaction:  $\text{rate} = -\frac{d[A]}{dt} = k[A]^2$   
can be integrated to give:  $\frac{1}{[A]} - \frac{1}{[A]_0} = kt$

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7	2.074
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9	2.063
10	2.057

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### ICT & Education: Conclusions - ChemCAL

- Student do use resource & feel they benefit from it
- All or nothing approach but generally high level of engagement
- Some of the basics (eg stoichiometry) can not be assumed – ‘underpinning’ material need to be available
- Students do perform well on questions given time (how does this translate to pressure of exams?)

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### ICT & Education: Big issues

**University**  
Ongoing support for ICT developments supported by one-off grants  
Workload issues for academics involved

**Department**  
Can we help students use their own IT and communication for self-learning networks

**Student**  
Social and technical issues with students studying at home

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### ICT & Education

## The End




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