5th Eurovariety in Chemistry Education 2013

University of Limerick, Limerick, Ireland

Date: 3rd – 5th July 2013

Theme: "Smarter Teaching-Better Learning"

University of Limerick
Ollscoil Luimnigh

ce rg chemical education research group

Institute of Chemistry of Ireland

NCE-MSTL National Centre for Excellence in Mathematics and Science Teaching and Learning

RSC | Advancing the Chemical Sciences

EuCheMS

UNIVERSITY of LIMERICK
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40 years of Innovation 1972 - 2012

Eurovariety 2013

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Eurovariety conferences
2005 Krakow, Poland
2007 Prague, Czech Republic
2009 Manchester, UK
2011 Bremen, Germany
2013 Limerick, Ireland

Division of Chemical Education

The European Association of Chemical and Molecular Sciences (EuCheMS) is a not-for-profit organisation founded in 1970. Its object is to promote co-operation in Europe between non-profit-making scientific and technical societies in the field of chemistry and molecular sciences.

The organisation can draw upon significant resources, having more than 40 member societies which in total represent some 150,000 individual chemists in academia, industry and government in over 30 countries across Europe.

EuCheMS is an Associated Organisation of IUPAC, and incorporates the role and responsibilities of the former Federation of European Chemical Societies and Professional Institutions (FECS) which adopted the name EuCheMS in 2004.

The scientific Divisions and Working Parties enhance networking in their own fields of expertise and promote collaboration with other European and international organisations. The Divisions and Working Parties of EuCheMS organise high quality scientific conferences in chemical and molecular sciences and interdisciplinary areas.

The EuCheMS Division of Chemical Education has two goals:

1. to look for new activities to promote chemical education research and practice in Europe
2. to improve the dissemination of information between countries.

It does this through:

1. Organising conferences on an annual basis which alternate between the European Conference on Research in Chemical Education and European Variety in Chemistry Education.
2. Sharing national reports which describe the activities in chemical education within each member country in a given year.
3. Producing occasional publications. Those currently available on our website are:
    - Empirical Research into Chemical Education: the motivation, research domains and infrastructure of a maturing scientific discipline
    - Making a Presentation in English at a European Conference
    - Handbook for Organisers of European Conferences

More details of our activities can be found at the following websites:

http://www.euchems.eu/divisions/chemical-education.html

https://sites.google.com/site/euchemsdivced/

UNIVERSITY of LIMERICK
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40 years of Innovation 1972 - 2012

The University of Limerick

The **University of Limerick** is an independent, internationally focused University with over 12,600 students and 1,400 faculty and staff. The Academic Year 2012-2013 marks an important milestone in the University of Limerick as we celebrate the 40th anniversary of the admission of our first cohort of students in 1972. The dominant element of UL's achievements in that time has been innovation - innovative programmes, innovative research, innovative staff, students and graduates who have made a significant difference in their careers and their lives throughout Ireland and around the world.

Limerick is the capital of Ireland's Mid-West region with an urban and hinterland population of over 200,000 and is noted for its shopping, its dining and entertainment, its historical significance, as well as its contributions to the arts. Conquered by the Vikings in the ninth century, this bustling modern city has a rich medieval past, which resounds around its ancient streets. Limerick has something to offer everybody thanks to its many cultural, historical, architectural, sporting, shopping and business activities. With almost 50 per cent of Limerick's population under the age of 30, it is a vibrant, living, cosmopolitan city. The County of Limerick is a place of rural charm and great beauty, with a gently undulating landscape that varies from the mountains of Ballyhoura in the Golden Vale to the Shannon Estuary.

Welcome from Professor Don Barry – President of UL

Conference Delegates

It gives me great pleasure to welcome Eurovariety 2013 to the University of Limerick.

Eurovariety attracts chemistry lecturers and educational professionals from around the globe to improve their shared understanding of chemistry teaching and learning at the tertiary level. We are proud to support any event which brings people together, opens dialogues and promotes innovation.

We are also pleased to support and encourage the teaching of the sciences, as these subjects are so important to the expansion of Ireland's technology industries, the stimulation of jobs and the continued growth of the Irish economy.

The theme of this year's conference is 'Smarter Teaching – Better Learning'. This theme serves to remind us that the purpose of all academic activity is to generate discussion and to enhance learning. Over the coming days I encourage you to engage with your colleagues, to listen and to learn and to build your own professional practice.

It is in this spirit of open dialogue that I welcome you to UL, invite you to explore our beautiful campus and take the opportunity to tour the wider Limerick Region.

Professor Don Barry
President, University of Limerick

Welcome from Pat Hobbs, the President, Institute of Chemistry of Ireland

On behalf of the Institute of Chemistry of Ireland, the Professional Body representing Chemists in Ireland, I would like to thank the University of Limerick and Peter Childs for inviting me to speak here today as one of the sponsors. On behalf of the Institute I welcome you here and hope you enjoy this Conference.

I come from an industrial background but have a connection with academia through student placements and Internships over 25 years. One thing I have observed, when interviewing prospective students, is that a significant proportion (30-40%) when asked why they choose to study chemistry at university answer "the influence of an inspirational teacher" in the 2 years before entering college. I think this demonstrates to importance of 2nd level teachers and their training in guiding students towards a career in chemistry. This is one of the topics we will hear about during this conference. A question might be posed: "Is there something in the teaching of chemistry that turns students off chemistry?"

I won't comment on all the topics but a few others caught my attention in particular. Problems in teaching organic chemistry – yes our little curly arrow etc. I know from the RDI subgroup of PharmaChemical Ireland, of which I am a member, that big Pharma companies are concerned about the competence of organic synthetic chemists trained in Ireland and will often bypass our colleges and look in Poland and Portugal. What are we missing?

Mathematics and chemistry is often a problem for students and I looking forward to hearing the presentations on this. To me mathematics is interesting and I love to read books on the history of mathematics and mathematicians so I just wonder if incorporating something like this into mathematics courses would wet the appetite for mathematics in general.

A topic I am familiar with is work experience programmes and in particular INTRA from DCU, where well trained students present themselves, full of enthusiasm and I can have them running experiments within 3 days. I believe their work readiness is due to the proportion of their time spent in lab practicals. I have found students from other institutions need more support and tuition before I can assign them work. What is the impact of reduced lab time and staffing on our young chemists?

With that question I will conclude. I will be staying on to listen to the presentations and hopefully be more informed at the end. Thank You.

Pat Hobbs

From Ilka Parchmann, the Chair, EuCheMS Division of Chemical Education

Dear participants of the 5th European Variety Conference: Eurovariety 2013!

In the name of the Division of Chemical Education of EuCheMS, the European Association for Chemical and Molecular Sciences, I would like to welcome you all to our 2013 conference in Limerick.

This conference offers a great opportunity for researchers and lecturers at university level in many different European countries to get new and interesting ideas, to discuss problems and challenges in tertiary chemistry education with each other and finally to learn from each other. It is unique in its combination of experienced practitioners and chemistry education researchers that does not exist in many other disciplines. In the name of our Division, I would like to thank all presenters and discussants for their active contribution to our common field of interest: to make the teaching and learning of chemistry even more successful and interesting than it already is in many European countries!

The Division of Chemical Education sponsors two series of conferences: Eurovariety and ECRICE, European Conference on Research in Chemical Education, which alternate. I would like to take this opportunity to invite you to come to the next ECRICE conference, which will be held in Jyväskylä**,** Finland, 7-10th July 2014: see https://www.jyu.fi/kemia/en/research/ecrice2014// for details.

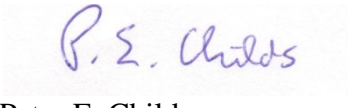
See you there again!

Ilka Parchmann

Welcome from Peter Childs – Chair of Organising Committee

I would like to add my welcome to all participants to Eurovariety 2013 – a welcome to Ireland, to Limerick and to the University of Limerick. I would to thank all the members of the International Advisory Committee (who reviewed papers) and the Local Organising Committee, for their hard work in getting ready for this conference. I would like to thank the University of Limerick for hosting the conference and providing the facilities. I would also like to thank the sponsoring bodies and the companies who have provided financial support for the conference; you can find these listed in the Book of Abstracts. The Eurovariety conferences, and the UK Variety conferences, are unique among chemical education conferences in that they focus on teaching and learning chemistry at third level (university and college), with a focus both on research and on practice. The target audience is people teaching chemistry at university or college level, including those with a responsibility for producing second-level chemistry teachers. The Eurovariety conferences, of which this is the 5th, draw participants from across Europe, but also wider afield, and provide a unique forum for reflection on the teaching of chemistry at third level and how to use the results of chemical education research to teach smarter, so as to improve learning.

A conference is successful if you meet new people and if you take away at least one good idea to try out in your own teaching. I hope Eurovariety 2013 in Limerick will be a success for every one of you.



Peter E. Childs

NCE-MSTL
National Centre for Excellence in Mathematics and Science Teaching and Learning

About the National Centre

The National Centre for Excellence in Mathematics and Science Teaching and Learning (NCE-MSTL) was established in 2008 under the aegis of the Shannon Consortium with funding from the HEA for an initial three year period (Phase 1). During Phase 1 the Centre has become a nationally recognised hub for research, policy and leadership in mathematics and science teaching and learning.

The Centre is a distributed centre hosted by the University of Limerick as the lead institute, and supported by the Shannon Consortium partners that include UL, Mary Immaculate College, Limerick Institute of Technology and IT Tralee. The National Centre has a virtual (national website www.nce-mstl.ie) and a physical presence (main facilities at UL with centres of expertise at MIC and LIT and ITTDublin).

Serving the National Interest in Science and Mathematics Education

The urgent need to raise Science and Mathematics knowledge and skills in order to serve critical national educational, economic and entrepreneurial needs is well documented and has not diminished since the initial SIF investment in the National Centre (NCE-MSTL) in 2008. The role and aspirations of the National Centre are consistent with Government economic and education policies on the Smart economy and recovery.

National priorities in science and mathematics education are likely to become more rather than less pressing in the coming years. It is now generally recognised that there is no short term solution to the problems involved and this realisation adds weight to the case for supporting centres like NCE-MSTL. Milestones and successes recorded during Phase 1 add evidence for this case.

Addressing national priorities in Science and Mathematics Teaching and Learning

The urgent need to raise Science and Mathematics knowledge and skills in order to serve critical national educational, economic and entrepreneurial needs is well documented and has not diminished since the initial SIF investment in 2008. The National Centre responds with a mission targeted primarily at educators/teachers, intended to improve both their subject knowledge and teaching ability, and thereby impacting upon students' performance at all four levels of the education spectrum. By stimulating interest in mathematics and the sciences and by increasing student participation in traditionally problematic subject areas, future employability and national literacy in these critical disciplines are enhanced.

What are we trying to achieve?

The role of the National Centre is to work with all stakeholders to achieve improved outcomes in science and mathematics teaching and learning for all students at all levels of the education system. In practice this means that the Centre is working with stakeholders to provide a better experience for students of mathematics and science at all levels; improve standards and performance across the system and increase take-up of higher mathematics and science in schools. To achieve these ends the National Centre engages in research, projects and activities that address the teaching and learning of science and mathematics at all levels.

Mission

The mission of the National Centre is to:

- Conduct best practice, evidence based research into teaching and learning of mathematics and science.
- Translate existing research into effective best practice in mathematics and science teaching and learning.
- Design, inform, advise and deliver nationally recognised evidence based CPD programmes.
- Collaborate and share information with all universities and institutions in order to formulate strategies that enhance mathematics and science teaching and learning from primary school, through secondary school to third level and fourth level.
- Promote scholarship in science and mathematics teaching and learning.

Rationale and *modus operandi*

It is recognised internationally that the problems associated with mathematics and science teaching and learning have their source mainly in the teachers' subject content knowledge and pedagogical content knowledge rather than in generic pedagogy or in any aspect of generic educational theory. A fundamental guiding principle driving the work of the National Centre is that good teaching in mathematics and science is based on good content knowledge in mathematics and science. All the academic and professional activities of the Centre are based on deep subject knowledge in mathematics and/or the sciences. Consequently, all our programmes are characterised by a strong emphasis on science and/or mathematics content integrating associated pedagogical content knowledge.

Good practices in mathematics and science teaching have to be identified, carefully adapted for local use, and monitored in use before they are generally adopted. Research supports approaches to improved pedagogy through better subject knowledge. The country cannot afford bad solutions for correctly identified problems or good solutions for wrongly identified problems.

The work of the centre is project-led within the following themes in science and mathematics education: Fourth and Third levels, Second level, Primary Education, Mathematical and Science literacy. Projects address important issues such as adapting good practices in mathematics and science teaching and learning for use in Ireland by research interventions in schools and other institutes and piloting such practices. These are then disseminated through CPD events organised by the Centre and all materials are made available on the NCE-MSTL website.

Guiding principles

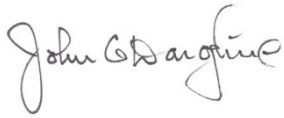
The Centre is committed to and guided by an approach that:

- attributes particular value to the development of strong subject-matter knowledge as a basis for strong pedagogical knowledge and practice in the sciences and mathematics,
- attaches importance to promoting practice that is informed by research,
- seeks to maximise contribution through collaborations and networks.

Research into Practice

The work of the Centre is strongly focused on translating research into practice so that research findings impact on science and mathematics teaching in Irish classrooms. The Centre has evolved a three-pronged strategy to make this happen: best practice solutions are identified or developed through evidence-based research; solutions are piloted in appropriate interventions and evaluated; CPD materials are developed and disseminated through CPD events and the NCE-MSTL website.

A unique aspect of this virtuous cycle is the use of specially developed *Resource and Research Guides* – a leaflet series that makes the outcomes of the Centre's research easily accessible to teachers with examples and recommendations for use in their classrooms. These leaflets are mailed to all secondary schools and can be downloaded from the Centre's website.



Professor (Emeritus) John O'Donoghue
Director

Key Information:

Directions: EuroVariety 2013 is being held in the **Main Building (29 on map), Block C, John Holland and Charles Parsons Lecture Rooms.** You can enter it through the Charles Bianconi tower, this entrance is directly behind the Students Union Building (30). When you enter go up the stairs or in the elevator to Level 1. Enter the double doors on your left and continue straight through the canteen to the other set of double doors. These will take you into the corridor where most of the talks and breaks will be taking place. There will be signs throughout the building to help you find your way.

- Toilets are on the landings of each stairwell.
- There is a bookshop (O'Mahony's), where you buy newspapers, and a shop (SPAR) on campus in the Students Union Courtyard (30).
- There are also excellent sporting facilities in the University Arena (18), which are available to members of the public.
- There are many cafes and restaurants available on campus: three are located in the Students Union Courtyard area: Paddocks, Stables and Scholars.

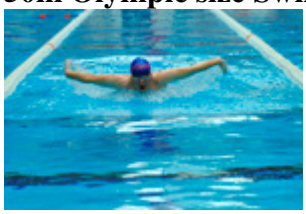
If you wish to visit the city centre it is recommended that you share taxis from the campus, or you can get a bus (stop is outside Stables, no 30 on the map, bus number 304 and a ticket should cost €1.20) and walk from the bus stop in town.

Swimming Pool and Sports Facilities on Campus

Delegates can avail of the University of Limerick 50m swimming pool during their stay on campus. The University Sports Arena is renowned for sporting facilities. It is Ireland's largest indoor sporting complex and has an impressive range of sports facilities aimed at providing the best

possible environment for both individual training and team development. These are no. 18 on the map.

50m Olympic size Swimming Pool



Conference Rates

- Swim & Gym Session €9.00
- Swim €6.00
- Gym €7.50

Limerick

Limerick is the gateway to Ireland's scenic Western coast. An ancient city, with a charter pre-dating that of London, Limerick epitomises Ireland's industrial and cultural renaissance. Limerick city is the capital of the Shannon Region and the third largest city in the Republic of Ireland. Its City Charter was granted in 1197. 1691 saw the capture of the city and the signing of the Treaty of Limerick. Its colourful and fascinating history is evident everywhere and is proudly maintained. Although small enough to offer a sense of intimacy, Limerick, with its university, museums, citadel and cathedral is undoubtedly a cosmopolitan metropolis.

The city of Limerick boasts galleries, theatre, excellent restaurants and a world class museum housed in the restored Custom House. King John's Castle bestrides the Shannon at one of its many bridges while St Mary's Cathedral is a small scale gothic masterpiece dating from the 12th century. Only a few miles from the city, the University of Limerick has played a major part in Ireland and Limerick's rebirth. Set on a magnificent parkland campus, beside the Shannon, the University is the centre piece of the National Technological Park. Above all, Limerick is a haven for Irish traditional music and you can find a lively 'session' on any night of the week.

Tangible remains of the past inhabitants go back 800 years to the building of King John's Castle. Nearby is the medieval St. Mary's Cathedral, and preserved on the opposite bank of the river is the Treaty Stone. Limerick boasts a fine crescent of splendid Georgian town houses built in the late 18th century. The Hunt Museum contains a unique collection of archaeological material and works of art, which were assembled by John Hunt, and housed in the renovated Custom House. And, of course, a city that contains all this also provides a generous selection of the best shops, restaurants, hotels, pubs and sporting activities. Key sites are: King John’s Castle, the Treaty Stone, the Hunt Museum, and the Milk Market (not to be missed on a Saturday morning). For further information on what to do and see when in Limerick, contact the Tourist Information Centre, located in Arthur's Quay in the City Centre. The centre is open all year round and is the ideal starting point for visitors to the city. Telephone: +353 - 61 - 317 522

Social Programme:

Wednesday 03/07/2013
Barbecue: *Time:* 20.00-23.00
Location: The Stables Club, Students Union Courtyard, University of Limerick, Limerick
Live Traditional Irish Music at 21:30

The Barbecue on Wednesday 3rd July will be held in the Stables Club on the University of Limerick campus. Founded in 1987, The Stables Club has grown to be the largest club on the University of Limerick campus. In that time, The Stables Club has become one of the focal point of campus social life. Entertainment will be provided by Acoustra, a four-piece group based in Limerick. Acoustra will be playing their unique fusion of Rock and Traditional Irish music. Entry will be by ticket.

Thursday 04/07/2013
Lunch: 12.45
Location: Eden Restaurant, Block E, Main Building. Please bring your lunch ticket.
If you need a vegetarian or special meal, please notify the people on the reception desk.

Dinner:
Location: Lakeside Hotel, Ballina, Co. Clare (15-20 minutes outside Limerick) overlooking Lough Derg.
Transport will be arranged by bus from the University, leaving at 7.15 p.m. on the road outside the Stables courtyard. The buses will return from the hotel around 11 p.m.
The banquet is included in the conference fee for those who have registered for the full conference.
Please bring your dinner ticket.

The Conference Dinner will be held in the Lakeside Hotel, Killaloe-Ballina. The hotel sits on the bank of the River Shannon and overlooks the twin heritage towns of Ballina and Killaloe, a busy fishing and boating centre in the mid-west region. The linked towns offer history and a beautiful riverside setting. A 13 arch stone bridge separates the towns with Killaloe on the Clare side and Ballina on the Tipperary side. Entertainment will be provided by four young talented Limerick musicians who play Traditional Irish and Folk music.

Friday 5/07/2013
Optional Trip to Bunratty Castle and Folk Park
There is an optional outing to Bunratty Castle on Friday 5th July at a cost of €20 per adult and €15 per child. Bunratty Castle (Irish: *Caisleán Bhun Raithe*, meaning "Castle at the Mouth of the Ratty") is a large tower house in County Clare, which lies in the centre of Bunratty folk village. The first dwellings to occupy this site were part of a Viking trading camp which has been dated back to 970. The Castle is represents an integral part of the history of this region. The folk park contains restored buildings from around Ireland, a 19th century village street and a 19th century country house and gardens. It is well worth a visit and is one of the Shannon region's premier tourist attractions. The cost includes bus to and from the University (leaving at 2 p.m.) and entry to the folk park. The bus will leave Bunratty around 6 p.m.

Thank you for your attendance at this conference. It has been our pleasure to have you here with us in the University of Limerick. We hope you enjoy the conference!

Best Wishes,
The Organising Committee

Programme Outline

Time	Wed 3rd July		Thursday 4th July		Friday 5th July	
9			**Plenary 3: Sabine Streller**		**Plenary 5: Michael Seery**	
10			**Session 3A:Chemistry Teacher Education** Paper 13 Paper 14 Paper 15	**Session 3B: Science Communication and Outreach** Paper 16 Paper 17 Paper 18	**Session 7A:Novel methods of teaching and learning chemistry** Paper 34 Paper 35 Paper 36 Paper 37	
11	Registration		*Coffee/tea*		**11. 20** *Coffee/tea*	
11.30	Registration		**Session 4A: Chemistry Teacher Education** Paper 19 Paper 20 Paper 21 Paper 22	**Session 4B: Peer Teaching and Learning** Paper 23 Paper 24 Paper 25 Paper 26	**11.45 Session 8A: General chemistry** Paper 38 Paper 39 Paper 40 Paper 41	
12.45	Registration		Lunch		**13.05-13.15** Close of conference	
14.00	**Welcome and opening ceremony** **Plenary 1 Rainer Glaser**		**Session 5: Workshops** **W1: ' Wikis – what they are and how they are used to facilitate and assess group assignment ', Claire McDonnell** **W2: ' Getting started in pedagogic research', Tina Overton** **W3: ' Publishing in chemical education – research and popular', Karen Ogilvy and Michael Seery** **W4: ' Promotion and outreach activities ', Sylvia Draper and Tim Harrison**		**14.15 – 17.00** EuChemS DiVChemEd Council meeting	**14.15 – 18.00** Optional outing to Bunratty
15.30	**Session 1A: Organic Chemistry** Paper 1 Paper 2 Paper 3	**Session 1B: General Chemistry** Paper 4 Paper 5 Paper 6	**15.30** *Tea/coffee*			
16.30	*Tea/coffee*		**16.00 Plenary 4: Natalie Rowley**			

17.00	**Session 2A: Organic Chemistry** Paper 7 Paper 8 Paper 9	**Session 2A: Problem-based Learning** Paper 10 Paper 11 Paper 12	**Session 6A: Inquiry-based Science Education** Paper 27 Paper 28 Paper 29	**Session 6B: Peer Teaching and Learning** Paper 30 Paper 31 Paper 32 Paper 33		
18.00-18.45	**Plenary 2: David McGarvey**		**Finish – 18.20**		Dinner for EuChemS DiVChemEd Council in Limerick	
18.45-19.30	Drinks and Poster session					
20.00-23.00	Barbecue on campus - Stables		Pick-up for conference dinner – 19.15 Conference dinner - Killaloe			

The detailed programme is given at the start of each day's abstracts.

Time	Wed 3rd July	
11.00-13.45	**Registration – C1 corridor** **Poster set-up**	
14.00-14.30	**Opening session: Chair: Peter E. Childs Jean Monnet LT** Welcome remarks by Prof. Don Barry, President UL; Professor Kieran Hodnett, Dean of Engineering and Science; Pat Hobbs, President, Institute of Chemistry of Ireland; Professor Ilka Parchmann, Chair, EuCheMS, Division of Chemical Education	
14.30-15.25	**Plenary 1:** ' Teaching college chemistry: context, collaboration and communication' ***Reiner Glaser*** ***Sponsored by Merck Sharp and Dohme*** MSD	
15.30-16.30	**Session 1A John Holland LT D1050** **Theme: Organic Chemistry** **Chair: Claire McDonnell** **1:** 'Computer says no .. knowing when enough technology is enough!', ***Barry Ryan*** **2:** ' Is there a place for closed, well-structured problems in PBL?', ***Mike Casey*** **3:** ' Blended learning and self-assessment to support teaching in organic chemistry', ***David Read and Charles Harrison***	**Session 1B Charles Parsons LT C1063** **Theme: General Chemical Education** **Chair: Mariann Holmberg** **4:** 'Development of tailored interventions to improve conceptual understanding', ***Madeleine Schultz, Gwen Lawrie, Tony Wright, Tim Dargaville, Roy Tasker, Mark Williams, Glennys O'Brien, Simon Bedford*** **5:** ' A multi-method investigation of university student's knowledge regarding chemical representations ', ***VahideTaskin, Sascha Bernholt and Ilka Parchmann*** ***6:*** *'Tools for university studies'*, ***Nina Aremo, Anu Keski-Koukkari and Taina Kaivola***
16.30-17.00	**Tea/coffee – C1 corridor** **Poster set-up**	
17.00-18.00	**Session 2A John Holland LT D1050** **Theme: Organic Chemistry** **Chair: Maria Sheehan** **7:** 'Flexible, online teaching and assessment of organic chemistry using MarvinSketch and SMILES', **G.C. Hargaden and Tim P. O'Sullivan** **8:**Teaching Organic Chemistry – a challenge or an opportunity?', **Anne O'Dwyer, Peter E. Childs and Noreen Hanly** **9:** 'Teaching Chemistry Through 'Discipline' Eyes'', **O' Leary, E.M., Keating, J.J. and O'Sullivan, T.P.**	**Session 2B Charles Parsons LT C1063** **Theme: Problem-Based Learning** **Chair: Ilka Parchmann** **10:** 'Problem solving: not one size fits all', ***Tina Overton, Helen St Clair-Thompson and Myfanwy Bulger*** **11:** 'Context and problem-based learning: an integrated approach', ***Dylan P. Williams and Katy J. McKenzie*** **12:** 'Beyond PBL: using dynamic PBL to teach sustainability', ***Tina Overton and Christopher Randles***
18.00 –18.45	**Plenary 2**: 'Enhancing the Student Experience in Undergraduate Chemistry' **David McGarvey** **Chair: Jane Essex John Holland LT D1050** RSC Advancing the Chemical Sciences Sponsored by the Royal Society of Chemistry's Chemical Education Research Group (CERG)	
18.45-20.00	Drinks reception and Poster Session - C1 corridor Bord Fáilte Irish Tourist Board ***Sponsored by Bord Fáilte***	
20.00-23.00	Barbeque in the Stables Club in the Students Union Courtyard on Campus. **(ticket needed)**	

Plenary 1:

Teaching college chemistry: context, collaboration and communication

Reiner Glaser
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Sponsored by Merck Sharp and Dohme

Abstract:
Interdisciplinarity is rapidly becoming a norm within both the professional and academic worlds, and the ability to collaborate is becoming an essential skill for all graduates. We have been interested in the development, implementation and assessment of new curricula to promote cross-disciplinary learning at all levels of college chemistry education. We will report on three such efforts, namely, the *Chemistry Is in the News* project for lower-division large lecture courses for science majors, the *Mathematics and Life Sciences* curriculum for the education of gifted STEM majors, and an upper-level seminar on *Scientific Writing in Chemistry* for chemistry majors. Peer review is essential to science and the students learn about various forms of peer review in these courses. *Chemistry Is in the News* (*CIITN*) is a curriculum that aims to teach students the desired skills by engaging student collaborative groups in a project that ties real world events and topics to the content taught in the classroom. While the collaborative activity has been successful in many ways, the challenge of maintaining individual accountability within the collaborative activity has persisted. The need to balance the tension between promoting collaboration and maintaining individual performance standards drove the development of an intra-group peer review system. Peer review presents a new set of challenges in learning communities of discipline-diverse students. As an example, we report on experiences with a research seminar of the *Mathematics and Life Sciences* program at MU, and we will highlight how such a class is socializing students for cross-disciplinary research. The seminar on *Scientific Writing in Chemistry* exemplifies a path for instruction on peer review that begins with rubric-based evaluations of elements of papers and leads all the way to near-authentic peer review of original research papers.

Biography:
Dr. Rainer E. Glaser, studied chemistry and physics at the Universität Tübingen (Diplom 1984), at the University of California at Berkeley (Ph.D. 1987), and at Yale University (post-doctoral), and he is currently a Full Professor of Chemistry at the University of Missouri, Columbia. Glaser is a physical organic chemist with interests in optical materials, catalysis, cancer chemotherapeutics and biomimetic CO_2 sequestration. Dr. Glaser has been interested and engaged in higher education throughout his career and with focus on fostering interdisciplinary learning. In 1995, Glaser began his education research with the novel curriculum, *Chemistry Is in the News* (*CIITN*), that he designed for chemistry education of science majors with funding by the Dreyfus Foundation and by NSF. More recently, since 2009, Glaser has been serving as co-PI on the NSF-PRISM grant *Mathematics and Life Sciences*, and he has been developing a new curriculum to teach *Scientific Writing in Chemistry* both a MU and at the University of the Chinese Academy of Sciences, Beijing. Glaser has enjoyed extensive collaborations with chemists, biochemists, physicists, mathematicians, astronomers, educators and journalists in the US, Europe and Asia. Glaser was elected AAAS Fellow in 2004 and Fellow of the Royal Chemical Society in 2006.

1: Computer says no .. knowing when enough technology is enough!

Barry Ryan
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Abstract:
The paper aims to describe the integration of several technologies into a First Year Foundation Organic Chemistry Module with the specific aims of improving communication, enhancing peer based learning, fostering a community of self-learning and providing the students with a real and virtual spaces to engage with each other and the content both synchronously and asynchronously. A further objective is to provide functional recommendations from practice for those interested in implementing such an approach in their own teaching. Finally, the majority of the technologies discussed are free to use and the paper will outline how these can be applied in other educational environments.

Engaging first year students in large lectures halls and laboratories can be particularly difficult. Students are exposed to a myriad of distractions, principally technology-based and available through their laptop and smartphones. In this case study, to circumvent these distractions and in an attempt in enhance student engagement, technology was integrated into the learning environment. The various forms of technology were chosen to improve communication, enhance peer based learning, foster a community of self-learning and provide the students with a real and virtual spaces to engage with each other and the content both synchronously and asynchronously. *Twitter* provided a method of communication between students and the lecturer in the form of an in class back-channel and also a means of rapidly disseminating information to the class. Additional technologies were used, both inside (*Clickers*) and outside the classroom (*PeerWise*), in order to prepare the student for the in-class learning activities and also to provide a structured independent and peer-driven learning environment. In this case study it was observed that the in-class technologies were readily and enthusiastically engaged with by the students, however, the outside class technologies were less so. Only the technology that had an assessment weighting associated received continuous student interaction. Post module evaluation noted that, although students welcomed the use of technology in their learning, there was a sense of being overwhelmed with technology and that the students needed space to engage with their different technology based communities; social, personal and educational. In light of this, the paper concludes with suggestions for other practitioners that which to integrate similar technologies into their learning environments.

2: Is there a place for closed, well-structured problems in PBL?

Mike Casey
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Abstract:
The use of open-ended, ill-structured problems is often listed as one of the essential characteristics of Problem Based Learning. While the use of problems of that sort seems eminently reasonable in the context of professional disciplines, in which practitioners are often faced with complex problems, their use in the basic Sciences is more problematic. There are excellent examples of the use of open-ended problems in introductory level Science courses, but it is not so clear how to apply them in some more focused, advanced level courses. Does it make sense to attempt to devise open ended problems when dealing with topics in which 'real life' problems have only one correct solution? If the use of closed problems seems appropriate to the subject material, are any of the major benefits of using PBL lost? Can the curriculum, which is often content heavy in the later years of Science programmes, be properly 'covered' using PBL? These issues will be discussed in relation to a 3rd year course in 'Mechanism in Organic Chemistry'. The evolution of the PBL methodology used, the type of problems used, and the nature of the 'scaffolding' provided in this course will be described. Closed problems, aligned with the intended learning outcomes, are now used, and it will be argued that they can be very effective. The case will be made that PBL can play a very valuable role in advanced level Science education, and that educators should not be deterred from adopting it by the (over) emphasis on using open-ended problems.

3: Blended learning and self-assessment to support teaching in organic chemistry

David Read and Charles Harrison
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Abstract:
In recent years, we have found that increasing numbers of students require support to ensure that they develop an effective approach to learning mechanistic organic chemistry. It is clear that incoming undergraduates have variable skill levels in this area, having typically encountered fewer mechanisms at A-level than in the past. To compound the problem, much of the focus is on learning 'the right way' to draw curly arrows rather than developing a deep understanding of underlying principles.

A set of supporting resources in the form of video tutorials were produced to reinforce understanding of the fundamentals which underpin mechanistic organic chemistry, and these were designed to improve students' skill levels and confidence. These online resources were combined with a self-assessed paper exercise to create a package which students completed as an Easter vacation activity which was not credit bearing.

The outcomes of the initial experiment included excellent levels of uptake by students, whose feedback indicated increased confidence in their ability to understand and apply their mechanistic knowledge. Detailed analysis of the evaluation data provides valuable insights regarding the features which students found most useful, and how they supported learning. This paper will describe the methodology and the outcomes from both the student and tutor perspective.

4: Development of tailored interventions to improve conceptual understanding

Madeleine Schultz[1], Gwen Lawrie[2], Tony Wright[2], Tim Dargaville[1], Roy Tasker[3], Mark Williams[3], Glennys O'Brien[4], Simon Bedford[4]
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Abstract:
Students entering tertiary chemistry arrive with diverse prior learning experiences in chemistry, creating a challenge for instructors in supporting learning progressions. In large general first-year chemistry classes, there is limited opportunity for instructors to evaluate individual students' existing mental models of key concepts and provide differentiated instruction. Concept inventories have been used for several decades to profile students' existing conceptions and extensive literature documents the alternative chemical conceptions held by students at all levels. While these misconceptions have long been recognised, effective interventions to enable students to challenge and correct their conceptions have received less attention.

We have designed a novel mechanism to deliver tailored learning interventions to students who possess poorly-formed conceptions. This uses student responses to a cluster of diagnostic questions around a specific concept as the trigger for a learning activity that is subsequently completed online. Students gain individual feedback from the diagnostic survey and then challenge their conceptions through engagement in visualisations of molecular level processes designed to cause cognitive dissonance. Key concepts to be remediated include phase changes, heat and energy, chemical reactions, solutions and chemical equilibria. The intervention modules are independent and self-paced. Evaluation of the effectiveness of the interventions includes diagnostic and summative test outcomes. The presentation will cover the development of our tools and preliminary results at three institutions.

5: A multi-method investigation of university student's knowledge regarding chemical representations

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Abstract:
Chemical representations, especially chemical formulae and equations, describe chemical contents in a well-defined but brief way. That is why chemical representations are a major tool for communicating about chemical contents. Learning this specific language is therefore an important goal for chemistry education. However, numerous national and international studies have shown that students have remarkable difficulties in understanding and using chemical formulae and equations. As most studies regarding chemical representations use test items that are placed on high school level, only little is known about university students' knowledge of those chemical representations which are first taught at university. That is why the study presented here aims at investigating university students' knowledge of chemical representations by using a valid and reliable test that includes test items on high school and university level. A pool of items was developed and reviewed by chemistry professors and university students regarding the items' comprehensibility, difficulty and relevance for university. After revision, the items were piloted with 220 chemistry students from eleven German universities and different semesters. From the data, 42 items with satisfactory statistical values remained in the item pool. Apart from this quantitative approach, an eye-tracking study in combination with think-aloud interviews is used to gain more insights into the processes that occur when students are working on items with chemical representations. Results of both quantitative and qualitative studies will be presented.

6: Tools for university studies

Aremo Nina[1], Keski-Koukkari Anu[2], Kaivola Taina[1]
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[2]Centre for Research and Development of Higher Education, Faculty of Behavioural Sciences, University of Helsinki
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Abstract:
Master's Degree should be completed in five years, but at the Faculty of Science, University of Helsini, quite a many students struggle with slow progress of studies and long studying times. One explanation for this could be that study skills applied at the high school can be ineffective and inappropriate for studies in higher education and practicing of wider study skills are needed.

Since 2009 the Faculty of Science has offered Study Skills –course once a year. The course is available for all students at the Faculty of Science during their bachelor or master studies. Annually around 100 students have enrolled on the course and about half of the participants pass the course. During this course students practice their study skills and discuss their studies and study skills in a peer group in an encouraging learning environment.

The main learning objectives in the course are improving time management, preventing procrastination, fostering study motivation, as well as preparing for exams and academic writing. In addition, they get weekly homework to practice various topics. For example, they observe their time management (sleep, studying contact and self, working, spare time, hobbies) during the first weeks and later on plan their own detailed study schedules.

According to student feedback, they found the course very useful and rewarding. Especially, peer group discussions and small weekly homework were mentioned promoting their own study skills. Paying attention to time and study management was appreciated giving them more self-confidence and information about their own studying habits.

7: Flexible, online teaching and assessment of organic chemistry using MarvinSketch and SMILES

Timothy P. O'Sullivan[1] and Gráinne C. Hargaden[2]

[1]School of Pharmacy and Department of Chemistry, ABCRF, University College Cork, Cork, Ireland. [2]School of Chemical and Pharmaceutical Sciences, Dublin Institute of Technology, Dublin, Ireland
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Abstract:
Learning by problem-solving is a key feature in the teaching of organic chemistry. In many institutions, this has traditionally taken the form of tutorials where students submit written answers which are assessed by a tutor with feedback given at a later date. However, current resource constraints have serious implications for this approach which is additionally aggravated by increasing student numbers. The use of online technologies to reinforce lecture material and to assess students is, therefore, increasingly attractive. A key requirement of any such system is the ability to draw and assess complex molecular structures.

While commercial packages are available, they have several significant drawbacks. These include high access costs for the institution or student, limited scope of questions and an overall lack of flexibility. With assistance from the National Academy for Integration of Research, Teaching and Learning (NAIRTL) we have developed and tested a system which can be readily implemented, where a bank of questions can be drawn upon by the instructor who would have total control over content, breadth, emphasis and difficulty of the individual assignments. Our system can be integrated with commonly used web-based learning (WBL) technology systems such as Blackboard or Moodle. These platforms are not "chemically aware" and therefore do not natively support the drawing or checking of chemical structures. However, by exploiting the SMILES (simplified molecular input line entry specification) algorithm, we can convert chemical structures unambiguously to ASCII strings which are then machine readable. Therefore, a combination of a WBL system used in conjunction with a JAVA-based drawing application (MarvinSketch) enables students to draw structures and generate the corresponding SMILES string which can be submitted for machine reading. Such a system requires no special software, other than a standard web browser allowing students to work at their own pace and even from home.

We describe how the above system is implemented and outline specific examples of the types of assessment employed. Additionally, we assess the impact of the system on students and evaluate the student feedback collated over the course of a year.

8: Teaching Organic Chemistry – a challenge or an opportunity?

Anne O'Dwyer [1], Peter E. Childs[1,2] and Noreen Hanly[2]
[1]National Centre for Excellence in Mathematics and Science Teaching and Learning, University of Limerick, Limerick and [2]Department of Chemical and Environmental Sciences, University of Limerick, Limerick, Ireland
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Abstract:
This paper addresses the problems of teaching Organic Chemistry. It has been found that many of the difficulties experienced by those teaching and learning Organic Chemistry at Second-Level persist at Third-Level. These include IUPAC nomenclature, classification of functional groups, reaction types, reaction mechanisms, characteristics of organic compounds and practical work. While many Third-Level students are meeting Organic Chemistry for their first time, others may have studied Chemistry at Second-Level. However, these latter students may also have preconceived misconceptions, which persist into Third-Level. There are also problems with visualisation of 3-D structures and reaction mechanisms. Organic Chemistry is abstract in nature and requires a formal level of cognitive understanding. There are thus many factors contributing to the problems experienced with Organic Chemistry, and hence they cannot be addressed by one simple solution. While Organic Chemistry can be challenging to teach, it provides an opportunity to implement strategies and ideas to increase learners' interest, motivation and understanding.

Organic Chemistry in Action! (*OCIA!)* is an innovative programme for teaching Organic Chemistry, which incorporates a combination of teaching resources and ideas from Chemistry Education Research (CER). Although the programme has been developed to address the Irish Second-Level Chemistry syllabus, the teaching approaches and strategies used are also applicable for Third-Level Organic Chemistry. The *OCIA!* materials were trialled and evaluated at Second-Level and the pupils involved in the intervention showed an increased understanding of, and interest in, Organic Chemistry. The *OCIA!* programme includes a teaching resource package containing a Teacher Guidebook, Pupil Workbooks and custom-made molecular model kits. The ideas of the *OCIA!* programme were well-received by Third-Level lecturers and post-graduate students in an exploratory workshop. This paper will show how the ideas of the *OCIA!* programme can be adapted for use in Third-Level Introductory Organic Chemistry lectures, tutorials and laboratory sessions.

9: Teaching Chemistry Through 'Discipline' Eyes

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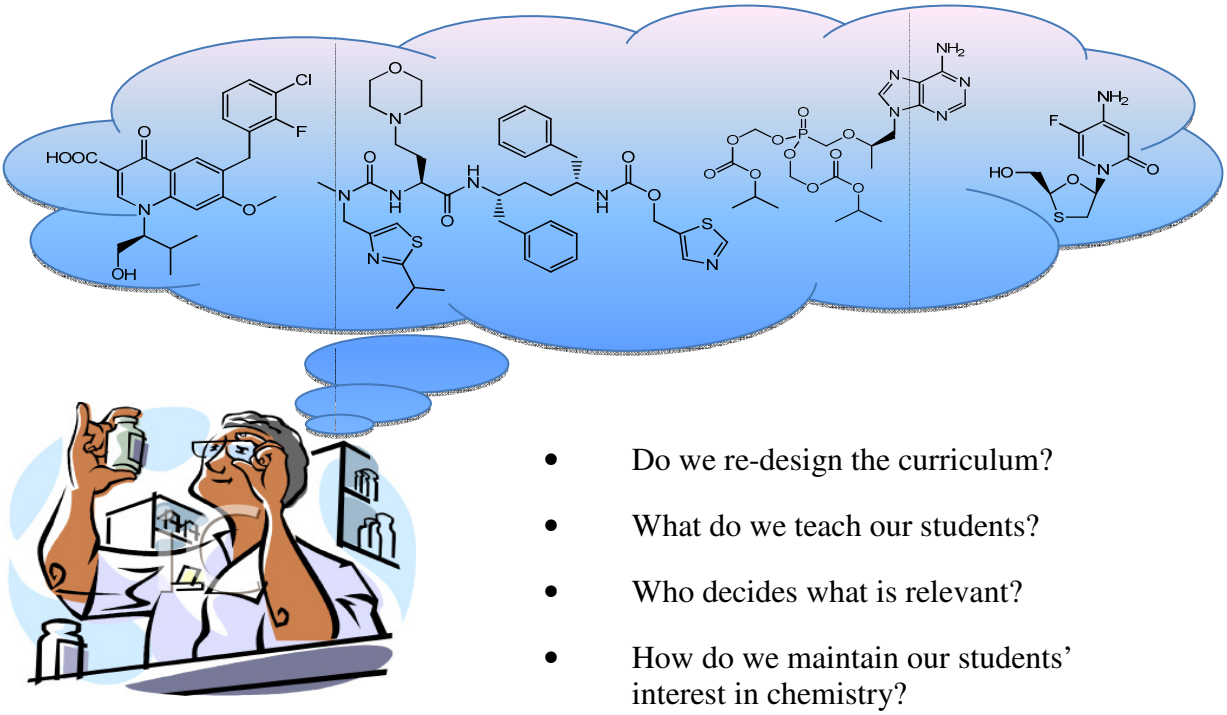

- Do we re-design the curriculum?
- What do we teach our students?
- Who decides what is relevant?
- How do we maintain our students' interest in chemistry?

The discipline of 'chemistry' is far reaching. There is a multitude of interesting topics to explore and teach to our students. However, it is important that the students are as interested in the chemistry we are teaching as we are. In particular, when teaching pharmacy students we may struggle to convince them of the importance of chemistry in their future career. The majority of students will become community pharmacists and see little place for 'arrow pushing' in their undergraduate studies. We have begun to ask the question "How do we teach our pharmacy students relevant chemistry and maintain their interest?". This presentation will outline how we have altered our focus and re-assessed how we teach chemistry to pharmacy students. Central to the new focus is the future career roles of our students in conjunction with the Pharmaceutical Society of Ireland (PSI) core competencies (core skills and capabilities identified as crucial for a practicing pharmacist). The presentation will outline how we are re-focusing the course and making it more relevant to the career path of a practicing pharmacist. Our main aim is to contextualise and integrate chemistry into their education.

10: Problem solving: not one size fits all

Tina Overton*, Helen St Clair-Thompson† and Myfanwy Bulger†
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Abstract:
Problem-based learning is becoming increasingly popular in chemistry education. Problem-based learning uses problem scenarios set within a real0life context. However, the problem solving experience differs from real life in that the problems are static, that is they remain as set throughout the activity. Most students come to similar solutions and produce similar outputs. Our innovation has been to introduce dynamic elements into the problem-based learning approach. Dynamic problem-based learning attempts to make the problem scenarios more 'real' by introducing dynamic elements. The dynamic elements may involve student choice in initial scenario, introduction of differing data sets or the introduction of external changes to the context. This presentation will introduce a dynamic problem-based learning activity in the area of sustainable chemistry. The implications of the dynamic features with respect to activity design, assessment, student learning and attitudes will be described.

11: Context and problem-based learning: an integrated approach

Dylan P. Williams and Katy J. McKenzie
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Abstract:
Context and Problem based learning (C/PBL) has been identified as an effective way of enhancing the learning experience of physical science undergraduates. The C/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. This innovative approach to teaching science can also greatly enhance the transferable skills of undergraduate students.

The Department of Chemistry at the University of Leicester has been using C/PBL in chemistry teaching since 2007. C/PBL is now used in a range of core teaching activities which include a ten week long group activity in a first year module and a series of contextualised extended investigation laboratory exercises. The integration of C/PBL into teaching at Leicester has improved the retention rate of first year students and has led to increased student confidence in solving complex problems. The varied modes of assessment for C/PBL activities have also led to an improvement in the transferable skills of Leicester chemistry graduates.

This presentation will discuss the practicalities of developing and integrating C/PBL resources into a chemistry degree programme, highlighting potential challenges as well as aspects of good practice. The presentation will conclude with a brief discussion of the impact that C/PBL has had on the student experience at Leicester.

12: Beyond PBL: using dynamic PBL to teach sustainability

Tina Overton and Christopher Randles
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Abstract:
Previous research has revealed that problem solving and attainment in chemistry are constrained by mental capacity and working memory. However, the terms mental capacity and working memory come from different theories of cognitive resources, and are assessed using different tasks. Our study examined the relationships between mental capacity, working memory, algorithmic and open-ended problem solving, and A level chemistry grades. The results revealed that the best predictor of algorithmic problem solving and A level grades was performance on a counting recall task, which requires the simultaneous processing and storage of information within working memory. The best predictors of open-ended problem solving were backwards digit recall and the figural intersection test. The results therefore demonstrated a dissociation between the cognitive resources underlying algorithmic and open-ended problem solving. The results are discussed in terms of practical implications for classroom practice and the design of problem-based activities.

Plenary 2: Enhancing the Student Experience in Undergraduate Chemistry

David McGarvey
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RSC | Advancing the Chemical Sciences

Sponsored by the Royal Society of Chemistry's Chemical Education Research Group (CERG)

Abstract:
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.

1. McGarvey D J, '*Investigating Commercial Sunscreens'*. *Educ. Chem.* (2007), **44**, 116-120
2. McGarvey D J and Haxton K J, '*Using Audio for Feedback on Assessments: Tutor and Student Experiences'* in Higher Education Academy, Physical Sciences Centre, '*New Directions in the Teaching of Physical Sciences*', Issue 7 (2011), 5-9.

Biography:
David McGarvey completed the Graduateship of the Royal Society of Chemistry (GRSC) at Paisley College of Technology (now University of the West of Scotland) in 1985 and went on to complete a PhD (1988) at the same institution (with George Truscott) involving the use of laser flash photolysis techniques to characterise the photochemistry and photophysics of photosensitisers for photodynamic therapy. Following postdoctoral positions at the University of Oxford (1988-1990) and Loughborough University (1990-1993), he was appointed Lecturer in Physical Chemistry at Keele University in 1993 and is now a Senior Lecturer and Faculty Learning and Teaching Director.

David's work in Chemistry Education has been strongly influenced and supported by the HEA Physical Sciences Centre team under the leadership of Tina Overton. His work encompasses the design and assessment of laboratory practicals and practical classes, taking a variety of approaches that combine real-world contexts with the development of graduate skills. He has disseminated his work through conference presentations and publications and more recently he has exploited technology to enhance teaching and learning with a particular focus on the use of digital audio for feedback and the use of screencasts for feedback and teaching. He has recently been appointed to the editorial board of 'Chemistry Education, Research and Practice (CERP)'.

RSC | Advancing the Chemical Sciences

The RSC's Chemistry Education Research Group

The Chemical Education Research Group (CERG) is one of the RSC's Special Interest Groups. The Interest Groups are member driven groups which exist to benefit RSC members, and the wider chemical science community, in line with the RSC's strategy and charter.

The CERG is concerned with promoting research at all levels of education and disseminating research findings to members of the Group. Members of CERG can help one another by sharing research expertise and locate others with similar interests through the Group's database.

At present, the Committee is working on the following projects:
• the preparation of short papers summarising key areas of research,
• an investigation into excellence in chemistry teaching in the UK.

Describing Practice in Chemistry Teaching (DePiCT):
The Chemical Education Research Group have already run the pilot phase of the DePiCT Project in which the chemistry content which was needed to be securely understood by specialist chemistry teachers was considered.

We are now moving forward to consider how these strands of knowledge become integrated into effective pedagogical practice. The IYC Challenge Grant has enabled the project to start face-to-face consultations with teachers. The teachers will constitute a focus group to consider our preliminary findings on excellent pedagogic practice in Chemistry, whilst also providing us with further research material through their accounts of their own work. This will form the basis of further data gathering, which we hope will include observations of practice as well as a collation of teaching resources for analysis.

Arising from this we envisage a community of Chemistry education researchers, and that the involvement of school-based colleagues will enable us to engage with further practitioners more readily. We believe that the project will culminate in a rich description of the attributes of excellent Chemistry teachers, which will shape future teaching practice and inform teacher educators' work. If you have an interest in this work please contact Dr. Vanessa Kind, vanessa.kind@durham.ac.uk

http://www.rsc.org/Membership/Networking/InterestGroups/ChemicalEducationResearch/

Time	Thursday 4th July	
09.00-10.00	**Plenary 3:** 'Translating university chemistry for the classroom' ***Sabine Streller*** **Chair: Pat Hobbs John Holland LT D1050** ***Sponsored by the Institute of Chemistry of Ireland***	
10.00-11.00	**Session 3A John Holland LT D1050** **Theme: Chemistry Teacher Education** **Chair: Jan Apotheker** **13:**' Tailored chemistry teacher education', ***Jan Lundell and Jouni Välisaari*** **14:** ' Cooperation with industry as a part of chemistry teachers' training at Jagiellonian University', ***Iwona Maciejowska*** **15:** To what extent can pre-service chemistry teachers deal with structure-property relations?', ***Stefanie Herzog, Sascha Bernholt, Mirjam Steffensky and Ilka Parchmann***	**Session 3B Charles Parsons LT C1063** **Theme: Science Outreach and Communication** **Chair: Sarah Hayes** **16:** 'From the classroom to the lecture theatre: Innovative ways to bring Chemistry and Chemical Research to Life.', ***Sylvia Draper and Paula Colavita*** **17:** 'Providing chemistry outreach for primary pupils: the experience of Bristol ChemLabs', ***Tim Harrison*** **18:** 'Promotion and outreach activities', ***Pauline Connell and Debbie Willison***
11.00-11.30	**Coffee/tea – C1 corridor**	
11.30-12.45	**Session 4A John Holland LT D1050** **Theme: Chemistry Teacher Education** **Chair: Orla Kelly** **19:** 'A new course module on education for sustainable development (ESD) and green chemistry in chemistry teacher education', ***Ingo Eilks and Mareike Burmeister*** **20:** 'Green chemistry: classroom implementation of an educational board-game ', ***Mike Coffey*** **21:** 'Impacts of a training program on prospective chemistry teacher's content knowledge, understanding and pedagogical content knowledge related to misconceptions .', ***Buket Yakmaci-Guzel and Sibel Yigit*** **22:**'When more is less: does more chemistry mean less understanding?', ***Muireann Sheehan and Peter E. Childs***	**Session 4B Charles Parsons LT C1063** **Theme: Chemistry Lecturer Continuous Professional Development (CPD)** **Chair: Paul Yates** **23**: 'The Australian chemistry discipline network', ***Mark Buntine, Gwen Lawrie, James Mitchell Crow, Glennys O'Brien, Madeleine Schultz, Siegbert Schmid, Daniel Southam, Brian Yates*** **24:** 'ICAB: a Dutch interuniversity chemistry lecturers network', ***Martin Goedhart*** **25:** 'University teaching qualifications for chemistry teachers', ***Jan Apotheker*** **26:** Training Teaching Assistants for Introductory University Level Chemistry Laboratories', ***Nada Djokic and Hayley Wan***
12.45-14.00	**Lunch - Main Restaurant (ticket needed)**	

14.00-15.30	**Session 5: Workshops (Sign up at registration)** **W1:** ' Wikis – what they are and how they are used to facilitate and assess group assignment ', ***Claire McDonnell*** **Location: CES Computer room** **W2:** ' Getting started in pedagogic research', ***Tina Overton*** **Location: John Holland LT D1050** **W3:** ' Publishing in chemical education – research and popular', ***Karen Ogilvie and Michael Seery*** **Location**: **Charles Parsons LT C1063** **W4:** ' Promotion and outreach activities ', ***Sylvia Draper and Tim Harrison*** **Location: C1061**	
15.30-16.00	**Tea/Coffee – C1 corridor**	
16.00-17.00	**Plenary 4:** 'Learning chemistry through inquiry' ***Natalie Rowley*** **Chair: Ingo Eilks** **John Holland LT** RUSAL AUGHINISH ***Sponsored by Rusal Aughinish***	
17.00-18.20	**Session 6A John Holland LT D1050** **Theme: Inquiry-based Science Education** **Chair: Sarah Hudson** **27:** 'The relationship between the degree of complexity of inquiry-type experiments and the development of arguments ', ***Rachel Mamlok-Naaman, Avi Hofstein, and Dvora Katchevich*** **28:** 'An Action Research Study of the Use of Inquiry Laboratory Practicals', ***Billy Madden and Marion Palmer*** **29:** 'Outcomes, Strategies and Challenges in Implementation of Authentic Chemistry Experiments in the Introductory Lab Curriculum', ***Vasiliki Lykourinou, Todd Gatlin, Adrian Villalta-Cerdas***	**Session 6A Charles Parsons LT C1063** **Theme: Peer Teaching and Learning** **Chair: Peter Davern** **30:** 'Using multimedia resources to facilitate peer-teaching', ***Dylan P. Williams, David L. Davies, Michelle Balonwu and Manmeet Banwaitt*** **31:**'Students supporting students – what can we learn from their questions?', **Odilla E Finlayson and Orla Kelly** **32:** 'A PACT with pharmacy students', ***Eileen M. O'Leary and Tim P. O'Sullivan*** **33:** 'Peer teaching: taking the recipe out of food analytical chemistry', ***Julie L. Dunne***
19.15	**Pick-up outside Stables for Conference Dinner in the Lakeside Hotel, Killaloe, Co. Clare (ticket needed)**	
23.00	**Return from Killaloe to hotel/campus accommodation**	

Plenary 3: Translating university chemistry for the classroom

Sabine Streller
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Sponsored by the Institute of Chemistry of Ireland

Abstract:
In principle, chemistry is a great subject. In chemistry, students can explore the world by planning and conducting experiments. Throughout such experiments students may examine natural phenomena and learn more about their environment and themselves.

The problem is, however, that most students do not share this particular view on science. Chemistry is said to be difficult to understand, far from one's daily life and its topics seem irrelevant and not to relate to students' concerns. This is why students are reluctant to study chemistry and are not necessarily interested to change their point of view. Or, in other words: The charm of chemistry stays locked and hidden for most parts of society.

A significant reason for this is how chemistry is taught at school. Chemistry lessons will only infrequently involve the students' interests and questions on issues relating to chemistry. But chemistry lessons will be rather based on the school curriculum's topics and objectives. Bridges between science and teaching and between science and students' conceptions are fragile and difficult to cross for both students and committed chemistry teachers. Even in academic teacher training at university, chemistry as a science and chemistry as a subject at school do not come together as often as it should be the case. Difficulties in teaching chemistry are predetermined.

In my presentation, I would like to show how the Department of Chemistry Education at the Freie Universität Berlin is building bridges between science and teaching in training future chemistry teachers. I will do this by presenting selected courses, which aim at providing ways to raise chemistry's attraction and how to make use of it in teaching. In short: it is about "translating university chemistry for the classroom".

Biography:
Sabine Streller is a fully trained grammar school teacher for chemistry and biology. She did her PhD in chemistry education. She has several years' experience in pre- and in-service science teacher training, especially in running CPD courses for science teachers. Her main research interests are students' interests in science and approaches to enhance the professionalization of in-service teachers and teacher education students. She is/was a member of the FUB group in the EU projects PROFILES and SALiS. In 2011/12 she was Professor of Biology and Chemistry education at RWTH University Aachen. She is currently a research assistant at Freie Universität Berlin, Division of Chemistry Education (chemistry didactics), and is involved in the preparation of science teachers and in running CPD courses.

About the Institute

The Institute of Chemistry of Ireland is the professional body representing chemists in Ireland. Its members are chemists who satisfy the requirements of the Institute with regard to qualifications and experience. The Institute promotes the study of chemistry, sets professional standards and organises lectures, meetings and social events for its members. It offers advice and comment to Government in areas relevant to the profession. The official journal of the Institute is titled Irish Chemical News.

Objectives

The main object for which the Institute is established is to advance education in Chemistry in Ireland through the operation of an organisation, which promotes advancement and knowledge of Chemistry in schools and third level colleges, including but not limited to publishing journals, conferring awards, sponsoring students, holding professional seminars, lectures and an annual congress.

Mission Statement

The Mission of the Institute of Chemistry of Ireland is to promote Chemistry and to represent the profession of Chemistry in Ireland.

In pursuit of these aims the Institute endeavours to:

- promote the advancement of the discipline of chemistry;
- sustain the profession of chemistry through the admittance to membership of suitably qualified candidates;
- provide an independent body of experts available for consultation, and make its members' expertise available to the public;
- advance the profession of chemistry by maintaining a relationship with other professional bodies, both here and overseas.

http://www.chemistryireland.org/

13: Tailored chemistry teacher education

Jan Lundell and Jouni Välisaari
Department of Chemistry, University of Jyväskylä, P.O.Box 35 (Survontie 9), 40014 University of Jyväskylä, Finland
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Abstract:
Chemistry teacher training relies heavily on efficient and interactive collaboration between education and chemistry teaching, and training schools. These provide students' with skills and knowledge in teaching and learning, in chemistry, and provide safe and familiar surroundings to practice teaching skills. Besides all this, the Department of Chemistry has created a M.Sc. level training program for chemistry teachers in pedagogical content knowledge. The focus of the training is on strengthening the students' chemistry content knowledge highlighted in Finnish national curriculum, provide authentic learning environment encompassing inquiry-based learning, and support students towards meaningful chemistry education based on research and assessment. The training involves plenty of laboratory-based activities, and ICT is used broadly. Moreover, a special training course on modeling and visualization in chemistry education is available to provide students with competence on ICT-enhanced teaching.

The presentation focuses on the pedagogical choices made when planning and realizing the training, as well as on how the teacher training program is connected with in-field teacher training, faculty pedagogical skill enhancements, and chemistry education research.

14: Cooperation with industry as a part of chemistry teachers' training at Jagiellonian University

Iwona Maciejowska
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Abstract:
How can one talk convincingly about the role of chemical industry in the economy without ever visiting a chemical factory or enthusiastically indicate the application of chemical knowledge in industrial processes without ever seeing a production hall? With great difficulty would be the reality, but none-the-less this is the situation that occurs in many national science teacher training programmes. This is due, in part, to the limited opportunities available within the educational system to draw these real-world experiences into the learning process; whether at the level of pupils, students or returning to schools as teaching staff. Following global trends and based on the Chemistry in Action program, one of the essential part of the teachers training that is prepared within the ESTABLISH project (www.establish-fp7.eu) is to foster linkages with local and familiar industries. This presentation shows how contact with industry was realised within the summer schools for teachers that were organized at the Faculty of Chemistry JU, with the teachers visiting Żywiec Brewery, BASF Myślenice, Dlubnia Water Treatment Plant in Krakow, Azoty SA Tarnów, Coca-cola Hellenic Staniątki, Oil-Rafinery Trzebinia SA, Institute of Ceramics and Building Materials.

15: To what extent can pre-service chemistry teachers deal with structure-property relations?

Stefanie Herzog, Sascha Bernholt, Mirjam Steffensky and Ilka Parchmann

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Abstract:
Whereas chemistry content in university is presented along the traditional areas of the discipline, i.e. inorganic, organic and physical chemistry, school chemistry is structured more predominantly according to basic concepts. Since future chemistry teachers face the challenge to link both ways of structuring this content, it seems vital to investigate how well they understand the basic concepts themselves and what they already know at different stages of their university education about the teaching and learning of such concepts. In order to do so, a pool of test items regarding the concept of structure-property-relations has been piloted with 220 pre-service chemistry teachers from eleven German universities at different levels of their university education. For both content knowledge and pedagogical content knowledge, the scales show satisfactory to good internal consistency. Regarding the content knowledge items, the resulting data show a progression of item difficulty regarding not only factors used to generate item variety from the start, such as number of cognitive steps to solve an item, number of perspectives addressed, or level of complexity, but also regarding certain content aspects, such as hydrogen bonds.

16: From the classroom to the lecture theatre: Innovative ways to bring Chemistry and Chemical Research to Life

Sylvia Draper and Paula Colavita

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http://www.tcd.ie/Chemistry/outreach/
http://www.tcd.ie/Chemistry/undergraduate/chemistry/sf/broad/
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Abstract:
The process of scientific enquiry is difficult to initiate in a packed School curriculum. To help convey an understanding of it we have developed a specific (TY to 5th year) **secondary school–based, outreach module as part of our structured postgraduate training programme.** The module, now in its third year is a recipient of a 2012 College service-learning, civic engagement award. Within the module, a group of self-selecting graduates are mentored to produce individual talks that explain what they do on a daily basis and the purpose of their on-going research. The students have developed novel, hands-on, student-centred experiments to complement their talks and both talks and experiments have been deployed in a number of schools in the Dublin area via on-site School visits. The hands-on activities are supported by a 2012 Discover Science and Engineering award.[1]

Chemistry can appear as a demanding, dry and fact-laden subject even at third level where it is taught to a disparate group of students with wide-ranging, end-career goals and very different abilities in Chemistry on entry. To tackle this, the School introduced **a team presentation exercise into the second year undergraduate curriculum** (2002 onwards).[2] The class (>260 students) is divided into teams of 8-10 and each group prepares a set of reports and subsequently a 20 mins presentation on a topic of their choice that illustrates the relevance of Chemistry to Life. The competition final, attended this year by over 150 secondary level school students and their teachers, was a lively and informative event.

1. DSE Partnership Funding 2012 - 3-D Research Kits: The Design, 'Development and Deployment of Research-informed Activity Kits for 2nd Level Students' P. Colavita, J. Daly, S.M.Draper
2.(a) Proceedings of National Academy's 5th Annual Conference, NAIRTL, 9-10th June 2011, N.McGoldrick, P.N.Scully, S.M.Draper; (b) B. Mc Goldrick , Bartosz Marzec , P. Noelle Scully , and Sylvia M. Draper *, J. Chem. Educ., Article ASAP, DOI: 10.1021/ed200643g, Publication Date (Web): January 11, 2013

17: Providing chemistry outreach for primary pupils: the experience of Bristol ChemLabs

Tim Harrison and Dudley Shallcross

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Abstract:
Bristol ChemLabS, the UK's Centre for Excellence in Teaching and Learning (CETL) in practical chemistry, delivers numerous outreach activity days per year for thousands of primary school pupils per year. These comprise demonstration assemblies and hands on workshops for pupils. The activities support the UK's Key Stage 2 science curriculum, to raise scientific understanding among the teachers and to raise pupils' science skills and aspirations and are used by overseas universities to the same advantage. The Bristol ChemLabS Outreach programme is self financing. This paper attempts to demonstrate the advantages to the pupils, their teachers, the postgraduates that help deliver the workshops and to the University of Bristol and to show how others can do the same.

18: Promotion and outreach activities

Pauline Connell and Debbie Willison
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Abstract:
The competitive nature of recruitment in Higher Education is clearly recognised. While a range of promotion and outreach activities, such as branding and student recruitment, are organised centrally within institutions, departments also have an important role to play in promoting themselves. To address this, the Department of Pure and Applied Chemistry at the University of Strathclyde appointed an Outreach Activities Champion over 15 years ago. Their task was to co-ordinate current outreach activity while also creating new opportunities to promote the department and courses. A relatively small team was established to implement this. A number of initiatives began to evolve through dialogue within this team and with colleagues in the secondary education sector. Successes in this area encouraged other colleagues to become involved in outreach activities. The department indicated further commitment with the appointment of a Marketing specialist who has taken responsibility for the design of our publicity material and the content of the Admissions page on our website. All external communications are produced to the highest specification to heighten the perception of the department as a professional organisation. As an indication of our commitment to outreach and the wide ranging scope of our activities, in 2011/12 we interacted with approximately 113 schools, 168 teachers and 2312 school pupils. Our presentation will describe the scope, and assess the success, of our activities to delegates.

19: A new course module on education for sustainable development (ESD) and green chemistry in chemistry teacher education

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Abstract:
This paper describes the development of a new course module on sustainability issues, essentials of Green Chemistry, and Education for Sustainable Development (ESD) for secondary chemistry teacher education at university. The module was based on empirical studies about the knowledge base of student teachers and experienced teachers on sustainability, Green Chemistry and ESD. It was created and cyclically refined using Participatory Action Research. The paper will give an overview about the course module and experiences gained during its now four-year application, including feedback collected from student evaluation sheets. Overall, the participants responded very positively to the course module. The student teachers stated that the module was interesting, important and valuable for their later profession as secondary chemistry teachers. They also emphasized that they now felt more competent in the area of sustainability, Green Chemistry and ESD.

20: Green chemistry: classroom implementation of an educational board-game

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Abstract:
The classroom adoption of a newly developed educational board game themed around chemical production, pollution mitigation and green chemistry principles is described.

Many disciplines utilise non-trivial game play to engage students in learning whilst illustrating key subject principles. In physical sciences there is a limited range of such activities available. This game offers educators in chemical sciences opportunity to use an engaging problem-based concept delivery method suitable for secondary-to-tertiary transitional students.

The game itself is moderately complex. Players compete to manage finances and resources to plan their simulated chemical production, developing their activities to minimise the chemical wastes produced. The "twelve principles of green chemistry" are illustrated using specific technology exemplars. Players purchase chemical plant and raw materials to create their product and wastes (represented by tokens), generating money for the next round of play. Wastes require disposal, eating into profits and forcing investment in upgraded technologies. The winning player is the wealthiest after six rounds. Advanced rules introduce Emissions Trading Scheme concepts. The game is available as a set of free PDFs.

Feedback from HE chemistry tutors (ViCE, 2011) was positive about the game mechanics and potential for classroom use. The game was piloted with NTU students, whose feedback showed they enjoyed the experience and that educational goals were met. Further sessions have been conducted at HE institutions in the UK (Tees) and, for teacher-training, in Germany (Bremen). Implementation of the game in these courses is reported, and responses of students and their engagement in this activity are outlined.

21: Impacts of a training program on prospective chemistry teacher's content knowledge, understanding and pedagogical content knowledge related to misconceptions

Buket Yakmaci-Guzel and Sibel Yigit
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Abstract:
This study investigated effects of a training program on prospective chemistry teachers' content knowledge in subjects of particulate nature of matter, chemical equilibrium and acid strength, and their understanding and pedagogical content knowledge related to misconceptions. The participants of the study were 22 prospective chemistry teachers from a public university in Turkey. The training program was designed by taking into account student misconceptions in above chemistry subjects and used several instructional strategies. Data regarding prospective teachers' content knowledge were collected through a chemistry concept test (CCT) before the training program and an equivalent form of this test (CCT-B) after the program. Data regarding prospective teachers' understanding and pedagogical content knowledge related to misconceptions and teaching efficacy beliefs were collected through a questionnaire (KBCMTEQ) before and after the training program. The findings of this study revealed that prospective chemistry teachers had several misconceptions before attending the training program. After attending the training program, the content knowledge of prospective chemistry teachers improved in particulate nature of matter, chemical equilibrium and acid strength subjects. The results also indicated that although prospective teachers had an understanding related to misconceptions before attending the training program, attending the training program increased their understanding and pedagogical content knowledge related to misconceptions in some aspects.

22: When more is less: does more chemistry mean less understanding?,

Muireann Sheehan and Peter E. Childs
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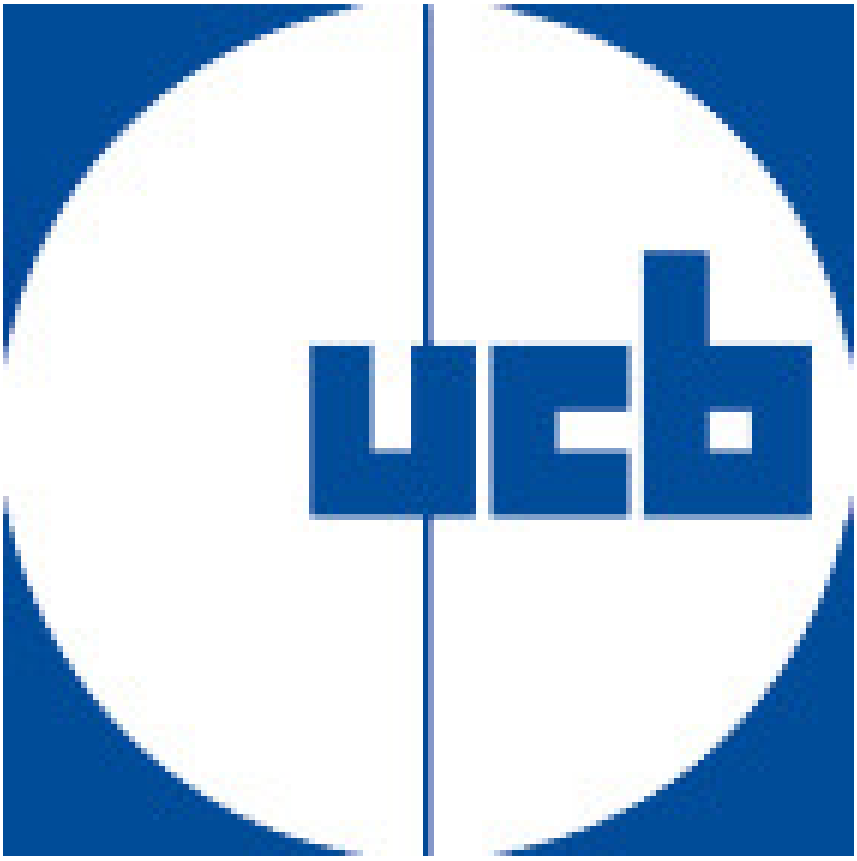
Abstract:
Irish third level education is failing to produce students that understand chemistry. This research project focused on the chemistry understanding of pre-service science teachers (PSSTs) about a selection of basic chemistry concepts. These PSSTs (n = 467) were studying on either consecutive or concurrent initial science teacher training programmes across Ireland. Consecutive programmes accept graduates of science degrees to study education and subject specific pedagogies for the duration of one year. Concurrent programmes involve the study of science, education and subject specific pedagogies for the duration of four years culminating in the award of an Honours Degree in science and education. Those following the consecutive model of teacher education study more science than those on the concurrent model. However, this does not appear to translate into increased understanding of basic chemistry concepts. Pre-service science teachers from each of the four years of study on concurrent programmes were included in this study. Those in their last year of study, having studied up to 10 chemistry modules, did not demonstrate a better understanding of basic chemistry concepts than those in their first year of study. These findings are of concern for science teacher educators as well as science educators.



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23: The Australian chemistry discipline network

Mark Buntine[1], Gwen Lawrie[2], James Mitchell Crow[3], Glennys O'Brien[4], Madeleine Schultz[3], Siegbert Schmid[5], Daniel Southam[1], Brian Yates[6]
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Abstract:
In 2011, the Australian Learning and Teaching Council funded the formation of the Chemistry Discipline Network. The main aims of the Network were to improve communication between chemistry academics around Australia and to work towards implementation of the Threshold Learning Outcomes for Chemistry (TLOs). The Network currently has 120 members and has become a unique resource for those teaching chemistry as well as for administrative bodies such as the Tertiary Education Quality Standards Agency. Our guiding principles of openness and inclusiveness have resulted in a broad membership representing all Australian universities. One important function of the Network is to reduce the isolation of teaching-intensive academics, in many cases at smaller and regional institutions. Monthly Skype meetings allow wide-ranging discussions including topics such as: content, structure of units and courses, practical work, administrative processes and also the scholarship of teaching and learning. We have mapped the chemistry taught across 12 Australian universities and are currently mapping four of these degree programs to the TLOs. Several workshops have led to significant progress in translating the TLOs to standards, and importantly to members getting to know each other. The Network has catalysed several joint grant proposals amongst members as well as improving communication around conference planning and symposium organisation, including developing a bid for the 2016 International Conference on Chemical Education to be held in Sydney.

24: ICAB: a Dutch interuniversity chemistry lecturer's network

Martin Goedhart

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Abstract:
In many universities teaching is a rather isolated activity. Contacts with colleagues are restricted to staff meetings in which the curriculum is discussed, and contents and teaching strategies of courses are discussed at a general level. Lack of collaboration with colleagues may easily lead to a curriculum, which students perceive as incoherent. Students do not see the relations between subjects and they have difficulties with varying expectations by lecturers.

In 2010, the Dutch Ministry of Education funded a project, called ICAB (Innovation Centres of Academic Science Education), which aims at promoting collaboration between lecturers of different universities. The ICAB project should enhance the quality of university programmes by exchanging good teaching practices and enable staff development through contacts between colleagues.

Five networks were formed: mathematics, computer science, physics, chemistry and biology. In the chemistry network, projects were launched on testing and on the development of an adaptive learning environment for quantum chemistry.
Although collaboration was fruitful in a number of cases, the overall effect of ICAB after a two year period was disappointing. We have found that collaboration between lecturers is difficult to realise, even when funding is available. In this contribution we will discuss how interuniversity collaboration should be organised to be beneficial both for the quality of teaching and as a model for staff development.

25: University teaching qualifications for chemistry teachers

Jan Apotheker
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Abstract:
Since four years the University of Groningen has implemented a scheme in which teachers need to qualify for a University Teaching Qualification. For the faculty of mathematics and natural sciences a special track has been established. One of the reasons is that the pedagogy of teaching science and mathematics is rather different from the pedagogy in other faculties.

Two different programs have been implemented. One for experienced teachers, having at least five years seniority. Usually these teachers will be associate or full professors. The other program is for young assistant professors, who are just staring their career.

In the first program teachers are put together in a two day session in which they write a portfolio describing that they have acquired a sufficient level of competency in four areas:

- (re)design of education
- teaching in lectures/ seminars/ tutorials
- coaching master and PhD students
- assessing the learning outcomes of courses
- use of evaluation from peers and students
- vision on education and own professional development

In the second program the teachers follow a number of workshops, and than write a similar portfolio.

The success rate of the first program is about 90%, of the second only 30%. In the presentation I will discuss probable cause and solutions.

26: Training Teaching Assistants for Introductory University Level Chemistry Laboratories

Nada Djokic and Hayley Wan
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Abstract:
Proper training of teaching assistants (TAs) can significantly contribute to improvement of student's learning in various chemistry laboratory exercises. At North American universities, graduate students are often employed as teaching assistants for chemistry laboratory classes. The graduate student population is usually quite diverse, which makes it very difficult to expect all teaching assistants to possess similar teaching abilities. In order to achieve the high teaching standards expected by the university and the undergraduate students, a significant amount of time must be invested in training teaching assistants and helping them to succeed in their teaching duties.

In order to satisfy the necessary requirements, an effective model for training teaching assistants with different teaching experience has been developed in the Department of Chemistry at the University of Alberta. We have implemented a successful model that is used every semester during the mandatory training sessions for our organic chemistry teaching assistants. Our model includes case studies of commonly encountered lab teaching scenarios, safety procedures, a marking workshop, mock pre-lab presentations from the new teaching assistants, guided demonstrations of administrative procedures and a mentorship program. This presentation will provide an overview of our teaching assistant training model and discuss the benefits of implementing such a program.

We Innovate Healthcare

W1: Wikis – what they are and how they are used to facilitate and assess group assignment

Claire McDonnell
School of Chemical and Pharmaceutical Sciences, Dublin Institute of Technology, Ireland.
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Location: CES Computer room

This workshop will provide a hands-on introduction to the use of wikis for teaching and learning chemistry. 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. Feedback and reviewing by tutors and peers is 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. Wikis are regularly used in organisations to allow groups to collaborate on projects and documents and to share knowledge and therefore the ability to use one is a valuable transferable skill.

Relevant applications of wikis will be discussed and demonstrated briefly (these will include context and problem based learning resources developed by the workshop facilitator for the Royal Society of Chemistry last year). Participants will then be shown how to carry out tasks using PBworks software that learners and academic staff need to be able to perform. They will also be provided with an opportunity to consider how this tool could be applied to their own teaching contexts and some guidelines on issues that often need to be considered will be discussed.

The conference themes that are relevant are problem-based and inquiry-based teaching and learning as wikis can be used to facilitate and assess group work.
Please note that an invitation to join a PBworks wiki will be sent to participants by e-mail the day before the workshop takes place.

W2: Getting started in pedagogic research

Tina Overton
President, RSC Education Division
Deputy Head of Department , Department of Chemistry, University of Hull, Hull, HU6 7RX UK

Location: John Holland LT D1050

This workshop is designed for colleagues who are interested in developing their teaching and learning from developing and evaluating innovations to carrying out pedagogic research which tells us something about how students learn and that is publishable in the research literature. We will identify the main stages in this journey and participants will start to plan for their own research project.

W3: Publishing in chemical education – research and popular

Karen Ogilvie and Michael Seery

Location: Charles Parsons LT C1063

Remit: spread between publishing research (as in *CERP*) and publishing for a more general audience (*EiC, The Mole* and *Chemistry World*)
Presenters: Karen J Ogilvie, Editor, *Education in Chemistry*/Managing Editor, *Chemistry Education Research and Practice (CERP),* Royal Society of Chemistry ogilviek@rsc.org
Michael Seery, Lecturer, School of Chemical and Pharmaceutical Sciences, Dublin Institute of Technology michael.seery@dit.ie

Why publish in chemistry?

One theme of this conference is outreach and better promotion of chemistry.

Those of us in the field of chemistry education are aware of the many misconceptions, bad perception and the lack of understanding of chemistry by the public. Why does this matter and why we need to involve the public? To ensure a sustainable future, there are many issues (energy, environment, food and nutrition, health, etc) that society needs to resolve.

Publishing is a very effective, high impact way of promoting science and chemistry in particular, in a positive and fair way. For example, it allows us to promote and support outreach activities by distributing content at events, etc. To promote chemistry successfully through publishing, we need to engage our audiences.

In this workshop we will consider a range of audiences, from those interested in educational research to the general public. We will ask you to think about the impact of different article types, language, medium and how each of these is suited to their target audiences.

By the end of the workshop, you will have discussed ideas for different article types and how to scope out these ideas. You will also have developed tools to write a pitch for an article of your choice for publication and considered the structure of an article so that a clear message is conveyed.

We will also touch on aspects to include in your writing which can help ensure that speculative articles are attractive to a commissioning editor for publication and research articles make a good impact on reviewers.

W4: Promotion and outreach activities

Sylvia Draper and Tim Harrison

Location: C1061

This workshop will describe various types of outreach and promotion activities run by university chemistry departments, illustrated by the examples of Trinity College Dublin (Sylvia Draper) and the University of Bristol (Tim Harrison). This is an opportunity to share your own experiences and learn from other people's work.

Plenary 4: Learning chemistry through inquiry

Natalie Rowley
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Sponsored by Rusal Aughinish

Abstract:
The interpretation of spectra used to be taught by traditional methods in the first year of our chemistry degree programme. The delivery consisted of lectures on each of the main spectroscopic techniques accompanied by a series of parallel workshops with a focus on spectral interpretation.

However, in order to encourage our students to become more independent learners and to develop their employability skills, it was decided to replace the traditional delivery by an enquiry-based approach. The current methodology uses a number of enquiry-based scenarios which place the students in the context of graduate chemists in a fictional company. They work in groups to solve spectroscopic problems of increasing complexity. Only once the students have completed all of the enquiry-based sessions do they receive lectures on each of the spectroscopic techniques. The lectures have a shift in emphasis compared to those delivered previously – the focus is on how each of the spectroscopic techniques work, where the spectral features appear in their respective spectra and why characteristic spectral features occur. This approach has proven to be popular with the students and a successful method of encouraging a deeper understanding of this area of study as well as developing employability skills.

Biography:
Dr Natalie Rowley is a Lecturer and Director of Innovation in Teaching in the School of Chemistry at the University of Birmingham, UK. She became a University of Birmingham Teaching Fellow in 2006, and a Fellow of the Higher Education Academy in 2007. She has been project leader on a number of University of Birmingham Learning Development projects in the areas of e-Learning and Enquiry-Based Learning, the latter of which led to her supervising the School's first MPhil student in Chemical Education research, the findings of which have recently been published. She was also joint project lead on a National HE STEM project on Science Communication. She is currently joint project lead on a University of Birmingham Centre for Learning and Academic Development funded project looking at lecture flipping

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The Alumina product is exported to smelters owned by Rusal in Russia and facilities in Europe, where it produces more than 0.92 million tonnes of Aluminium metal. This versatile metal has worldwide appeal for its lightness, durability and its total recyclability.

27: The relationship between the degree of complexity of inquiry-type experiments and the development of arguments

Rachel Mamlok-Naaman, Avi Hofstein, and Dvora Katchevich
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Abstract:
One of the goals of science education is to provide students with the ability to construct arguments – reasoning and thinking critically in a scientific context. Over the years, many studies have been conducted on constructing arguments in science teaching, but only few of them have dealt with studying argumentation in the science laboratory in general and in the chemistry laboratory in particular. Our research focuses on the process in which students construct arguments in the chemistry laboratory while conducting different type of inquiry experiments. The experiments that were assessed for their argumentation level differed in their level of complexity. It was found that the more complex experiments served as a better platform for the development of arguments; both in the level of argumentation as well as in its relative numbers.

28: An Action Research Study of the Use of Inquiry Laboratory Practicals

Billy Madden and Marion Palmer
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Abstract:
This study assessed the effect of varying the degree of inquiry in laboratory practicals in an Institute of Technology Level 7 module in chemical instrumentation. A range of laboratory instruction styles were assessed for their suitability for use in Level 7 chemical instrumentation laboratory practicals and comparative studies of these styles from the literature were reviewed.

An action research framework was adopted, which collected data from students and staff in the Institute as well as looking at course, departmental and institutional documentation. Action research changes were implemented to increase the degree of inquiry in chemical instrumentation laboratory practicals. A range of research instruments were used to plan, monitor and observe the effects of these action research changes.

The findings from these research instruments showed that increasing the degree of inquiry in laboratory practicals from the level of structured investigation to unstructured investigation was welcomed by students and that incorporating pre-lab and post-lab exercises as part of the transition to a higher degree of inquiry was specifically identified as leading to improved student understanding of laboratory practicals.

Using an action research framework resulted in improvements to the running of the chemical instrumentation laboratory practicals while also causing the researcher to alter his own behaviour in laboratory practicals to aid student learning.

29: Outcomes, Strategies and Challenges in Implementation of Authentic Chemistry Experiments in the Introductory Lab Curriculum

Vasiliki Lykourinou, Todd Gatlin, Adrian Villalta-Cerdas
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Abstract:
It has been extensively documented in literature that inquiry based labs and student engagement in authentic experimentation can increase student's interest in learning science and support their skill development and understanding of the nature of science much more than traditional 'cookbook' labs. One of the main challenges in implementing a curriculum that involves students in experimental planning, data processing and interpretation is the preparation and proper training of the instructors or teaching assistants (TAs) facilitating such laboratory activities.[1]

This study reports the curricular modifications and implementation process to revise the General Chemistry Laboratory program at a research-intensive US university. The instructional design was based on mandates outlined in National Research Council reports[2] and learning goals highlighted as central in laboratory instruction at the undergraduate level.[3,4] The curriculum revision efforts focused on (a) the development of multi-week projects using topics or themes based on goals and challenges of the modern chemical research such as material design, quality control or drug development (b) creation of a laboratory environment that cultivates student familiarity with the scientific process as it is practiced through engagement in experimental design and cycles of planning to addressed the problems posed by the laboratory projects and based on student gathered results and observations.

An extensive assessment of student's and graduate teaching assistant's perception of the learning environment was used to further guide the ongoing curricular reform and evaluate how it corresponds to the learning goals of the laboratory curriculum. The results of this assessment will be discussed as well as the detailed outline and rationale for the chosen training and preparation of the teaching assistants who are facilitating the laboratory activities.

1. Roehrig, G. H., Luft, J. H., Kurtziel, Turner, J. A., **2003**, J. Chem.Educ., *80* (10), 1206-1210.
2. Singer, S. R., Hilton, M. L., Schweingruber, H. A., (Eds.), *America's lab report,* **2006**, Washington, D.C: National Academies Press.
3. Talanquer, V., Pollard, **2010**, J. *Chem. Educ. Res. Pract*., *11*, 74-83.
4. Kelly, O. C, Finlayson, O.E., **2007**, *Chem. Educ. Res. Pract*., *8* (3), 347-361.
5. National Research Council (NRC), *Beyond the molecular frontier,* **2003**, Washington, DC: National Academy Press.

30: Using multimedia resources to facilitate peer-teaching

Dylan P. Williams, Michelle Balonwu, Manmeet Banwaitt and David L. Davies
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Abstract:
The use of peer-teaching in chemistry education has become increasingly common in recent years. Examples of peer-teaching include context and problem based learning activities (C/PBL); peer critiques of work (such as peer-feedback on oral presentations or essays) as well as collaborative working in course workshops. Another approach to peer-teaching is the use of final year students as peer-mentors in workshops or during private study.
A group of four final year project students in the Department of Chemistry at the University of Leicester were assigned a project to plan and develop a series of screencapture resources. The project students were briefed that their resources were to be based on subjects from the first two years of the chemistry degree. Before creating the clips the project students surveyed other students to get feedback which informed the content covered in the clips and the style of presentation. The Adobe programmes Captivate and Presenter were used to produce short, focused screen capture clips.

The response to the peer generated clips was positive with significant numbers of year one and two students watching the clips and some indications of improved performance amongst those who had watched the clips. The project gave the final year students a greater appreciation of the pedagogical basis of university teaching as well as an insight on how to integrate innovative resources into a course.

This presentation will describe the planning and production of these resources as well as the findings from an evaluation of the use of the clips by undergraduate chemistry students.

31: Students supporting students – what can we learn from their questions?

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Abstract:
Recent studies have indicated a tendency for students to adopt a surface learning approach in their studies of chemistry. Increasingly, students who progress into 2nd year of undergraduate degree programmes can have difficulty in dealing with the 2nd year content or have difficulty in addressing higher order questions. Student peer support has been explored as a means of encouraging effective learning in higher education. A further development which enhances peer supported learning is the use of Peerwise (http://peerwise.cs.auckland.ac.nz). Peerwise is a freely available web tool that provides an online framework where students can create and answer problems. Additionally, students can comment and discuss the answers to the problems created.

In this study, a group of 2nd year students used the peerwise tool to create assessment multiple choice questions in the area of kinetics. Over the four week lecture course, students were asked to do a minimum of creating 4 problems, answer 20 problems and comment on 8 problems. With 117 students involved in the lecture programme, this resulted in the generation of over 400 problems. Analysis of these problems has shown that they vary in depth, correctness and relevance. However, they give a very good indication of the student's understanding of the lecture content. Student comments have been analysed in terms of deepening the discussion on the individual questions. The use of the peerwise tool provides continuous information to the lecturer on misunderstandings developed within the lecture programme.

32: A PACT with pharmacy students

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Abstract:
PACT (**P**eer **A**ssisted **C**hemistry **T**utorial) was implemented in the School of Pharmacy, University College Cork. The PACT scheme was adapted from the **P**eer **A**ssisted **L**earning programme, better known as **PAL**, previously organised in the School of Science, Engineering and Food Science. The aim of PACT was to increase the students' confidence in chemistry and to facilitate independent learning. The scheme involved the students working in small groups on pre-set problems. The tutors (member of academic staff) facilitated the session, provided guidance, initiated discussion and encouraged participation. However, the students were tasked with analysing the problems and ultimately suggesting a solution. Feedback was collected at the end of the process and the impact of the scheme was assessed. PACT proved to be a valuable "learning" experience for both students and tutors.

33: Peer teaching: taking the recipe out of food analytical chemistry

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Abstract:
This presentation describes the implementation over several years of an alternative to 'recipe-style' laboratory practicals for a group of third year students studying applied chemistry as part of a BSc Nutraceuticals degree. The main objectives of the laboratory re-design are to better prepare students for the more independent final year research project, and to integrate key employability skills into the curriculum. The approach retains many of the 'tried and tested' food chemistry experiments, but involves using a group peer-teaching methodology which aims to add value to the experience for the students. The anticipated added value includes improving research skills through trouble-shooting and optimising experiments; academic written skills through preparing teaching resources; oral communication and presentation skills through peer-teaching; and employability skills through group organising and planning.

Student evaluation, focussing on a cohort of students' *perception* of preparedness for final year projects and placements after the chemistry practicals in third year, and re-visiting the cohort following their final year projects and work placement, will be presented.
Finally, the approach has seen several iterations, some of which were due to personal reflection and student feedback, and some enforced through increased class sizes and reduced class contact hours for practicals. The presentation will highlight how various technologies were successfully utilised to overcome some of the barriers to retaining the pedagogy, and consider how resource issues will impact on student learning. For the benefit of practitioners, assessment and feedback mechanisms will be briefly discussed. Furthermore, insights into food analysis will be apparent, which may be of interest to those teaching general chemistry courses as a means to add context to chemistry practical work.

Time	Friday 5th July
09.00-10.00	**Plenary 5:** 'The more we do, the less they do..? Effective use of technology in chemistry education', ***Michael Seery*** **Chair: Mike Casey John Holland LT D1050** RSC Advancing the Chemical Sciences ***RSC HE Award Lecture: Sponsored by the Royal Society of Chemistry's Tertiary Education Group***
10.00-11.20	**Session 7A John Holland LT D1050** **Theme: Novel Methods of Teaching and Learning in Chemistry** **Chair: David McGarvey** **34:** 'Chemical Experiments: Learning by Collaborative Video Creation ', ***Christian Niemczik, Ingo Eilks and Verena Pietzner*** **35:** 'A Comparative Study of an Online and a Face-to-Face Chemistry Course: Exploring Differences in Students' Achievements by Using Bloom's Taxonomy', ***Ozcan Gulacar, Fehmi Damkaci, & Charles Bowman*** **36:** 'Different Responses to Flipped Learning from Undergraduate Chemistry Students.', ***David Nutt*** **37:** 'Scaffolding for cognitive overload using pre-lecture E-resources (SCOPE) for first year chemistry undergraduates', ***Claire McDonnell, Christine O'Connor and Sarah Rawe***
11.20-11.45	**Coffee/tea in C1 Corridor Poster removal**
11.45-13.05	**Session 8A John Holland LT D1050** **Theme: General Chemical Education** **Chair: Marie Walsh** **38:** 'Chemistry and science student's preconditions for university study in Germany and Australia – a comparative analysis', ***Mareike Klostermann, Siegbert Schmid, Adrian George, Maike Busker, Adam Bridgeman, Ilka Parchmann*** **39:** 'Teaching Chemistry in the Context of a Cross-Disciplinary Research Seminar', ***Rainer E. Glaser, Jennifer Hart, Eric Ludwig, Jennifer Fellabaum, George Smith, Francis Schmidt, Dix Pettey, and Carmen Chicone*** **40:** 'Exploring the sources of students' challenges with stoichiometry by using a new coding scheme', ***Ozcan Gulacar and Charles Bowman*** **41:** 'The Hidden Problem of Language in Teaching Chemistry at Third-Level', ***Marie C. Ryan and Peter E. Childs***
13.05- 13.15	**Close of conference: Peter Childs and Ilka Parchmann**
13.15	Lunch is available in the various restaurants on the University campus at your own cost.
14.00 – 18.00	Optional trip to Bunratty Castle and Folk Park – please sign up and pay on registration. The bus will pick-up outside on campus outside the Stables and return you there afterwards.
14.15-17.00	EuCheMS Division of Chemical Education Council Meeting **Chair: Ilka Parchmann** Faculty Meeting Room, Lonsdale Building

Plenary 5: The more we do, the less they do..? Effective use of technology in chemistry education

Michael Seery, School of Chemical and Pharmaceutical Sciences, Dublin Institute of Technology
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RSC HE Award Lecture: Sponsored by the RSC's Tertiary Education Group

RSC | Advancing the Chemical Sciences

Abstract:
The use of technology in chemistry education is becoming increasingly prevalent and the education literature has many examples of the use of technology in various forms: virtual learning environments, online homework, clickers, etc, reporting a positive effect on the use of a given technology innovation. However, there is evidence to show that many of these technologies are often at early adopter stage. A factor in this may be the fact that there is often a sense among teaching staff that incorporation of technology requires a lot of work on their behalf that may not yield any noticeable enhancements of student learning. This presentation aims to discuss what role technology can play in chemistry education illustrated with examples from the author's own practice.[1-4] The decision to include technology or not is one grounded in pragmatism, where any expected gain in learning is considered in the context of the time required to develop and integrate a given technology into teaching. Key principles for good practice in design of learning resources from a cognitive load theory perspective will be highlighted.

1. M. K. Seery and R. Donnelly, *The implementation of pre-lecture resources to reduce in-class cognitive load: A case study for higher education chemistry*, **British Journal of Educational Technology**, 2012, **43(4)**, 2012 667–677.
2. M. K. Seery, *Moving an in-class module online: a case study for chemistry*, **Chemistry Education Research and Practice**, 2012, **13 (1)**, 39–46.
3. M. Seery, *Podcasting: Support and Enrich Chemistry Education*, **Education in Chemistry**, 2012, Issue 2 (March), 19-22.
4. M. Seery, *Jump-starting lectures*, **Education in Chemistry**, 2012, Issue 5 (Sept), 22-25.

Biography:
Dr Michael Seery is a lecturer in physical chemistry at Dublin Institute of Technology and was the winner of the 2012 Royal Society of Chemistry Higher Education Teaching Award for his work in the use of e-learning in the teaching of physical chemistry. He was previously awarded the Irish Learning Technology Association Jennifer Burke Award and a National Academy for Integration of Research, Teaching, and Learning Teaching Excellence Award.
His current interests focus on prior knowledge and cognitive load in chemistry, and the reducing of this load through various teaching strategies, including e-learning. He has studied the performance of chemistry students on the basis of their prior knowledge, and introduced online pre-lecture activities aimed to reduce the cognitive load for novice learners in lectures.
He has published in *Chemistry Education Research and Practice* and *British Journal of Educational Technology* and presented at national, European, and US education conferences. He is involved in the *European Chemistry Thematic Network* (now EC2E2N), co-authoring two chapters in the RSC book "*Innovative Methods of Teaching and Learning Chemistry in Higher Education*" on laboratory education and problem- and context-based learning. He is a member of the editorial board of *Education in Chemistry* and writes about the use of technology in chemistry education at www.michaelseery.com.

RSC | Advancing the Chemical Sciences

Royal Society of Chemistry Tertiary Education Group (TEG)

The ***Tertiary Education Group*** was founded in 1987 and is one of the RSC's Special Interest Groups. The aims of the Group are to:

- Provide a forum for the fruitful discussion of the teaching and learning of chemistry at Higher Education level.
- Support and promote the development, dissemination and wider use of effective teaching and learning activities.
- Promote the wider recognition of good work in chemical education at Higher Education level.

The main activity of the Group revolves around our annual conference *Variety in Chemistry Education*, usually attended by around 100 academics. Through it mixture of short oral presentations, oral bytes, interactive workshop sessions and informal discussion, it offers an opportunity for the exchange of ideas and sharing of practice in relation to learning and teaching in chemistry higher education. It also provides a forum for the dissemination of research into pedagogy and innovative learning.

This year Variety in Chemistry Education (ViCE) and the Physics Higher Education Conference (PHEC) are holding their second joint venture on 29th-30th August 2013 in the Department of Chemistry and Central Teaching Laboratories at the University of Liverpool. For further details see the conference website at www.liv.ac.uk/vicephec/ .

34: Chemical Experiments: Learning by Collaborative Video Creation

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Abstract:
The paper presents a course module for chemistry teacher education. In the course module chemistry student teachers learn how to create learning videos to document and present chemical experiments in science classes. The paper discusses the objectives, experiences and feedback from the participants. Already in 1980, Bargh and Schul showed positive effects of anticipating and expecting to teach on the learners' cognitive gain. Benware and Deci (1984) found out, that learning for the purpose of teaching motivates students - more than learning for a test. To create a learning video in a collaborative setting can also be interpreted as project based learning, which Thomas (2000, p. 1) defined as a "complex task, based on challenging questions or problems, that involve students in design, problem-solving, decision making, or investigative activities; give students the opportunity to work relatively autonomously over extended periods of time; and culminate in realistic products or presentations".
"Learning by Collaborative Video Creation" in our project has a constructivist approach (Harel & Papert, 1991), it is project-based and challenges the learner's teaching and also technological competencies. The objectives of the course module were:

- to foster collaborative learning and social interaction;
- to support deeper learning and better understanding of a chemical experiment, the chemical concepts behind, and chemistry learning by using practical work;
- to reflect the experimental set-up and procedure in the video creation process and by peer reviews and groups discussions (e.g. within the storyboard writing); and
- to learn and experience a new learning design by a project based approach – for later adaption as chemistry teachers.

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Harel, I. & Papert, S. (1991). Constructionism: research reports and essays, 1985-1990. In: Epistemology & Learning Research Group (Eds.), *Massachusetts Institute of Technology. Epistemology & Learning Research Group & Media Laboratory*, Norwood: Ablex.
Thomas, J. W. (2000). A review of research on project-based learning. Retrieved. 23 February 2013 from http://173.226.50.98/sites/default/files/news/pbl_research2.pdf.

35: A Comparative Study of an Online and a Face-to-Face Chemistry Course: Exploring Differences in Students' Achievements by Using Bloom's Taxonomy

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Abstract:
While online and face-to-face (F2F) courses have been compared in numerous studies, there has been a lack of focus on online chemistry courses. This study was conducted to compare the success of students instructed in an online or F2F general chemistry course for non-majors. One hundred forty six exam questions were categorized according to Bloom's revised taxonomy and student success on each problem was analyzed. Comparison of online and F2F courses showed significant differences at the lowest order of thinking, "remember," with online students performing better than F2F students. A similar result was seen with the next order of thinking, "understand," but there were no significant differences observed between online and F2F students for exam questions at the "analyze" level. The observed advantage for online students may be because online instruction promotes better memorization of facts or because students good at memorization gravitate towards online courses. No significant differences were seen between online and F2F courses when comparing the various chemistry topics covered in the exams. Online instruction appears to be as effective as F2F instruction when teaching introductory chemistry topics.

36: Different Responses to Flipped Learning from Undergraduate Chemistry Students

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Abstract:
Flipped learning, in which material is covered by the students in their own time, often with the help of video podcasts, is starting to become established in higher education. Over the past year I have 'flipped' two undergraduate lecture courses for the first time: a 2nd year course on spectroscopy (lots of new material that needs to be covered) and a 4th year course on molecular modelling (much more descriptive and research-focussed). This was the first time either of these classes had experienced this teaching method. Through surveys carried out before and after the courses, plus student feedback, I have been able to compare and contrast the responses of the two year groups to this approach. Engagement and participation among the second year students was higher than among the fourth year students. In fact, several fourth year students commented that they would have preferred traditional lectures. Although this was a small study and my first trial of flipped learning, this raises a number of interesting questions about the transition from dependent to independent learner and the impact of different approaches at different stages of development.

37: Scaffolding for Cognitive Overload using Pre-lecture E-resources (SCOPE) for First Year Chemistry Undergraduates

Claire McDonnell, Christine O'Connor and Sarah Rawe,
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Abstract:
The aims of this project were; (i) to develop additional online pre-lecture resources for first year chemistry undergraduates at level 7 and level 8 to complement those prepared in 2010-11 for level 8 students by a colleague, Dr Michael Seery, (ii) to evaluate the effect of implementing the new resources by analysing quantitative (test and exam results) and qualitative (pre- and post-implementation surveys and focus group interviews) data. Ten pre-lecture activities on organic chemistry were prepared and used with 87 level 8 students in semester 2 of the 2011-12 academic year and 95 students in 2012-13.
The E-resources were designed to;

- reduce cognitive load by introducing some new terms and concepts before the lecture
- incorporate worked examples to scaffold students' learning
- provide short online test questions with immediate feedback so that students could identify areas of difficulty.

The anticipated benefit was that that the gap in performance often observed in first year between learners who have and have not studied chemistry at Leaving Certificate would disappear.

Analysis of mid-semester test and examination results showed that, among groups with similar CAO points levels, the gap in performance between those who had and had not studied chemistry at Leaving Certificate was eliminated. The surveys and focus groups undertaken revealed that learners felt more confident and that they could focus more in the lecture when they had completed a pre-lecture activity.

38: Chemistry and science student's preconditions for university study in Germany and Australia – a comparative analysis

Mareike Klostermann[1], Siegbert Schmid[2], Adrian George[2], Maike Busker[3], Adam Bridgeman[2], Ilka Parchmann[1]
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Abstract:
Drop-out rates for many university courses are unsatisfactorily high, especially in science sub disciplines such as physics or chemistry. Surprisingly, only a few studies have investigated possible reasons for the high drop-out rates in those subjects. Therefore, in the current project students' preconditions for university study are investigated. Students with weak backgrounds in the field of chosen study are more likely to struggle at university and ultimately to drop out altogether. Consequently, participants of chemistry bridging courses in Germany and Australia were asked to complete questionnaires based on a three variable model (individual variable, task variable and strategy variable). The individual variable includes their prior knowledge in chemistry as well as their interests and expectations regarding their future studies. The content variable includes all aspects relating to chemistry content and involves students' perceptions concerning their studies. Finally, the strategy variable takes account of students' learning strategies. These three aspects are considered to be relevant for either dropping out of studies or continuing successfully. The questionnaires are analyzed in a detailed way. Moreover, differences concerning both student groups are also shown and implications regarding increased support at the beginning of chemistry studies are highlighted. A short overview of the both school and university systems in Australia and Germany will also be given.

39: Teaching Chemistry in the Context of a Cross-Disciplinary Research Seminar

Rainer E. Glaser,[a] Jennifer Hart,[b] Eric Ludwig,[b] Jennifer Fellabaum,[b] George Smith,[c] Francis Schmidt,[d] Dix Pettey,[e] and Carmen Chicone[e]
[a]Department of Chemistry, [b]Department of Educational Leadership and Policy Analysis, [c]Department of Biological Sciences, [d]Department of Biochemistry, [e]Department of Mathematics, University of Missouri, Columbia, Missouri 65211, USA
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Abstract:
We report on the design, implementation and assessment of the research seminar offered as part of the NSF-PRISM supported "Mathematics and Life Sciences" program at MU. The seminar format aims for 25-minute research talks followed by 25 minutes of defense, discussion and extrapolation. The emphasis on equal time between presentation and scientific discussion is a stratagem of this course to stimulate open and frank discussion and cross- and interdisciplinary brainstorming, exchange and education, and student performance is assessed in this spirit. The seminar grade is affected by the student's attendance, the assessment of the student's research presentation (rubric-based peer review of science content and presentation skills), the assessment of the student's peer reviewer performance (meaningful, balanced, written constructive criticism), and the assessment of the student's discussant performance (attention and comprehension; seeking and providing clarification; content of mini-paper; contribution to discussion). The grading scheme reflects a shift from the traditional assessment of the speaker to an assessment of members of the learning community. The presentation will highlight how such a class is socializing students for research.

40: Exploring the sources of students' challenges with stoichiometry by using a new coding scheme

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Abstract:
Success with problem solving depends on several variables, including students' conceptual understanding, strategies, and skills. Determining the influence of each variable is an important task in revealing the sources of the challenges with problem solving. A coding scheme is presented and used to evaluate solutions of seventeen university students working several stoichiometry problems in a think-aloud protocol. The stoichiometry problems are evaluated as a series of sub-problems (e.g., writing chemical equations, mole concept, empirical formulas, mass percent, or limiting reactant), and the coding scheme is used to categorize each sub-problem solution as successful, neutral, or unsuccessful, with more detailed codes comprising the neutral and unsuccessful categories, for a total of eight codes. A relatively high frequency of neutral results was found in which students simply did not realize when or how to approach a sub-problem. A lack of conceptual understanding of the mole concept appears to be closely related to students skipping crucial steps in stoichiometry problems, especially the sub-problems stoichiometric ratio and mole concept. Students' failures were also observed to be due to a lack of basic knowledge, such as the names of chemical compounds. The application of the new code system was shown to reveal difficulties that might have otherwise been missed by an analysis that focused on end results only.

41: The Hidden Problem of Language in Teaching Chemistry at Third-Level

Marie C. Ryan and Peter E. Childs
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Abstract:
The language of science is a problem that students face at both second and third level education. Wellington and Osborne (2001) claimed that "language is a major barrier (if not the major barrier) to most students in learning science" (p. 2). Science has its own language and difficulties presented in acquiring and understanding the language act as impediments for many students. However, the work of Cassels & Johnstone (1980 and 1985) and Johnstone (1988) has indicated that the problem lies not so much in the technical language of science, but in the vocabulary and usage of normal English in a science context. Students and teacher see familiar words and phrases which they both 'understand', but the assumption that both understandings are identical is just not tenable (Barber, 1962; Sager *et al.,* 1980; Kennedy & Bolitho, 1984). To date in Ireland, little research has been conducted into the role which language plays in the teaching and learning of science at third level, or on the transition from second level.

This study is a part of a larger project looking at the problem of language in the teaching and learning of science in Ireland. It follows a study which identified the specific problem areas of language in science teaching of a diverse cohort of second-level Junior Cycle pupils of science. The purpose of this paper is to identify student teacher's understanding of the non-technical words that are used in the teaching of science and also to identify the specific problem areas of language in science teaching and learning.

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List of posters for Eurovariety 2013-06-10

- **P1 A problem-based experience to enhance transferable skills acquisition in a chemistry lab course for civil engineering undergraduates**
  Ignacio López-Coca, María José Arévalo, and Guadalupe Silvero
  iglomar@unex.es
- **P2 Virtu-O-Chem: Helping Students to Easily Transition into a University Level Organic Chemistry Laboratory Course**
  Nada Djokic, Chunyan Zhang, Dennis Hall and Hayley Wan
  hayley.wan@ualberta.ca
- **P3 Laboratory notebooks – what are you assessing?**
  Laura Rice, Leeanne Hinch, Odilla E Finlayson
  laura.rice2@mail.dcu.ie
- **P4 Oenology Course: from H_2O to C_2H_5OH**
  Justyna Dobrowolska-Iwanek, Iwona Maciejowska
  maciejow@chemia.uj.edu.pl
- **P5 Anti-cancer Drugs used in Human Medicine**
  J.J. Keating
  jj.keating@ucc.ie
- **P6 Introductory Chemistry For Pre-medical Students: A Problem Based Teaching and Learning Approach**
  Jomy Samuel
  Jroberts7@devry.edu
- **P7 Context As a Way How to Get Students Involved in Chemistry**
  Eva Stratilová Urválková, Hana Čtrnáctová
  eva.urvalkova@gmail.com
- **P8 P8 Pupil to Professional: The Strathclyde Chemistry Lifecycle**
  Pauline O'Connell and Debra Willison
  pauline.connell@strath.ac.uk and d.willison@strath.ac.uk

P1 A problem-based experience to enhance transferable skills acquisition in a chemistry lab course for civil engineering undergraduates

Ignacio López-Coca, María José Arévalo, and Guadalupe Silvero

Grupo de Innovación Didáctica en Química, ([a] Escuela Politécnica, [b] Facultad de Veterinaria)

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Abstract:
A problem-based project has being conceived and developed as a means for the teaching-learning of a chemistry lab course for civil engineering undergrads. Special focus has been placed onto the acquisition and assessment of personal skills such as problem solving, teamwork, ability to communicate and initiative. Students are hypothetically located in a geographic region with little resources and they are asked to prepare a proposal for building a well by using unregulated building materials, notwithstanding that a minimum quality for the materials has to be tested and met. Students work in four-strong teams and are fully responsible for the whole proposal. They will have to handle atypical situations where out-of-the-box thinking is a must; much teamwork and coordination will be needed, and finally their proposal will be defended in public.
Students needed to find out what kind of chemical tests could be run on all untested materials to ascertain their quality and aptness. Untested materials were limited to three categories: (a) aggregates (b) cement and (c) water for mortars. The experiments selected, respectively, for each category were methylene blue test, free calcium oxide content, and grease and oil content. Finally, these experiments were carried out in the lab.
Feedback, in the form of anonymous survey, showed that students acknowledge the attainment of personal skills. Moreover, another distinct added benefit of this experience is that students find it highly challenging, motivating, and rewarding, and it provides them a closer view of the links between chemistry and their training as civil engineers.

Acknowledgements:
Thanks are due to *SOFD-Universidad de Extremadura* (grant A2-2013-64) for funding and support. Authors would like to thank the students that enrolled in this project, as well.

P2 Virtu-O-Chem: Helping Students to Easily Transition into a University Level Organic Chemistry Laboratory Course

Nada Djokic, Chunyan Zhang, Dennis Hall and Hayley Wan
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Abstract:
A major concern with students who are transitioning into university level organic chemistry laboratory courses from high school is that they are expected to enter into a laboratory environment and carry out experiments when most of them have never been exposed to the glassware, equipment, techniques, or even stepped inside of a laboratory before. This lack of preparation causes stress during class and has an effect on the student's focus and ability to truly understand the material, as well as complete the experiment within the allotted timeframe. Better preparation for the lab will help to reduce student stress, which in turn, will create a safer working environment. In order to better engage students in the learning of

organic chemistry and help relieve stress and safety concerns associated with organic chemistry laboratory courses, we have developed an interactive, virtual organic laboratory for chemistry students of all levels (supported by a University of Alberta TLEF grant). This virtual laboratory provides a learning and practice platform for chemistry students before they come to the lab, allowing them to become more familiar with the experimental procedure and equipment, which will result in a more comfortable, enjoyable and safer laboratory experience. We will highlight our accomplishments and provide an overview of our completed tutorials to date.

P3 Laboratory notebooks – what are you assessing?

Laura Rice, Leeanne Hinch, Odilla E Finlayson

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Abstract:
The production of laboratory reports is generally considered necessary for undergraduate chemistry students. These reports are a record of the activities carried out and are typically assessed to determine students understanding of the chemical techniques and concepts covered. The assessment of laboratory reports tends to be itemised with a strict marking breakdown. The repeated writing of laboratory reports can be excessively time consuming and not lead to life-long skills which are useful in research or industrial laboratories. Students often tend to focus too much on unnecessary procedural detail and not enough on the meaning of their results.

For this reason, the maintenance of laboratory notebooks was introduced into a chemistry laboratory module for a pre-service teacher programme for Physical Education and Biology teachers. The assessment of this module was based on class tests and a laboratory notebook which the students maintained throughout the module. Students were given guidelines for what was expected of the content of their notebooks. Their notebooks were to include all the information necessary to repeat the experiments, address the chemical concepts covered using molecular level drawings where possible, and also suggest ideas of how the experiment/activity could be used in their future teaching. Students were not given a marking scheme of how their notebooks were to be graded.

An assessment rubric for the module was developed based on the notebook guidelines provided. The variety of students interpretation of the guidelines given is discussed and the results are compared to class tests associated with each laboratory activity.

P4 Oenology Course: from H_2O to C_2H_5OH

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Abstract:
Postgraduate studies in oenology, opened one year ago, are offered at Jagiellonian University for all candidates with a master's degree. The studies will provide the participants with an advanced knowledge of the process of winemaking, including its historical, geographical and cultural aspects, as well as information connected with vine-growing, biology of grapes,

microbiology of wine, sensory analysis of wine and influence of wine on human's health. In order to understand all the above aspects, each participant has to gain some basic chemistry knowledge at first. Unfortunately time devoted to this is very limited.

There were no other prerequisites for the candidates to be enrolled on the studies, apart from a master's degree. The participants of the studies are of a wide range of age and specialize in many different fields. Most of these people had their last contact with chemistry in upper secondary school. In such cases, an approach "chemistry in context" is used.

All presented topics (such as chemical substances, reactions, etc.) are related to the chemistry of wine. They are discussed and explained in the following order:

1. general knowledge questions (connected with the current topic),
2. discussion of the topic,
3. link to the next topic.

This approach allows the participants to focus on their favourite topics, be active, and feel quite comfortable in the field which they are unfamiliar with.

P5 Anti-cancer Drugs used in Human Medicine

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Abstract:
Undergraduate pharmacy students quickly single out what subjects they perceive as being the most important from a pharmacy practice perspective. Pharmaceutical chemistry does not usually end up in this category. We have recently been attempting to further address students' perceptions and attitudes to pharmaceutical chemistry by making the subject as relevant as possible in their undergraduate programme and to their future career. A poster which displays the structure, physicochemical properties and clinical target of the commonly approved drug substances of major drug classes could be a useful teaching aid and increase the students understanding of the relevance of pharmaceutical chemistry to their immediate pharmacy studies and future careers. This poster presents, in tabular format, of the most commonly used drugs approved worldwide for the treatment of cancer. The poster would be of relevance not just for pharmaceutical chemistry lecturers, but to all staff teaching cancer-related material to pharmacy undergraduates. Similar posters could also be developed for other major drug classes.

P6 Introductory Chemistry For Pre-medical Students: A Problem Based Teaching and Learning Approach

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Abstract:
In recent years, members of the higher education community, individually and through several expert panel reports, have raised concerns about the science content in the current premedical and medical education curriculum. The 2009 Scientific Foundations for Future

Physicians (SFFP) report, sponsored by the Howard Hughes Medical Institute (HHMI) and the Association of American Medical Colleges (AAMC), recommends competency-based approaches for the preparation of undergraduates who will become medical students, and medical students who will become physicians. The report encourages a more interdisciplinary and integrative science courses for students enrolled in pre-medical courses. The American Chemical Society (ACS) has adopted the recommendations of the SFFP report and is working with various colleges and universities to implement them.

Although the report focused on pre-medical education for physicians, the recommendations are applicable to all healthcare professionals. At the undergraduate level, the challenge is to develop strategies to implement the recommendations. The introductory chemistry course for nursing students at the Atlanta Campus of DeVry University/Chamberlain College of Nursing is undergoing major changes, in part, in response to the new guidelines put forth by the SFFP report and American Chemical Society (ACS). In implementing these recommendations we are using a Problem-based teaching and learning format. I will describe our restructuring efforts, using the example of acid-base chemistry.

P7 Context As a Way How to Get Students Involved in Chemistry

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Abstract:
Science faculty of Charles University in Prague participates in two European projects focusing on inquiry-based teaching and learning: *COMBLAB*'s objective is to develop science activities using microcomputer-based laboratory and *ESTABLISH* is encouraging broader use of Inquiry-Based Science Education (IBSE) by implementing and testing developed learning units in secondary schools.

COMBLAB laboratory worksheets are based on elements of IBSE and POE (predict-observe-explain) methods which is supported by refined didactic concept. Eighteen science activities have been created with new didactic sequence considering motivation as a crucial point in students' involvement. Further laboratory work has to be designed by students themselves while teacher has a role of facilitator. *COMBLAB* activities aim on developing not just knowledge and skills (learning competencies) but also other competencies, like social, personal and communication, when students have to communicate their results at the end of lab course via email, short conference or telephone call from a patient.
ESTABLISH has developed eighteen science units, like Polymers around us, Chemical care, Sound or Blood donation that contain worksheets and activities for students. For each unit has been developed also teachers material that includes basic information about unit, background theory for better understanding, pedagogical content knowledge and pedagogical path.

Presented poster is focused on implementing *COMBLAB* and *ESTABLISH* units into secondary school teaching. The data from *COMBLAB* activity *The Life of Yeast* and *ESTABLISH* activities *Household cleaners* from unit Chemical care have been evaluated. The results show that attractive context of the activities has a significant impact on students' motivation and performing the laboratory.

P8 Pupil to Professional: The Strathclyde Chemistry Lifecycle

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Abstract:
The time a student spends studying at University is a formative period in their journey to a successful career. We believe that a University education is not only an important part of that journey, but that a department's influence can be much further reaching. Our poster will reflect how Strathclyde Chemistry is involved with its students **before** they arrive at University and long after they graduate. Important areas of work which will be explored are:

- Outreach and marketing
- Admissions Processes
- In house marketing
- PDP
- Alumni Clubs
- International Alumni Network

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