APPLYING TECHNOLOGY TO ENHANCE CHEMISTRY EDUCATION

Chemistry Is All Around Us Network Conference – *Initiatives in Chemistry Teacher Training*, 29th Nov. 2013

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1. Background and Introduction

2. Examples of Applying Technology in Teacher Education in Chemistry

3. Examples of Using Technology at Second Level to Enhance Chemistry Education

4. Examples of the Application of Technology to Improve Chemistry Education on Introductory Undergraduate Chemistry Courses

5. Over to You / Conclusion

#chemistryisallaroundus
@clairemcdonndit
Being Guest Editor on a Themed Issue of Chemistry Education Research & Practice was ...

An experience that allowed me to learn a huge amount about the review and editorial process and about current work in using technology to improve chemistry education.

A considerable amount of work with very tight turnaround times and deadlines.

But ...
E-learning – should the E also stand for enhanced?
### CERP Themed Issue – Themes and Article Titles

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- 16 in-service teachers in Israel (aged 40-62).
- Development of content knowledge, technological knowledge and pedagogic knowledge as well as technological pedagogical content knowledge (TPACK) examined (survey, interviews, analysis of videos).
- Self efficacy also assessed.
- Development of YouTube video editing skills in the context of chemistry topics the teachers wanted to teach for a given pedagogic purpose.
- Free software used - Movie Maker.
2. Diagnosing pre-service science teachers’ understanding of chemistry concepts by using computer-mediated predict-observe-explain tasks, *Sesen*.

- 22 pre-service teachers in Turkey (University of Istanbul).
- Videos were used to allow students to compare their predictions with observations of events.
- Topics were surface tension, cohesion, and adhesion forces.
- Participants then developed explanations for what they observed.
3. Using wiki to create a learning community for chemistry teacher leaders, Shwartz and Katchevitch.

- 20 in-service chemistry teachers (aged 32-52) in Israel.
- Used a wiki learning environment in a professional development programme for teacher leaders – series of tasks.
- Questionnaires, interviews and thorough analysis of wiki contributions and collaborative result.
- Resulted in the development of a functioning collaborative team.
- Some evidence that increased wiki participation was linked to having a more learner-centred perspective on teaching.
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- 78 second level students (16 years old) in two schools and study performed in two academic years. Control group used.
- “Does watching a simulation on a computer screen while attempting to solve a problem have an effect on students’ ability to solve the problem?”
- Two problems (ideal gas law). Simulation shown after 15 minutes.
- Students who had used simulations recorded a higher achievement.
5. On the development of a computer-based learning and assessment environment for the transition from lower to upper secondary chemistry education, *Krause, Kienast, Witteck and Eilks*  
- Online environment for students to develop their own understanding of topics at lower secondary level before progressing to upper secondary level.

- Detailed study on simulation design using liquid-vapour equilibrium as an example.  
- Second and third level learners were participants.
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7. How does viewing one computer animation affect students’ interpretations of another animation depicting the same oxidation-reduction reaction?, *Rosenthal and Sanger*.

- United States, viewing simpler simulations before more complex ones allowed learners to explain what they were observing more effectively.
- Attributed to the reduced extraneous cognitive load for viewing the simpler animation.
8. Implementation and assessment of cognitive load theory (CLT) based questions in an electronic homework and testing system, Behmke and Atwood.

• Cognitive load theory applied to the design of online homework for an introductory chemistry course in the United States.
• Learners facilitated to develop mastery of the stages of answering online chemistry questions.
• Multistep problems down into smaller steps and gradually reduce the support provided to the learner on a phased basis - method called “static fading”.

Applying Technology to Enhance Chemistry Education | Third level


- Study carried out in United States.
- Use of interactive simulations to provide implicit scaffolding to students undertaking guided inquiry activities.
10. Line up, line up: Using technology to align and enhance peer learning and assessment in a student centred foundation organic chemistry module, Ryan.

- Large first year group in Dublin Institute of Technology; technology used to facilitate peer learning.
- Personal response systems (Socrative app for smart phones an option also).
- PeerWise software - provides structure and support for independent learning by allowing learners to create, answer, review and discuss multiple choice questions (Web 2.0 model).
- Online multiple choice question assessment method hosted in a secure virtual learning environment.
- Technology facilitated student debate & student centred discussion.
• Example from my own practice
• Piloted in 2012-13 with about 50 First year students.

http://peerwise.cs.auckland.ac.nz/

Assignment:
“You are required to
1. Write 2 x MCQs with 4 possible answers (1 correct answer and 3 distractors) and feedback and input them into the PeerWise software.
2. Answer 5 x MCQs prepared by your class colleagues.
3. You must comment on and rate 3 x MCQs developed by your peers”
Intro to Med Chem

People

Students (who've contributed questions)

47

Highest Reputation scores

Highest Reputation scores of all students in this course

<table>
<thead>
<tr>
<th>Rank</th>
<th>Total Reputation score (components)</th>
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<tr>
<td>1</td>
<td><strong>2042</strong> (52q, 253a, 124r)</td>
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<tr>
<td>5</td>
<td><strong>1460</strong> (21q, 191a, 90r)</td>
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Questions

- Display participation summary
- View scores of all students
- View badges earned by students
- Show users in leaderboard tables
- Display user list for this course

- View individual questions
- Export all questions
- Import questions from course
I wrote it because I was hoping only people who attended the lecture would get it right.

Fairly certain you should have converted your volume units into m³. Still it's a nice question.

Boyles Law, \( P_1V_1 = P_2V_2 \)
You rearrange the equation to get \( V_2 \).
So the equation is then \( \frac{P_1V_1}{P_2} = V_2 \)
The pressure is in kPa so you multiply by 1000 to get it into Pa.
The author left the volume units at cm³ even though they should have been converted to m³.
Wikis – Example from my own practice

Molecules that Matter Assignment

• Used during Weeks 3 to 6 of a Professional Skills module with Year 3 students (BSc Medicinal Chemistry & Pharmaceutical Sciences) since 2009.

• Groups of 3-6 students prepare a webpage on a molecule that they choose from a selection provided.

• Target audience is senior cycle secondary school students.
## Team 3 - Lysergic acid

**Molecular formula:** C15H16O2N2 (1)
**Melting point:** 238-240\(^\circ\) (1)
**Number of chiral carbons:** 2
**Synthesis**

byergoline fungioscuring on ryefrom [tryptophan](#) and DMAPP
involving 7 enzymatic another non-enzymatic step (2).

[Biosynthesis of lysergic acid from tryptophane](#)

Lysergic acid can be prepared semisynthetically by isomerization of paspalic acid with potassium hydroxide or sodium hydroxide (7).

## Comparing versions of Team 3 - Lysergic acid

Showing changes between **March 13, 2009 at 4:55:01 pm (crossed-out)** and **March 13, 2009 at 7:07:25 pm (underlined)**
Assessment Marks Example

Wiki page (group): 50%.  
**Individual** contribution: 50%

Average for **group** wiki mark (2012-3): 72 ± 5

Average for **individual** wiki mark (2012-3): 68 ± 13.5
Conclusions and Further Information

• Information and communication technology should not replace good teaching practice but it can complement and enhance it and should only be incorporated if it improves learning.

• The teaching role now will often encompass engaging students actively in learning, facilitating group collaboration and supporting self-regulated learning. Technology can often provide an effective means to achieve this.
Seery, M. K.; McDonnell, C. Chemistry Education Research and Practice 2013, 14, 227

Hopefully some of the technology applied in these articles may be useful to Chemistry teaching and learning in your context (or you may be using it already)

• The special issue of Chemistry Education and Practice is available here; http://pubs.rsc.org/en/journals/journalissues/rp#!issueid=rp014003&type=current
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