Variety in Chemistry Education 2012

and

Physics Higher Education Conference 2012

University of Edinburgh

30-31 August 2012
This year's conference is generously supported by the Royal Society of Chemistry Tertiary Education Group and Education Division, the Institute of Physics and the Higher Education Academy.

Organising Committee
Ross Galloway
Tina Overton
David Sands
Natalie Rowley
Simon Bates
Karen Moss
Programme

Thursday 30th August

10.00  Arrival, registration, coffee

10.50-11.00  Welcome and introduction

11.00-11.45  **Keynote lecture**  
From test tube to YouTube  
*Martyn Poliakoff, University of Nottingham*

11.45-12.45  **Oral presentations**  
The Flipping Lecture  
*Simon Lancaster, University of East Anglia*  
Chemistry Clips: Multimedia resources for teaching problem solving  
*Dylan Williams, University of Leicester*  
Supporting learning though the use of pre-lecture screencasts  
*Katherine Haxton and Dave McGarvey, Keele University*  
A level playing field? Students’ experience of assessment in STEM disciplines  
*Alison Kay, University of Edinburgh*

12.45-13.15  **Oral bites**  
Strategies to improve interactions between international and home students to enhance learning and teaching  
*Gita Sedghi, University of Liverpool*  
Analysing and improving the engagement of international students in online learning  
*Simon Collinson, The Open University*  
Student reflections on laboratory reports  
*Martin Pitt, University of Sheffield*  
Students making videos about lab classes  
*Paul Taylor, University of Warwick*  
Taking the experiment home: Can you invert the laboratory?  
*Helen Vaughn and Lynn Moran, University of Liverpool*

13.15-14.00  Lunch

14.00-15.30  **Choice of parallel workshops**  
Wikis: What are they and how are they used to assess group assignments?  
*Claire McDonnell and Michael Seery, Dublin Institute of Technology*  
Ill-structured problems in physical science: Is it discipline specific? A qualitative research approach  
*Tina Overton, Marsali Wallace, Ross Galloway, Universities of Hull and Edinburgh*  
Microscale chemistry activities for the ‘traditional’ chemist  
*Bob Worley, Brunel University*

15.30-16.00  Tea/coffee
16.00-17.00  **Choice of parallel sessions of oral presentations**

**Focus on physics**
Conceptual understanding in physics (30 mins, several presenters)
*Derek Raine, University of Leicester, et al*
An understanding of gender differences in conceptual understanding of Newtonian mechanics
*Niels Walet and Marion Birch, University of Manchester*
The Gateway to Physics & Engineering – a novel widening participation programme
*Lucy Hadfield, University of St Andrews*

**Focus on chemistry**
Formative assessment: Carrots and sticks
*Stephen Ashworth, University of East Anglia*
Tracking career aspirations of undergraduate chemists
*Tina Overton, Ruth Mewis and Mike Cole, University of Hull, HEA and MMU*
Making the ordinary extraordinary: Employability though PBL and practical work
*Karen Moss, Nottingham Trent University*
Design a fireworks show: A context and problem-based approach to transferable skills training
*Gan Shermer, University of Bath*

**Focus on chemistry laboratories**
Turning lab problems to educational advantage
*Jenny Burnham, University of Sheffield*
Evaluating RELITE: Student perceptions of learning in a redesigned lab course
*Jacqui Robson, Durham University*
Creative thinking: A new approach to chemistry labs
*Julita Gasowska, Durham University*
Developing research ready undergraduates
*Anna Bertram, University of Nottingham*

17.05-17.50  **Keynote lecture**
Creating, implementing, and validating educational materials for third-level science
*Paul van Kampen, Dublin City University*

18.00  RSC TEG AGM for members of TEG

**Friday 31st August**

9.00-9.45  **Keynote lecture**
Enhancing the Student Experience in Undergraduate Chemistry
*Dave McGarvey, Keele University*

9.45-10.45  **Oral presentations**
PeerWise 30 min (3 combined)
*Morag Casey, University of Glasgow, Judy Hardy, University of Edinburgh, Kyle Galloway, University of Nottingham*
Getting turkeys to vote for Christmas: Self-assessed summer vacation work
*David Read, University of Southampton*
Taking the timetable out of oral presentations
Katherine Haxton, Keele University

10.45-11.15  Tea/coffee

11.15-12.45  **Choice of parallel workshops**
Business skills resources for chemistry in HEIs
*Samantha Pugh, Patrick McGowan, University of Leeds, Paul Taylor, University of Warwick, Kevin Parker, KKI Associates*
Delivering effective practical science online
*Eleanor Crabb and Nick Braithwaite, Open University*
Screencasts for all: Getting started with screencasting in Camtasia
*David Reed and Simon Lancaster, Universities of Southampton and East Anglia*

12.45-13.30  Lunch

13.30-14.45  **Choice of parallel oral presentations**
**Focus on physics**
*New Physics curriculum*
*Helen Vaughn and Lynn Moran, University of Liverpool*
Role of assessment type on gender performance
*Robyn Donnelly, University of Edinburgh*
Development of problem solving ability in second level physics
*Bruce Sinclair, University of St Andrews*
Students’ use of resources whilst solving problems
*Marsali Wallace and Ross Galloway, University of Edinburgh*
Interactive teaching in group online synchronous tutorials for astronomy
*Anne Campbell and Lisette Petrie, The Open University*

**Focus on chemistry**
Developing a distance learning module in analytical chemistry for practitioners in industry
*Matthew Almond, University of Reading*
Developing and trialling PBL resources for chemistry students
*Dylan Williams, University of Leicester*
Addressing research informed teaching in and out of the curriculum
*Neil Williams and Gillian Lambe, Kingston University*
Can I have a word please? Strategies to enhance understanding of subject specific language
*Simon Rees and Megan Bruce, Durham University*
Peer assisted learning compliments peer mentoring
*Gita Sedghi, University of Liverpool*

**Focus on chemistry laboratories**
Good laboratory practice
*Julita Gasowska, Durham University*
Handling the equipment and the concepts: A first lab class
*Martin Pitt, University of Sheffield*
Video podcast pre-labs for enhancing learning
*Roy Lowry, Plymouth University*
Students’ perceptions of a chemistry lab course
*Stephen Ashworth, University of East Anglia*
Chemistry and physics laboratories: Do students think they are worth the effort?
*Peter Sneddon, University of Glasgow*

14.50-15.30 Oral bites
Addressing the Employability Agenda
*Alison Voice, University of Leeds*
New Quantum Curriculum
*Derek Raine, University of Leicester*
Storify
*Simon Lancaster, University of East Anglia*
Enhancing students learning using the SMART Posium
*Gita Sedghi, University of Liverpool*
Founding Chaucer University
*Richard West, Chaucer Education Project*
Towards a theory of conceptual understanding
*David Sands, University of Hull*
Developing and evaluating quantum mechanics animations for physics and chemistry students
*Antje Kohnle et al, University of St Andrews*
Mark schemes, model answers and assessment for learning
*Kristy Turner, University of Manchester*

15.30-15.40 Closing discussion

15.40 Coffee/tea, depart
Keynote Lectures

1. From test tube to YouTube
   Martyn Poliakoff, University of Nottingham

2. Creating, implementing, and validating educational materials for third-level science
   Paul van Kampen, Dublin City University

3. Enhancing the Student Experience in Undergraduate Chemistry
   Dave McGarvey, Keele University
1. **From TestTube to YouTube: A tribute to Ronald Nyholm**  
   **Martyn Poliakoff**  
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   This lecture tells a story of something which came as a complete surprise to me. It explains how my participation in making some videos for the University of Nottingham’s YouTube channel, www.test-tube.org.uk led to my collaborating with a very talented video-journalist Brady Haran, www.bradyharan.com and the creation of the YouTube channel, The Periodic Table of Videos, www.periodicvideos.com. This began as a collection of 120 videos (one for each of the 118 elements of the Periodic Table, plus an introduction and a trailer). Quickly, it gathered momentum and now (10 pm on 15th July 2012) has 412 uploaded videos with 90,124 subscribers and a total >23.6M views in over 200 countries. In this lecture, I explain how the concept has developed over the four years of the project suggest tentatively how the channel came to be successful. In 2011, I was fortunate to win the RSC Ronald Nyholm Prize for Education, for my work via YouTube, and so the material will be presented in the form of a tribute to Ronald Nyholm

   I particularly thank Brady Haran for his friendship and outstanding work. I am also very grateful to my fellow presenters on Periodic Videos, Pete Licence, Debbie Kays, Steve Liddle, Neil Barnes, Darren Walsh, Sam Tang, Rob Stockman, John Moses and Andrei Khlobystov and to all of those who have let us visit their laboratories or archives. I also thank the organizations which have sponsored PTOV including EPSRC, COST, the University of Nottingham, Briggs plc, the RSC, Aldrich Chemicals, Microsoft, Anamax Charitable Foundation and the RACI

   3.**”The Periodic Table of Videos“ SPORE Essay - Science Prize for Online Resources for Education (B Haran and M. Poliakoff) Science (2011) 332, 1046-1047.  

2. **Creating, implementing and validating educational materials for third-level science**  
   **Paul van Kampen**  
   Physics, Dublin City University  
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   Having been trained as an experimental physicist, I changed my research area to that of physics education research some 10 years ago. My research mostly concerns the identification of problems students have in certain areas of physics, and the design, development, implementation and validation of educational materials to address these problems. This does not just concern factual, conceptual or mathematical difficulties; it is also about the nature of science, and about students appreciating and enjoying what science is about.

   In this talk, I will share some of my experiences: how I got to incorporate and make sense of qualitative research methods, and how my research influenced my teaching, be it in lectures, labs, or tutorials. Many of my experiences would likely apply as much to chemists as to physicists
wishing to make a contribution to the body of research, and I will focus on these. I will discuss the teaching and learning of different student cohorts: undergraduate science students, and pre-service and in-service science teachers.

3. Enhancing the Student Experience in Undergraduate Chemistry

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Over the past ten years I have been active in the design and development of approaches to teaching, assessment and feedback that aim to engage and challenge students, develop their skills and enhance their learning. Much of this work has centred on the design and development of undergraduate laboratory practical activities, ranging from simple enhancements of standard laboratory practicals to new practicals that combine real-world contexts with the development of a range of transferable skills [1]. I have also employed technology extensively in teaching and assessment of undergraduate chemistry, including the use of digital audio for feedback [2] and the use of screencasts for teaching and feedback. I will describe and reflect upon some of these approaches in the light of my own experiences, feedback from students and the increased prominence of employability and Graduate Attributes within Higher Education in the 21st century.

Oral Presentations

1. The Flipping Lecture
   *Simon Lancaster, University of East Anglia*

2. Chemistry Clips: Multimedia resources for teaching problem solving
   *Dylan Williams, University of Leicester*

3. Supporting learning though the use of pre-lecture screencasts
   *Katherine Haxton and Dave McGarvey, Keele University*

4. A level playing field? Students’ experience of assessment in STEM disciplines
   *Alison Kay, University of Edinburgh*

5. Conceptual understanding in physics (30 mins, several presenters)
   *Derek Raine, University of Leicester, et al*

6. An understanding of gender differences in conceptual understanding of Newtonian mechanics
   *Niels Walet and Marion Birch, University of Manchester*

7. The Gateway to Physics & Engineering – a novel widening participation programme
   *Lucy Hadfield, University of St Andrews*

8. Formative assessment: Carrots and sticks
   *Stephen Ashworth, University of East Anglia*

9. Tracking career aspirations of undergraduate chemists
   *Tina Overton, Ruth Mewis and Mike Cole, University of Hull, HEA and MMU*

10. Making the ordinary extraordinary: Employability though PBL and practical work
    *Karen Moss, Nottingham Trent University*

11. Design a fireworks show: A context and problem-based approach to transferable skills training
    *Gan Shermer, University of Bath*

12. Turning lab problems to educational advantage
    *Jenny Burnham, University of Sheffield*

13. Evaluating RELITE: Student perceptions of learning in a redesigned lab course
    *Jacqui Robson, Durham University*

14. Creative thinking: A new approach to chemistry labs
    *Julita Gasowska, Durham University*

15. Developing research ready undergraduates
    *Anna Bertram, University of Nottingham*

16. PeerWise 30 min (3 combined)
    *Morag Casey, University of Glasgow, Judy Hardy, University of Edinburgh, Kyle Galloway, University of Nottingham*
17. Getting turkeys to vote for Christmas: Self-assessed summer vacation work  
   *David Read, University of Southampton*

18. Taking the timetable out of oral presentations  
   *Katherine Haxton, Keele University*

19. *New Physics* curriculum  
   *Helen Vaughn and Lynn Moran, University of Liverpool*

20. Role of assessment type on gender performance  
   *Robyn Donnelly, University of Edinburgh*

21. Development of problem solving ability in second level physics  
   *Bruce Sinclair, University of St Andrews*

22. Students’ use of resources whilst solving problems  
   *Marsali Wallace and Ross Galloway, University of Edinburgh*

23. Interactive teaching in group online synchronous tutorials for astronomy  
   *Anne Campbell and Lisette Petrie, The Open University*

24. Developing a distance learning module in analytical chemistry for practitioners in industry  
   *Matthew Almond, University of Reading*

25. Developing and trialling PBL resources for chemistry students  
   *Dylan Williams, University of Leicester*

26. Addressing research informed teaching in and out of the curriculum  
   *Neil Williams and Gillian Lambe, Kingston University*

27. Can I have a word please? Strategies to enhance understanding of subject specific language  
   *Simon Rees and Megan Bruce, Durham University*

28. Peer assisted learning compliments peer mentoring  
   *Gita Sedghi, University of Liverpool*

29. Good laboratory practice  
   *Julita Gasowska, Durham University*

30. Handling the equipment and the concepts: A first lab class  
   *Martin Pitt, University of Sheffield*

31. Video podcast pre-labs for enhancing learning  
   *Roy Lowry, Plymouth University*

32. Students perceptions of a chemistry lab course  
   *Stephen Ashworth, University of East Anglia*

33. Chemistry and physics laboratories: Do students think they are worth the effort?  
   *Peter Sneddon, University of Glasgow*
1. **The Flipping Lecture**  
   *Dr Simon J. Lancaster*  
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   In the classic pattern of University education a student attends a lecture and is expected to work independently to try to understand and apply the material covered. In the flipped lecture approach a screencast recording of a classic lecture is published online and watched in advance by the students. The contact hour itself is used to deliver a highly interactive problem solving session utilising an eclectic mixture of low and high tech audience response devices. Preliminary evaluation will be presented.

2. **Chemistry Clips - Multimedia Resources for Teaching Problem Solving in Chemistry**  
   *Dr Dylan P Williams*  
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   The use of multimedia resources has become increasingly significant in undergraduate chemistry teaching recently. A number of implementations of multimedia resources have recently been demonstrated ranging from full lecture capture\(^1\) to screen capture clips.\(^2\)\(^-\)\(^4\)

   A series of short focused multi-media resources were developed based on areas of the chemistry and interdisciplinary science degree courses that students often have difficulty with (including molecular symmetry, group theory and introductory biosynthesis) based on the approaches described above and a similar project in Engineering at Leicester.\(^5\) The resources were generated by producing PowerPoint slideshows and using Adobe Presenter to add speech. Incorporation of animations and other interactive elements was found to be much more difficult (Flash animations embedded into these presentations occasionally failed to appear correctly). Evaluation of student attitudes towards the resources revealed that they were appreciated by students and they were particularly useful for distance learners and for exam revision. A number of improvements were suggested such as the inclusion of more in-depth content. The development of these types of resources can be done by final year undergraduate project students.

   This presentation will describe the production of these resources as well as the findings from an evaluation of the use of the clips by undergraduate students on the chemistry and i-science degree courses at the University of Leicester.

We have employed pre-lecture screencasts within the chemistry curriculum at Keele University for the purposes of (i) pre-lecture preparation, (ii) releasing timetabled contact time for more interactive student-centred learning activities and (iii) as post-lecture learning resources to provide flexibility for students to learn at a time and pace that better suits individual learning styles. We have also employed screencasts to provide cohort assessment feedback and as ‘how to’ guides in the use of software and online resources [1,2]. Pre-lecture screencasts have been prepared on a range of topics within the 1\textsuperscript{st} and 2\textsuperscript{nd} year chemistry curriculum and include a suite of screencasts on mathematics for chemistry. We have used Camtasia Studio [3] software combined with tablet laptops to capture synchronous digital pen annotations, mouse movements and narration and we have employed features that enable students to pause, scroll and navigate the screencasts and to be able to access them provided they have access to the internet. The use of pre-lecture screencasts has enabled us to release valuable contact time for more interactive learning activities such as problem-solving workshops, lecture self-tests, discussion and clicker quizzes. Student feedback on the pre-lecture screencasts is overwhelmingly positive as demonstrated by the following representative student comments:

- ‘I think that the screencasts are an important part of my study as it helps me to understand topics better and at my own pace’.
- ‘Screencasts improve understanding before and after lectures’

(Feedback from Keele 1\textsuperscript{st} Year Chemistry Students 2011-12)

We will also discuss the pros and cons of screencasts as well as offering some practical ‘how to’ tips and other applications of the technology.

4. **A level playing field? Students’ experience of assessment in STEM disciplines.**

   Alison Kay  
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   The first year of study at a new university is a critical time of transition for all students, whether at undergraduate or postgraduate level. The challenges of settling in to a new learning environment are heightened for international students, who are faced with a range of additional challenges and pressures. They have to contend with adapting to life in a new country and a new culture as well as adjusting to approaches to teaching and learning, which may be very different to their previous experiences.

   There is some evidence that international students perform significantly less well than home students in essay based assessments; however, there has been little research to date within STEM disciplines. Although assessments in these subject areas are perhaps less critically dependent on language skills, many other factors may affect international students’ performance, for example prior educational and assessment experiences and a different ‘base’ of subject knowledge compared to UK students.

   We present results from a project which aims to unpick these differences, not just in final exams or overall course marks, but also across the variety of assessment tasks that comprise the continually assessed components of many courses. The focus is on students in their first year of study in a range of scientific disciplines at the University of Edinburgh, at both undergraduate and taught masters level.

   We will highlight differences in undergraduate attainment at both course and discipline level, taking into account students’ prior educational backgrounds. We will also present results from two questionnaires, completed by both undergraduate and postgraduate students, asking about students’ previous experiences of assessment; their experiences thus far at Edinburgh; and their views about the purposes of assessment and feedback.

5. **Conceptual Understanding in Physics**

   Derek Raine *(with David Sands, Sam Nolan and Antje Kohnle)*  
   *University of Leicester*  
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   The talk will report on the HESTEM project to enhance students’ conceptual understanding through a variety of approaches. Derek Raine will introduce the project and the web site of resources. The presentation will also include short talks on some of the specific sections of the web site by David Sands on the use of modelling, Sam Nolan on the use of laboratory simulations, Antje Kohnle on an annotated bibliography of multi-media resources and Derek Raine on the use of vodcasts explaining common misconceptions.
6. An investigation of gender differences in conceptual understanding of Newtonian mechanics

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At the University of Manchester we have been using the Force Concept Inventory (FCI)\(^1\) to evaluate our first year students’ conceptual understanding of Newtonian mechanics before and after instruction, for the past four years. Data have been obtained on over 900 students (~20% females). Analysis of these data has revealed a significant difference in the mean scores obtained by male and female students, with the males outperforming the males by 10-20%.

We have compared our data with similar data obtained by Docktor and Heller\(^2\) at the University of Minnesota. Although our students’ mean scores are somewhat higher than those obtained by students at Minnesota, we observed some fascinating similarities when we analysed the answers to individual questions. At both Manchester and Minnesota, the male students perform better than the females on nearly all of the thirty questions on the FCI. However we were surprised to find that the gender gap is greatest for the same questions at both universities. We will present an analysis of the most common incorrect responses given by the students and discuss the implications in terms of the misconceptions which appear to be most prevalent amongst female students.

References:

7. The Gateway to Physics & Engineering – a novel widening participation programme

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The “Gateway to Physics and Engineering” is a new and innovative widening participation programme that has been running since 2010 in the School of Physics and Astronomy. Its primary purpose is to widen access to St Andrews for students from non-traditional backgrounds who do not meet our current entry grades of AAAAA at SQA Higher or equivalent.

The Gateway programme provides an intensive first year in physics and mathematics for up to 15 students. Gateway first year students spend roughly half of their time on existing maths and
physics modules, and half working as a cohort with a dedicated tutor. Building confidence, instilling a good work ethic, and developing key academic skills are the primary goals during level one. The other half of their time is spent on traditional core physics and mathematics modules with additional support and tutoring provided by the Gateway tutor. On completion, the Gateway year opens up progression to second year physics, mathematics or astronomy courses at St Andrews.

Over the past three years the programme has admitted 42 students (12 in 2010, 15 in 2011 and 15 students expected in 2012). The first cohort has now progressed into our honours programme with some students performing exceptionally well in level two modules. Here I present an overview of the programme and the activities developed for the three dedicated Gateway modules. I also present results of preliminary evaluation of students’ progress in terms of novice/expert attitudes towards physics and learning gains.

8. **Formative assessment: carrots and sticks.**
   
   *Stephen H. Ashworth*
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   Chemistry students often appear to struggle with basic mathematical manipulations when tackling physical chemistry. Is this due to a lack of competence or a lack of confidence? This presentation will illustrate the potential positive effects of mandatory engagement with practice questions.
   
   The strategy of mandatory engagement will be outlined and the mechanism used here for generating many unique practice questions with tailored feedback will be covered. Finally the result of the intervention on exam scores will be discussed.

9. **Tracking career aspirations of undergraduate students**
   
   *Tina Overton (University of Hull), Ruth Mewis (Higher Education Academy), Mike Cole (Manchester Metropolitan University)*
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   Are academic staff aware of the career aspirations and motivations of their undergraduate students? Do undergraduates’ career aspiration change over time? Do they differ between institutions? We attempted to answer these questions by carrying out a survey of career aspirations, motivations to student chemistry, and perceived career planning support needs of undergraduates on all years of BSc and MChem programmes at our two universities. This presentation will describe our findings and discuss their implications for student support and careers advice.
10. Making the Ordinary Extraordinary – Developing employability through PBL and Practical work

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On 16th March 2011 David Willetts¹ stated “Shortages in critical areas are also compounded by the variable quality of UK graduates’ practical laboratory skills – which raises some questions about some university curricula and current levels of engagement between universities and industry.”

STEM graduates have identified ‘development deficits’ in their degree programmes in areas of key skills for employment (e.g. oral-presentation skills, time-management, team-work, problem-solving and planning /designing experiments).²]

There is also clear evidence that employers of STEM graduates require a different profile of skills from their future employees to meet the changing demands of the market place; with high levels of professional STEM skills plus well-developed personal and transferable skills. However employers often feel that STEM graduates are poor at evidencing their practical and professional skills hence limiting their employability.³

In our HESTEM project we developed approaches to improve the ability of STEM students to articulate their practical and professional skills, and enhance their employability. Our project has involved students from Chemistry, Physics, Forensic Science & Computing and has developed:

- A process of employer engagement in the design and running of an industrially relevant curriculum with skills-based assessments
- The development of problem-based learning materials – that increase students’ engagement with their learning and foster the skills and qualities industry seeks
- Competency based assessments which focus on both practical/professional competencies and transferable skills in a robust manner.
- Using skills mapping and portfolios to evidence skill development in chemistry and forensics

Examples to be discussed include:
- i) The conversion of an ordinary lab experiment into an extraordinary problem-based learning exercise that crossed two year 1 chemistry modules
- ii) The development of competency based assessment in physics and chemistry practicals
- iii) Development of a portfolio assessment tool for Digital Imaging in Forensics

Several reports have identified that STEM graduates feel there is a lack of opportunity to develop key skills during their degree and that this is often felt by their employers.\(^1\) This deficit was highlighted in an RSC report which recommended that Universities should embed training in transferable skills, ideally using context and problem based learning (CPBL).\(^2\) Although a bank of CPBL resources already exists, this project (funded by HE STEM SW) aimed to develop a discipline appropriate resource which provided students with an opportunity to develop some key scientific and transferable skills such as enterprise, commercial awareness, risk assessment, teamwork and communication in a fun and engaging way without particularly focussing on learning chemical content.

The activity tasks students with designing and running a simulated fireworks display, through which the students develop key transferable skills and use some basic undergraduate chemistry and physics knowledge. The project is based on good practice from a similar Institute of Physics project which was initially designed for secondary school pupils.\(^3\)

The resources have been developed with involvement from industry and alumni allowing us to improve the alignment between skills needs of employers of STEM graduates and the needs of the graduates themselves. In addition, the use of student peer-mentors in the activity has the additional benefit of improving the communication and employability of these students as well as those undertaking the task.

The project is readily transferable to other STEM departments as the task involves basic mechanics, numeracy and general science. The presentation will outline the design process; the resources and evaluation data gained, and include feedback from undergraduate and postgraduate students involved in the project. In addition the published resources will be freely available to others in Higher Education.

\(^1\) “Skills Required by New Chemistry Graduates and their Development in Degree Programmes”, Higher Education Academy, UK Physical Sciences Centre, November 2010: see http://www.heacademy.ac.uk/assets/ps/documents/graduate_skills/chemistry.pdf (accessed Jan 2012)


\(^3\) Nottingham Science City Future Skills Group (2008) and employers forum for this project (October 2011)
12. Turning teaching-lab problems to educational advantage

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This session will outline the development of a new strategy for dealing with recurrent problems in teaching lab practicals. Unless they can be rectified, problems with practicals undermine the good intentions of a lab course and detract from the quality of the student learning experience. If the cause of a problem is not obvious, it cannot be fixed quickly. Sitting tight until the end of the academic year and hoping that not too many students notice is not a moral solution to a problem. Replacing a problem practical can only be done if a suitable spare has been tested and can be supported by existing lab resources and chemicals.

Two instances where problem practicals have been turned into “mini-projects” will be described. In the first instance, students were asked to extend a practical involving the isolation of metal complexes of DMSO by deviseing methods to isolate similar complexes for which no suitable route had been reported. In the second instance, students were set to work exploring a series of problems that had arisen with the neutralisation of the acetylation of ferrocene. These mini-projects worked well because, being based on existing teaching-lab practicals, the chemistry and skill sets were at a suitable level for the students.

Mini-projects give students the opportunity to engage with laboratory work and analytical techniques more fully than they would in the normal proscribed lab programme. The mini-projects described have proven to be a lot of work, a lot of fun, and unexpectedly informative about the effectiveness of the laboratory curriculum. The lessons learned from these experiences will be reported and discussion invited on whether this type of activity can become an integral part of a laboratory curriculum.

13. Evaluating RELITE: Student perceptions of learning in a redesigned first year chemistry laboratory course

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The HE STEM-funded project “RELITE (Research-Led Innovative Teaching Experiments): Reinventing First Year Laboratory Courses” saw the redesign of the first year chemistry laboratory course at Durham University to embed a more integrated, research-led ethos more in
keeping with the current university education strategy and to move away from a very rigidly traditional approach. More context- and inquiry-based learning activities, opportunities for problem-solving, group- and team-working exercises and the provision of resources for independent study to both support learning and to stretch and challenge the most able students were introduced. In addition, strategies were implemented to ease the transition from sixth form practical lessons to the undergraduate laboratory for incoming first year students in the Chemistry, Natural Science and MBB (Molecular Biology and Biochemistry) degree courses.

The course was implemented during the 2011-2012 academic year. As part of the evaluation of the new course, student perceptions of their learning in the laboratory were examined. This data was collected by recording the discussions held in a number of student focus groups followed by analysis of the key themes and patterns. Unprompted written comments made by students as part of the standard course evaluation questionnaires provided centrally by the department were also analysed. Student perceptions of their learning were then used to identify strengths of the new laboratory course and to address areas requiring further development.

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In an increasing competitive market, Chemistry students need to be able to exceed expectations. For those students who will not work in industry or laboratories, our improved Advanced Organic Chemistry course offers transferable skills that will enhance their career prospects.

There is a scope for promoting the problem-solving or creative thinking activities essential for a deep-learning outcome so important for the businesses and institutions that will employ them after University. Without these set of skills, their competitiveness will continue to decline over time. Employers are increasingly interested in individual initiative, creativity and adaptability: students able to face challenges in different contexts using their Chemistry knowledge.

Our redesigned course is based on a project that each student has to conduct during their twelve-day period laboratory sessions. These sessions start with the Wittig reaction which offers a solid base for future, more advanced Chemistry as it requires essential skills such as how to set up an overnight reaction with temperature control, vacuum distillation to purify liquids, etc.

The project is based on the most recent discoveries to offer relevant, up-to-date information on the latest developments in the field. We offer students the chance to make their own choices along the way to promote initiative, self-confidence, problem-solving and time-management skills.

The approach we are presenting focuses on developing the technical skills vital in the research laboratory. We believe our project will instil a curiosity-driven approach and a research-oriented mind-set that will allow students to face unforeseen challenges in their professional lives.
15. Developing Research Ready Undergraduates

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The practical courses at Nottingham had remained largely traditional with students following detailed experimental procedures during the first three years of the degree course. When students started research projects in their 4th year they initially lacked many of the skills required to be successful researchers and found the contrast in practical approach challenging.

Over the past three years we’ve developed mini-research projects which all 3rd year students take with the aim of bridging the gap between ‘recipe-style’ practical's and research. Students do three mini-projects over the course of the year, one in each section of organic, inorganic and physical chemistry. Students are given a brief outline of the aim of the project and then work in a team, with the support of an academic, to devise a research plan to address the problem posed. At the end of the project students are required to write a report in the style of a scientific paper and do an oral presentation.

Integrated into the 3rd year practical module are sessions on transferrable skills which occur before the projects commence, these sessions concentrate on the skills required to search the literature, write scientific reports and carry out oral presentations. These sessions build on those students receive in their 1st and 2nd years. One of the many positive aspects of this new course is that by cycling through the process three times the quality of the reports and presentations increase noticeably over the year.

16. PeerWise:
A Two Institution Replication Study of Peer Learning and Collaboration

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We present two major results from a comparative study [1] of the implementation of PeerWise [2] as an online tool for student-led (and instructor-free) learning in undergraduate physics. In 2010-11, we piloted PeerWise with the level 1 physics class at the University of Edinburgh [3] and found a high quality of submissions as well as a positive correlation between student activity and end-of-course examination score; we undertook a similar study during the 2011-12 academic session, finding similar results. In 2011-12 we also successfully implemented
PeerWise at level 2 physics in the University of Glasgow and found similar levels of engagement, quality of submissions and positive correlations between student activity and academic gain. We suggest, therefore, a model for high-impact student-learning and conceptual gain with minimal instructor intervention required.

[1] https://www.wiki.ed.ac.uk/display/SGC4L/Home

Synoptic Activities using Online Peer Learning
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In order to support our students during their revision and exam preparation we have developed a novel synoptic revision exercise using the online PeerWise system [1]. The implementation of PeerWise was in line with other institutions taking part in the JISC funded cross-disciplinary study SGC4L [2], however the context of the task was modified to reflect the learning needs of our year long chemistry module. Academic staff involvement was passive after introducing the assignment to the cohort via scaffolding activities, thus generating an entirely student-led peer-learning environment for the live task. Student engagement exceeded all expectations with consistent high levels of activity during the second semester, over the Easter holiday and in the exam revision period. The student comments were also very productive with extensive peer-learning occurring over a very wide range of topics. Student feedback has been very positive, with requests to use PeerWise in future years.


Student Generated Content For Learning
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Over the past year we have been conducting a JISC-funded, large-scale, multi-institutional study - Student Generated Content For Learning (SGC4L) - into the use of PeerWise, an online question authoring and sharing system. PeerWise promotes peer learning and feedback, and harnesses the creativity of students to generate a large repository of course questions. The process of creating original questions requires high-level cognitive engagement and a fresh approach to the course by students.

We have deployed the system in a number of different classes in different disciplines (physics, chemistry and biology) and with different year groups. In this presentation we would seek to
give an overview of the scope and aims of the project, and report on its general outcomes. Use of the system in our classes has been highly successful, with good levels of student engagement and high quality contributions by the students. We believe we have established a usage model that is highly effective and can be straightforwardly adopted by other instructors.

Presentation proposals for detailed case studies of the system's use have been submitted by Morag Casey (physics) and Kyle Galloway (chemistry). Should these proposals be accepted, we would like to suggest combining all 3 elements into one longer presentation (say 30 minutes): this would remove the need for repeated descriptions of background and context, and would allow the audience to easily compare and contrast experiences in physics and chemistry while retaining an overview of the whole project.

17. Getting turkeys to vote for Christmas: The benefits of self-assessed summer vacation homework

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Following the success of projects in lecture capture (1) and screencasting, (2) we have developed activities in which video mark schemes are used to support students in carrying out self-assessment of work they have undertaken in their own time. The positive response from students and the evident educational benefits prompted us to explore opportunities for the wider development of this approach.

This presentation will outline the findings of a project in which summer vacation homework encompassing inorganic, organic and physical chemistry was issued to students for completion prior to the commencement of Year 2 of their studies. Students then carried out self-assessment of their work after returning to Southampton in a process which facilitated the collection of extensive feedback and reflective comments.

Among the key findings was the fact that students were overwhelmingly in favour of being given them homework during every summer vacation break, with analysis of the comments received shedding light on the benefits to students of both the summer homework and the self-assessment process itself.


18. **Taking the Timetable Out of Oral Presentations**  
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One barrier to the inclusion of more oral presentations in the current Chemistry and Medicinal Chemistry BSc Dual Honours course at Keele University course is a lack of time. For larger classes, oral presentations represent a significant commitment of staff and student time and effort, particularly if peer-assessment is involved. Oral presentations are a key area for development with students, particularly with the emphasis on employability skills and allow the students to work towards several key employability skills through the planning, giving and assessing of the presentations. First year Chemistry students at Keele in 2011/12 were given the opportunity to carry out 5 minute oral presentations in their choice of format. The main condition was that the presentation had to be uploaded to a group blog on the KLE for sharing with a small group of students. A variety of screencasts, podcasts and videos were produced and assessed by self-, peer- and tutor-led assessment using Google Documents to create surveys. The act of pre-recording the presentations removes much of the performance anxiety for the students and allows them to repeat or edit their presentations until they are satisfied with the results. This adds to the diversity of assessment in our programmes, and also allows students more choice of format for assessment than is usual, leading to more creative results. The variety of assessment formats (self-, peer- and tutor-led) creates richer feedback for the students to use to develop their skills in subsequent presentations.

This presentation will look at how students can be supported when giving oral presentations in different formats, suggestions for best practice based on this assignment, and hear from the students themselves through feedback received during the evaluation process.

19. **New Physics Curriculum**  
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To expedite the critical thinking and problem solving skills of early undergraduate physics students, the University of Liverpool have redeveloped their curriculum to focus on creating self-sufficient (independent) learners through the context and enquiry based learning techniques (EBL) in years 1 and 2 in order for increased confidence and attainment in years 3 & 4. The programme, called “New Physics”, is launched in welcome week with Undergraduate Physics Olympics and the year 1 project (Mission to Mars) which outline expectations in workload and collaborative achievement. The programme continues with problem classes and laboratory work dedicated to showcase and use skills such as peer-assessment and group learning needed to
succeed in physics degrees alongside traditional lecture courses. These skills sessions are gradually phased out as the course progresses. Laboratory work in years 1 and 2 has been designed to include practical problem solving by removing some of the scaffolding in experiments at the end of year 1 and the inclusion of long open-ended team projects in year 2. The intention is to increase students’ confidence at tackling practical problems (e.g. facing new equipment), discourage reliance on instructions and developing good experimental technique before the final year, individual, open-end project. The open-ended team projects are designed with a focus on learning new material as well as new skills.

An early evaluation through focus groups lead us to believe that the aims to create independent learners has been partially met as there is a proportion of the cohort who are actively engaging with EBL approach. Even partial success means that these students enter year 2 better prepared to learn which we will be evaluating in due course. There are indications that the assessment methods will need to be further developed to better support learning in this curriculum design.

20. Role of Assessment Type on Gender Performance

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The gender disparity in participation and performance in physics is well documented. This talk details on-going work to investigate the role played by assessment type on the gender discrepancy in student performance at undergraduate level. Data from courses at the University of Edinburgh will be presented illustrating the gender performance profiles in course assessments and end-of-course examinations. Although the primary focus is on physics undergraduate performance we investigate these results in comparison to those in other degree disciplines including chemistry.

Data collected from first year introductory physics courses show that female students are consistently outperforming male students in coursework assessment, suggesting a slight inclination of females towards continually assessed elements of the course. Results from course examinations show a less distinct pattern. This study has been extended to investigate the extent to which this gender difference in performance persists as students progress through their undergraduate degree programme.
With the aim of improving students’ problem-solving abilities, we have implemented a number of revisions to our level-two physics small-group tutorial system in 2011/12. Our level-two cohort is a mixture of students who have joined us straight from A-levels or Advanced Highers and those who have been through our first year programme. Students meet weekly in groups of four with a tutor.

The additional strategies trialled this session included rubric-based forms where tutors gave feedback focusing on five aspects of problem-solving that students could have used in tackling the tutorial work, tutorial problems that made explicit reference to problem-solving strategies, and the development and use of video problems requiring students to interpret and take data from video clips. The last was in part an attempt to strengthen connections between physics and what the students perceive as the “real world”. Video analysis software was also used to produce material targeting issues of student comprehension that we had seen.

We have evaluated these schemes through student questionnaires and discussions, and scores on tutor feedback forms. Results show progress in problem-solving ability, and also give pointers to how this may be enhanced further. More video problems will be trialled next session using lessons learned from this year.

After University students will use a range of resources, including textbooks and the internet to help them solve real-world problems. These problems could be as part of further study or in the workplace. Students use resources to solve homework problems in their Physics degree at the University of Edinburgh. However during University there is no specific evaluation of these skills and currently little research in this specific area.

A smartpen was used in order to record second year Undergraduate physics students thinking aloud whilst solving physics problems. This study explores students’ problem solving strategies whilst supplied with a textbook and the internet. Internet use was recorded by using Camtasia on a laptop provided to the students. Interesting approaches have been seen, including matching surface features of a problem to those in a textbook (Chi et al. 1981) and pattern matching variables in their problem to those on the high school SQA website of formulas.
As expected without the basic foundational knowledge students are unable to solve problems even with the wealth of information of the internet at their fingertips. It is hoped that this study will provide an interesting insight into students’ problem solving strategies with the availability of resources.

23. Interactive teaching in group online synchronous tutorials for astronomy
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   The introduction of new online tools for blended and distance teaching in Higher Education presents many challenges, not only in learning new functionality, but in using the tools in pedagogically effective ways.

   In the past few years in the Open University there has been a huge institutional drive to the use of online tools for learning and teaching, including the synchronous online tool, Elluminate, to replace or augment face-to-face tutorial sessions. In common with other web-conferencing software, Elluminate supports audio, a shared whiteboard and text chat, as well as many other tools that can be useful for supporting student activity. However, it can be difficult for time-starved tutors to envisage using the software for much more than a ‘chalk and talk’ online, using Powerpoint presentations with the opportunity for student questions.

   In this paper we will present some of our strategies to facilitate astronomy learning in small and large groups, with a focus on interactivity and active engagement by students. We also believe there is great scope for collaborative development of resource, sharing, and for team-teaching, and will discuss how we worked together before and during online astronomy tutorials. This presentation will be relevant for any physics, astronomy or chemistry staff who are involved in online teaching, either blended or wholly distance, particularly where there is a focus on facilitation of learning and active student engagement.

24. Development of a Distance-Learning Module in Analytical Chemistry for Practitioners in Industry
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   As an HE-STEM funded project we have developed a distance-learning module in Analytical Chemistry for use by practitioners in industry. The module is aimed specifically at those working in analytical laboratories in industry who do not have formal HE-level qualifications in chemistry but who would like to develop their knowledge in this area, particularly with a view towards career development. During the academic year 2011-12 we have written course material for
distance learning, including assessments and are currently trialling some of this material on a small cohort of students from industry. In this presentation we shall discuss:-

1. How industrial partners were selected
2. How a small group of students were selected to trial the scheme
3. How specific topics were selected to include in the programme
4. How distance learning material including on-line tests were developed and tested
5. How practical work was included in the course
6. How the material was delivered to the students
7. How assessment was carried out
8. What the students thought – student feedback

We shall include specific coursework material and we shall include thoughts on how this material will be developed further into a sustainable resource which may be used to train a greater number of industrial analytical chemists over the coming years.

25. Developing and trialling problem based learning resources for undergraduate chemistry students

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Problem based learning (PBL) has been identified as an effective way of enhancing the learning experience of physical science undergraduates.1-2 The PBL approach works by setting students open-ended problems with engaging scenarios which help illustrate the variety of ways in which the students’ understanding of the subject may be applied as well as the importance of problem solving skills to professional scientists.3 This innovative approach to teaching science can also greatly enhance the transferable skills of undergraduate students.3

This project is based on the development of a new PBL case-study and the evaluation of its effectiveness in a pilot phase implementation. This case study forms part of a series of new PBL and context based learning (CBL) resources produced by a number of institutions in association with the Royal Society of Chemistry (RSC).

A new PBL case-study (of equivalent value to a 5 credit module) based on the key area of Energy was developed together with an accompanying tutor guide both of which are to be made freely available as open educational resources (OERs).

The resources developed during this project have been piloted in three institutions with a range of different cohorts (including BSc interdisciplinary science and BSc secondary education students). The case-study has been fully integrated into a new second year module at Leicester using a sustainable model. Initial feedback suggests students find the resources engaging and appreciate the transferable skills development.

This presentation will discuss the practicalities of developing this resource including strategies for collaborating with other authors and advice on how to ensure authenticity of case-studies as
well as a summary of the key findings from the pilot project. The presentation will conclude with a brief discussion of the practical aspects of integrating PBL resources into existing degree programmes.


26. Addressing Research Informed Teaching in and out of the Curriculum

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Research Informed Teaching has been interpreted in a variety of different ways, depending on the discipline and the university. This is not surprising considering it is commonly sub-divided into Research Tutored, Research Led Research Based and Research Oriented teaching as well as teaching informed by pedagogic research and getting PhD students involved in teaching. This presentation will illustrate how all these aspects of Research Informed Teaching have been addressed in Physical Science courses at Kingston. There will be specific focus on extra-curricular activities including an evaluation of a summer undergraduate research internship programme and Undergraduate Research Journal linked to a promising researcher prize. In the latter, students are encouraged to submit a short research paper based on their undergraduate project by the award of prizes and the opportunity to see their work in a bound in-house journal. Novel ways of involving research students in undergraduate teaching, such as “Peer-Led Development of Standard Operating Procedures and Posters for the use of Advanced Research Equipment”, will also be covered.
27. Can I have a word please? – Strategies to enhance understanding of subject specific language in Foundation Level Chemistry  
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Durham University’s Foundation Centre provides the opportunity for non-traditional students (e.g. mature or with few formal qualifications) to pursue a degree in any subject. This paper reports on our research into the use of different strategies to develop understanding and use of subject specific language in chemistry.  

Similarities are often drawn between learning scientific and a foreign language e.g. Rincke (2010). This is because, for students to be successful, they have to comprehend and make use of a new and developing vocabulary in order to communicate within the subject area. These challenges of increasing and developing their subject vocabulary are particularly significant for non-traditional students.  

We describe the production of online resources to encourage the development of student explanations of scientific terms via a student constructed E-glossary and etymological activities as part of a suite of activities used throughout the course to develop understanding of scientific terminology. We will also report on our work to develop a chemistry corpus and concordancing activities for foundation students. We reflect on the contribution of these different strategies and how the resources can be enhanced in the future.

28. Transition - Peer Assisted Learning Complements Peer Mentoring  
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Peer Assisted Learning (PAL) which is a student-to-student support scheme has been implemented at the Chemistry Department, University of Liverpool. This scheme complements the University’s existing Peer Mentoring Programme. The role of a peer mentor is to offer practical support and advice to new students, and to refer them as appropriate to other services and contacts. This project has been funded by the National HE STEM Programme which supported us to plan the PAL scheme based on particular needs at the Chemistry Department, after carefully studying the system at other universities. Higher year students who are trained for peer assisted learning and peer mentoring by the Educational Development Office at the University of Liverpool deliver subject and pastoral support to lower year students. The PAL scheme enhances senior students’ confidence, communication and employability skills.
The scheme has been set up to support the first year undergraduate students to adjust to university life and also to help them with maths and organic modules. Maths subject is one of the most difficult courses for the first year undergraduate students at the Chemistry Department, especially for students without A-level in maths. In addition, the scheme has been set up to support the international students from China (XJTLU) arriving in Liverpool for their second year undergraduate studies. Our senior undergraduate students help them with general key skills and practical skills in the areas of difficulties for most international students, which have been highlighted by our research within different departments at the Faculty of Science and Engineering, University of Liverpool. The scheme also supports the distance learning students at the Chemistry Department who need extra support with maths subject. We develop online resources, a university social network, a set of guidelines for PAL facilitators and also the guidelines to introduce the scheme to new students.

29. Good Laboratory Practice
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Educational videos are very useful tools in HE in general and Chemistry in particular. They can show techniques such as handling a chemical reaction and equipment and at the same time can be very entertaining... or boring. Boring videos are rarely watched and only a very determined person will finish watching them and learn the lesson they trying to teach. In education there is a need for shorter, more realistic and entertaining movies. Nowadays time is money. You need to grasp the viewers’ attention and keep them engaged.

We decided to use our Undergraduate students to help us to film educational videos and prepare the content of the Advanced Organic Laboratory webpage. Their enthusiasm, down-to-earth approach and experience helped us to prepare content that is more understandable, interesting and approachable for their fellow students.

The project was successful in improving the students’ engagement and in creating new educational tools for the Chemistry Department. It was also fun for the students and staff involved. Students had an opportunity to learn more advanced techniques, deepen their own Chemistry knowledge and feed it back to teachers and their colleagues. Filming, music composing, teaching, presenting, learning Chemistry (theory and techniques) and acting – new ‘stars’ were born.
30. Handling the equipment and the concepts – a first chemistry class

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We have found that first year students with good A level chemistry grades (A or B) are often not as competent in basic activities such as weighing out, preparing solutions or titrations as might be expected. In order to protect our equipment and consolidate these necessary skills, a simple set of activities have been developed for a first practical session to get students competent with the use of some laboratory equipment.

This provides some efficiency in the use of demonstrators, and also allows inculcation of good laboratory practice. The activities promote some thought about quantitative work and use of important relationships such as those between moles and other physical quantities. Students come in as small groups at 15 minute intervals and move round stations in the laboratory. Each station has a demonstrator. The first check is that they have a notebook with equations and calculations in, or they are sent away. They then carry out the tasks and calculations required, starting with weighing out on an analytical balance and making up a solution. This has proved helpful preparation for further practicals such as chemical synthesis. However, an additional benefit is the creation of a data set of class measurements of the same thing which can be used in a tutorial on uncertainty in scientific measurement. As this is data created and thus owned by the students, it is more engaging than tables of actual or hypothetical variation.

31. Video Podcast Pre-labs for Enhanced Learning

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Using very simple equipment, I have produced seven short (5-7 minute) video podcasts. These are designed to introduce Stage I chemistry students to individual physical chemistry laboratory sessions.

The podcasts were aimed to clarify issues with understanding of how to assemble or use unfamiliar laboratory equipment and the subsequent data analysis. Using video footage allowed me to show how to address these areas, which is much clearer than a description in a laboratory script. Equipment could be shown being assembled from various angles and simple PowerPoint animations used to demonstrate concepts or data analyses. Pre-lab questions were embedded within each video. These questions were designed to ensure that the student interacted with the material and to enable discussions within the laboratory about common misconceptions. These questions were quickly marked at the beginning of the lab session and any
misconceptions highlighted could be corrected before data were taken. The method of producing the podcasts was chosen to be as easy as possible, using readily available equipment.

Initial evaluations show that the majority of students view the podcasts more than once and feel more prepared and more confident prior to the lab.

The presentation will cover how to create a video podcast of reasonable quality relatively easily and the results of on-going evaluations with students.

32. Student perceptions of the chemistry lab course at UEA.
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This presentation will report the results of a survey of chemistry undergraduates at the University of East Anglia. The intention was to discover the perceptions of the cohort specifically with respect to the first year laboratory course. Did it (the lab course) prepare them adequately for subsequent laboratory based modules? How did this affect their confidence in the teaching laboratory? What, looking back, would the students suggest for improvements to assist them. Although these data only apply to one chemistry department working within its own constraints and evolution, it has proved to be a useful exercise. It has enabled us to take these perceptions into account when planning the next evolution of the laboratory course.

33. Chemistry and Physics laboratories – do students think they’re worth the effort?
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Laboratory teaching has been a mainstay in Chemistry and Physics since the mid 1800s. Research has shown [1,2] that students in both subjects leave school education with a generally positive attitude to this mode of teaching. This presentation reports on how those attitudes stand after the first year of higher education. It also compares what the two groups of students believe they learn from their respective labs.

167 Chemistry students and 181 Physics students were surveyed on their attitudes to, and experiences of, laboratory teaching at university. Both groups reported a continuation of the positive attitudes they had upon arrival – laboratories in both subjects are useful, interesting and enjoyable. There are, though, differences in the experiences of both groups, with Chemistry students feeling more confident than their Physics counterparts, whilst the Physics students felt that laboratories link more strongly with coursework than Chemists.
In terms of their ideal experiments, the majority of Chemistry students preferred easy experiments, whilst Physics were split between easy ones and challenging ones. In terms of what they gained from their labs, both groups rated learning about the intended outcomes of the experiment as the most important, whilst the development of laboratory skills was identified as the key improvement they gained.

The overall picture is broadly consistent between the subjects, suggesting that laboratories are inherently beneficial, no matter what their subject content.
Oral Bites

1. Strategies to improve interactions between international and home students to enhance learning and teaching
   *Gita Sedghi, University of Liverpool*

2. Analysing and improving the engagement of international students in online learning
   *Simon Collinson, The Open University*

3. Student reflections on laboratory reports
   *Martin Pitt, University of Sheffield*

4. Students making videos about lab classes
   *Paul Taylor, University of Warwick*

5. Taking the experiment home: Can you invert the laboratory?
   *Helen Vaughn and Lynn Moran, University of Liverpool*

6. Addressing the Employability Agenda
   *Alison Voice, University of Leeds*

7. New Quantum Curriculum
   *Derek Raine, University of Leicester*

8. Storify
   *Simon Lancaster, University of East Anglia*

9. Enhancing students learning using the SMART Posium
   *Gita Sedghi, University of Liverpool*

10. Founding Chaucer University
    *Richard West, Chaucer Education Project*

11. Towards a theory of conceptual understanding
    *David Sands, University of Hull*

12. Developing and evaluating quantum mechanics animations for physics and chemistry students
    *Antje Kohnle et al, University of St Andrews*

13. Mark schemes, model answers and assessment for learning
    *Kristy Turner, University of Manchester*
1. Developing strategies and activities to improve interactions between home and international students to enhance teaching and learning

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Starting from September 2012, the Chemistry Department at the University of Liverpool will start admitting Chinese students onto the second year undergraduate course directly from XJTLU in China. The usual problems of integrating home and international students will be more difficult, since both groups would already have established peer groups. This project aims to propose a general framework to facilitate interaction between home and overseas students within the Faculty of Science and Engineering, which will mutually be beneficial to all students and staff. This will be achieved by a review of the implementation of internationalisation at the University of Liverpool, such as the design of taught modules, induction process and group activities.

This project runs by the Chemistry Department and the Centre for Lifelong Learning Centre at the University of Liverpool. We have studied the experiences of home and overseas students and their interactions with each other within the Faculty of Science and Engineering during the past years. This included collecting information on existing internationalisation experiences within the Faculty and the Guild of Students. To collect the data, we have conducted semi-structured interviews with university staff who have experience with integrating home and international students. Also, we have arranged focus groups with home and international undergraduate students.

We have implemented the peer mentoring and peer assisted learning (PAL) scheme for international students. Peer support helps international students during the transition period to adapt to a different set of demands in new environment. Peer mentors and PAL leaders are trained by experienced staff at the Centre for Lifelong Learning.

In addition to proposing a general framework to facilitate teaching a diverse range of international and home students, we provide pre-arrival guidelines for international students and introduce induction activities based on improving interaction between home and international students.
2. **Analysing and improving the engagement of international students in online teaching**  
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The global nature of online teaching is a key attribute, however the literature recognises that student engagement and numbers falls more during online courses than traditional courses. As universities strive to attract and retain international students the key questions then arise what is the level of engagement and experience of international students and how might we improve it? In particular are there any specific issues found for the online teaching of international students compared to traditional teaching?

Ongoing work funded by the HEA will be presented surveying students and academics within STEM subjects for student engagement with online forums and tutorials, focussing on chemistry. International students are being interviewed via an e-mail questionnaire to identify barriers and aids to their successful study. From the literature concerning traditional university teaching, potential areas of contention include their level of English, misunderstandings arising from differences in their educational and cultural background, difficulties in attending synchronous tutorials and feelings of isolation.

This research will yield a general guide for best practise in the design of online teaching and learning activities. This will be piloted with chemistry tutorial activities based on an internationally relevant environmental context, on which further student feedback will be sought. It is thought that our findings will be relevant to the teaching of international students at more traditional universities and in other STEM disciplines.

3. **Student Reflections on Laboratory Reports**  
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If you have not done so, try asking your students to reflect on what they got out of carrying out an experiment. This helps them to engage with the educational process rather than just following instructions and can produce useful insights for the academic.
4. **Students making videos about lab classes**  
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As part of Warwick Chemistry's Level 2 Key Skills training our students make a short Youtube style video about one of the experiments from the Level 1 lab classes. They are marked on Narrative, Engagement, Presentation and Teamwork.

The Oral Bite will explain the brief and show examples of the videos our students produced.

5. **Taking the experiment home: Can you invert the laboratory? (what could possibly go wrong?)**  
*Helen Vaughan & Lynn Moran*  
*Central Teaching Laboratories and Department of Physics*  
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Pre-laboratory activities and virtual experiments are allowing students to study some practical skills at a distance and at their convenience. But it is universally acknowledged that there are some things you just can’t take home. The Central Teaching Laboratory at The University of Liverpool has invested in a new electronics system, National Instruments MyDaq, for each year 2 student. The intention is for students to complete as much of a laboratory practical as they can before a lab session and to use it to work on an open ended project. It is hoped that the laboratory demonstrator time can be used on the more challenging aspects of electronics.

We would be really interested in collaborating with other universities that use the system and hearing any experiences of home laboratories.

6. **Addressing the Employability Agenda**  
*Alison Voice*  
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With students now paying much higher fees it is of greater importance than ever to be able to inform prospective students of the variety of employment options for graduates with a physics or chemistry degree. And having decided to embark on this route, they need high quality employability skills embedded into their degree programme, to prepare them to enter such graduate employment. This session will address the challenges and issues that all of this poses and offer some ideas/solutions from our experience.
7. **New Quantum Curriculum**  
*Derek Raine*  
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Following on from the December 2011 meeting at IOP on the Quantum Curriculum this short presentation will give an update on the IOP project to provide learning and teaching materials for a contemporary approach to quantum theory in undergraduate programmes.

8. **Storify**  
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One of the problems with the use of social media, particularly Twitter, is its transient nature. Why invest all that effort if it will become invisible in a week? How do we capture the valuable discussion? Storify provides a solution through a facile and intuitive web interface allowing snippets of social media exchanges to become lasting narrative records. For example, [http://storify.com/S_J_Lancaster/vicephec](http://storify.com/S_J_Lancaster/vicephec) is the Storify for this very conference!

9. **Enhancing Student Learning Using the SMART Podium**  
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One of the lecture theatres at the Chemistry Department, University of Liverpool, is equipped with a SMART Podium. Trials within the Department using tablet PCs, in a similar fashion to SMART Podiums, to deliver physical chemistry and maths lectures have received very positive feedback by students. Delivering lectures with podiums promote innovation in learning and teaching, including increasing the use of e-learning. This will be achieved through the provision of the SMART Podium as an interactive electronic equipment to be used in the lecture theatres.

Within the Chemistry department there is an ongoing project to record the lectures. The SMART podium gives us the opportunity to capture all text and annotations made by the lecturer. Therefore, the recordings would offer a much more complete capture of the lecture experience facilitating students’ understanding. We have shown previously that students are very interested in the recorded lectures, use them frequently, and find them especially useful as revising material for challenging subjects. Additionally, these
recordings are extremely valuable for students for whom English is not the first language, hence in part facilitating internationalisation of learning and teaching in the Liverpool University.

The SMART podium is an interactive touch screen monitor which allows lecturers to annotate and highlight the teaching material using “electronic ink” via the SMART podium’s screen using a battery-free stylus. This “electronic ink” supplements the original image being displayed by the projector (e.g. PowerPoint presentation, website, videos etc.) with the annotations displayed on the projector screen instantly at high resolution. The SMART Notebook application also allows addition of pictures to the teaching material as required during the lecture from Notebook Gallery or their own database.

10. Founding Chaucer University, As An Open Technical University Developing As A Modern Mechanics Institute.

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The aim of The Chaucer Education Project is the founding of Chaucer University, as an Open Technical University developing as a modern Mechanics Institute. The virtual learning environment at www.vle.tcep.org.uk homepage includes links to background information and media coverage.

Enabling Chaucer University to improve the learning experience of students, including those with Dyslexia and Dyscalculia, to enable them to achieve their full potential from Level Zero to Level Eight, is a fundamental part of the concept model for The Chaucer Education Project, which evolved from evaluation of difficulties encountered in understanding the theoretical concepts in Chemical Physics, where theoretical principles have traditionally been taught and demonstrated instead of discovery based practical projects.

Until a Royal Charter is granted to incorporate Chaucer University and empower it to award degrees and other recognised levels of qualification in its own right, The Chaucer Education Project has been designed to be developed through two companies working in parallel: a charitable company; and a subsidiary commercial company, with the Office of Qualifications validating each course unit.

The principal task for the charitable group will be the founding of Schools of Engineering, Management and Medicine, with a flexible, continuously-assessed and modular, vocational course unit structure, able to be taught through a combination of full-time, part-time and distant learning teaching methods. The Chaucer Education Project also involves the research and development work to design, produce and deliver all the educational equipment kits, teaching and other facilities and resources necessary.

The question system on The Chaucer Education Project website is a demonstration of capability being developed for interactive teaching and learning methods suitable for all levels. The third
11. Towards a theory of conceptual understanding

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The phrase “conceptual understanding” is used extensively in the physical sciences, yet what does it actually mean? There is a very real and practical, every-day notion that conceptual understanding denotes an ability to apply knowledge. Thus defined, it seems to be one of things that is easily recognised when it is seen, or not seen as the case may be, but the definition is somewhat nebulous and tells us nothing about how understanding might be tested. This difficulty is compounded by the lack of an accepted definition of what we mean by a concept. This talk will therefore examine the general theory of concepts with a view to developing a working definition of conceptual understanding. I will draw on a wide-ranging and diverse body of knowledge, ranging from philosophy to psychology and physics education research, to show how a theory of conceptual understanding begins to emerge naturally from the definition of a concept. I’ll show the relationship between a concept and a model, which is another widely used but ill-defined term in physical sciences, and use examples from my own research into the teaching of mechanics to illustrate the essential points.

12. Developing and evaluating quantum mechanics animations for physics and chemistry students

Antje Kohnle (presenter), Cory Benfield, Donatella Cassettari, Tom Edwards, Aleksejs Fomins, Alastair Gillies, Georg Haehner, Christopher Hooley, Natalia Korolkova and Bruce Sinclair
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Since 2009, we have been developing and evaluating visualizations and animations for the teaching and learning of quantum mechanics concepts at university level [Kohnle et al., Am J Phys, 80 2 (2012) 148]. The QuVis animations build on education research and our lecturing experience, and aim to specifically target student misconceptions and areas of difficulty in quantum mechanics. Each animation includes a step-by-step exploration that explains key points in detail, and many include instructor resources consisting of worksheets with full solutions. Animations and instructor resources are freely available at www.st-andrews.ac.uk/~qmanim, and can be played or downloaded from this site. Animations are available on a wide range of topics from introductory to advanced quantum mechanics.

Evaluation work guides the design and content of the animations. Evaluation used includes student questionnaires, a diagnostic survey to evaluate learning gains, observation sessions with
a small number of student volunteers and observations during a teaching session in which students interact with animations.

This presentation will give an overview of the QuVis animations for physics students. It will also highlight recent work on extending the resource to be useful to chemistry students studying introductory quantum mechanics by modifying existing animations, developing new animations, and developing resources for chemistry instructors (see www.st-andrews.ac.uk/~qmanim/chemistry). We have carried out initial evaluation of these animations in a level two St Andrews chemistry module. The evaluation consisted of a survey given to all students and individual observation sessions with 13 chemistry student volunteers interacting with previously unseen animations. Over the next academic year, we plan to substantially increase the number of animations available for chemistry students, and to use evaluation outcomes to improve these animations.

13. Mark schemes, model answers and assessment for learning

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The provision of mark schemes for students to use in their preparation for examinations has been hotly debated in many institutions and appears time and time again on student evaluation forms. Students entering HE have been able to download past papers and mark scheme from the websites of public examination boards for many years now and continue with that expectation as undergraduates yet many universities do not make these freely available. In this presentation I will present to you a ‘middle ground’ alternative to releasing full mark schemes to students that is being trialled here at Manchester together with some commentary on our journey to where we are now with this kind of assessment for learning. 200 undergraduates begin degrees in chemistry each year at Manchester and although they enter with broadly similar and excellent A-level grades, their skills in tackling examination questions vary widely. Using materials freely available within universities I will present a way to give students model answers without releasing marking schemes.
Workshops

1. Wikis: What are they and how are they used to assess group assignments?
   Claire McDonnell and Michael Seery, Dublin Institute of Technology

2. Ill-structured problems in physical science: Is it discipline specific? A qualitative research approach
   Tina Overton, Marsali Wallace, Ross Galloway, Universities of Hull and Edinburgh

3. Microscale chemistry activities for the ‘traditional’ chemist
   Bob Worley, Brunel University

4. Business skills resources for chemistry in HEIs
   Samantha Pugh, Patrick McGowan, University of Leeds, Paul Taylor, University of Warwick,
   Kevin Parker, KKI Associates

5. Delivering effective practical science online
   Eleanor Crabb and Nick Braithwaite, Open University

6. Screencasts for all: Getting started with screencasting in Camtasia
   David Reed and Simon Lancaster, Universities of Southampton and East Anglia
1. **Wikis – What Are They and How Are They Used to Assess Group Assignments?**
   Claire Mc Donnell and Michael Seery
   Dublin Institute of Technology
   School of Chemical and Pharmaceutical Sciences
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Wiki software is free, easy to use and allows learners to work and to write collaboratively to produce a report, webpage or any other type of online content. Contributions made by each member to a wiki can be tracked to assess their quality and whether they were made across the entire timeframe of the assignment. Peer and tutor feedback and review are facilitated by the comment and page editing options and the wiki also provides a useful archive of all of the information that is relevant to a particular assignment. In addition, wikis are regularly used in organisations to allow groups to collaborate on projects and documents and to share knowledge and the ability to use one is a valuable transferable skill.

This workshop will provide participants with a hands-on introduction to the use of wikis in teaching and learning Chemistry. Some information will be provided on four context and problem based learning resources recently developed by the workshop facilitators for the RSC as part of the National HE STEM Programme. Use of wikis is incorporated into these materials. After a short introduction during which these learning resources and other relevant applications will be discussed and demonstrated, participants will be shown how to carry out the tasks that students and academic staff need to be able to perform using PBworks software. They will also be provided with an opportunity to consider how this tool could be applied in the context of their own teaching and some guidelines on issues that often need to be considered will then be discussed.

In order to provide access to a wiki during the workshop, e-mail addresses for participants will be required in advance.

2. **Ill-structured problems in the physical sciences: a qualitative research approach**
   Tina Overton (University of Hull), Ross Galloway (University of Edinburgh) and Marsali Wallace (University of Edinburgh)
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The aims of the workshop are:

- To de-mystify qualitative research by involving participants in a practical example.
- To encourage participants to think about the use of ill-structured problems and how they can apply to both physics and chemistry education.

This will be a hands-on workshop where participants will have experience of doing qualitative research by being a part of it themselves. The workshop plan is laid out below.
1) **Introduction to this workshop, to qualitative research and ill-structured problems. ~10min**
Participants will be given a brief overview of the activities planned for the workshop and then an introduction to qualitative studies using smartpens.
- Introduction to workshop, what the plan is for the session.
- What is a smartpen?
- Using smartpens for qualitative research
- What ill-structured problems are and why they are important

2) **Group work to solve ill-structured problems. ~15min**
Participants will split into disciplinary specific groups i.e. physics and chemistry, to solve two ill-structured problems. One member of the group will be given a smartpen to act as a scribe for the group.

3) **Groups analyse their own discussions. ~25min**
After solving the problems set in the previous part of the workshop, participants will be asked to listen back to their own group’s discussion and code the main strategies they used to solve the problem individually. They can then compare these results to see if they achieve inter-rater reliability and if not what would they do.

4) **Open discussion on this research process and questions/ experiences shared from others. ~5-10min**

5) **Presentation of results on Undergraduate physicists and chemists solving ill-structured problems. ~10mins**

6) **Make your own ill-structured problem. ~15-20min**
The final part of this workshop will give participants a chance to think up their own ill-structured problems that could be used in both physics and chemistry.

7) **Wrap up and close ~5min**

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3. **Microscale Scale Chemistry Activities For The “Traditional” Chemist**

*Robert Worley*

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The UK has included practical work in courses for over 100 years, using traditional equipment, Bunsen burners, test tubes etc.

There is much resistance to this approach in the UK where traditional methods are held in esteem. An initiative by the Royal Society of Chemistry in 1997(1) did secure some interest schools but it quickly waned. There are also some schemes in various Universities (2) but it is not popular. There have to be special circumstances to make this approach preferable to traditional procedures. Health & safety, environmental concern, reduced levels of support staff, shortening
of student-teacher contact time and increased costs are now beginning to make an impact. The introduction of new materials such as carbon-fibre rods as electrodes, and the projection of micro-events onto a screen using a digital camera/microscope, enhance the technique even further.

In this workshop, visitors will be able to observe and/or carry out some reduced and microscale techniques related to typical chemistry activities such as “displacement, precipitation, indicators, gas chemistry, electrolysis, reaction kinetics and enthalpy changes. A microscale organic preparation kit will also be on show. Some of these can be viewed on the CLEAPSS U-tube channel(3) and seen in an article in Education in Chemistry(4).

(1) Microscale chemistry, RSC,1997
(3) http://www.youtube.com/user/CLEAPSS is an organisation in the UK to which all schools in England, Wales, Northern Ireland and many parts of the World, subscribe. It provides support and advice to teachers, technicians, Head Teachers and governors/trustees on how best to use high quality practical work to support pupils learning in science and design & technology. To this end it has had to “translate” European and UK safety law, designed for industry into the school environment.
(4) Microscale Chemistry Revisited, Education in Chemistry, 49, (3) 19

4. Business Skills Resources for Chemistry for Higher Education Institutions
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The lack of business skills and commercial awareness in STEM graduates has repeatedly been cited by industry in recent years. Traditional ‘bolt-on’ teaching of business skills by business schools to chemistry students has been unsuccessful and is in decline. In response to this, the RSC has commissioned 5 UK HEIs (Leeds, Warwick, York, Edinburgh (with KKI Associates) and Nottingham) to develop resources teaching subject-contextualised and relevant business skills for chemists for full integration into the chemistry curriculum. Some resources will also provide the opportunity for self-study through online activities.
The resource developers will present views from industry and how that influenced their resource design, but for most of the session they will let delegates sample some of the interactive activities devised for the resources.

5. **Delivering effective practical science online – a reality?**

_Eleanor Crabb, Nick Braithwaite_

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The development of practical skills is a vital part of any STEM related HE programme of study. Practice in the STEM disciplines is changing rapidly with new information and communication technologies making it possible to work together globally, share data and facilities. However, undergraduate practical science has proved somewhat slow in adjusting to these trends. The concept of ‘pre-labs’ online is becoming increasingly common, but how about practical science itself? Is it possible to deliver effective practical science online?

A suite of investigations has been developed by the Science Faculty of the Open University, covering the breadth of science, as part of a fundamental reappraisal and realignment of existing methods of teaching practical science. Such a realignment should be guided by rigorous research and development, addressing usability, sustainability and pedagogical effectiveness and is a focus of the Wolfson OpenScience Laboratory.

Investigations take the form of:

- **Interactive Screen Experiments** - Photo-realistic recordings of real experiments where a student’s actions determine the precise course of the experiment.
- **3-D Immersive Environments** - Applications of fly-through, avatar-based technologies that enable students to explore and interact with equipment and collate/assess real scientific data.
- **Remote experiments/observatories** - automated equipment accessed/controlled remotely in real-time by students.
- **MegaLab Experiments** - Investigations in which large numbers of remote students contribute data to make discoveries of common interest, giving a new meaning to the term ‘social science’.

This workshop/presentation aims to explore the effectiveness of online practical science. We will present an overview of the work developed for our Practical Science suite of modules, with hands-on illustration of investigations in chemistry and physics. Discussion will include topics such as:

- Strategies in developing and delivering practical science online
- Sustainability of virtual laboratories.
- Institutional collaboration
- Methods of encouraging and supporting relevant institutional change.
6. **Screencasts for all: Getting started on screencasting with Camtasia**

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According to Wikipedia, “a screencast is a digital recording of computer screen output, also known as a video screen capture, often containing audio narration. Just as a screenshot is a picture of a user's screen, a screencast is essentially a movie of the changes over time that a user sees on his monitor.”

Screencasts have grown in popularity in recent years, with both students and staff recognising their effectiveness in supporting learning. With advances in software and hardware, screencasting is no longer the preserve of the learning technologist. The software package Camtasia is widely recognised as being a highly effective tool for the production of screencasts, which scores highly on ‘user-friendliness’ and accessibility. Camtasia allows anyone with a modest grasp of modern ICT to rapidly produce screencasts and related educational video resources.

This workshop session is aimed at educators who wish to explore the capabilities of Camtasia and the educational potential of screencasting. The session is aimed at those who are new to Camtasia, but we will have experienced colleagues on hand who will be able to work with intermediate users who wish to broaden their knowledge and skills.

Participants will be required to bring a Mac or Windows laptop with Camtasia installed (a free 30-day trial version is available from Techsmith http://www.techsmith.com/download/camtasia/default.asp), and preferably a USB headset with microphone, although this is optional. Please come prepared with a short Powerpoint presentation on which to base the screencast. The expectation is that all participants will complete the workshop having generated their own example of a screencast.