Variety in Chemistry Education and Physics Higher Education Conference ViCEPHEC21 (16-20 August 2021)

Monday 16 August 2021 - Friday 20 August 2021

University of Glasgow (virtual)

Book of Abstracts

Contents

Plenary Session 1: Monday 16th August 2021 / 1

Welcome

Plenary Session 1 / 2

Keynote: The Trials and Tribulations of becoming a SOTL Scholar

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The Scholarship of Teaching and Learning (SoTL) is a widely disputed term, and an even wider disputed discipline within the field of education. As of today, there is no agreed definition yet. However, the sector does agree on some defining characteristics of SoTL. SoTL is concerned with matters of learning and teaching in higher education, SoTL is public, and SoTL is subject to a form of peer feedback. After this, opinions then diversify. SoTL can be anything, for example, from a published literature review on an issue, to a reflective practice piece, to a blog, to an evaluation and even all the way to full blown inter-institutional educational research. My suggestion, thus, is not to attempt one definition to rule them all, but to think about SoTL in terms of different categories or potentially sub disciplines. Boyer (1990) already suggested different types of SoTL, but it seems this classification hasn't stuck. Other aspects I will try to disentangle are the differentiations between "Scholarship", "Scholarly", and "Scholarship of Teaching and Learning". We will explore some basics about how to get started with SoTL.

Plenary Session 1 / 3

Break

Plenary Session 1 / 35

Are our students studying smart? Insights into the study strategies and metacognitive awareness of undergraduate students in Spain and the UK

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The approach that students take in their studies at university is critical not only for their academic success but is equally important in life-long learning for their career and professional development. Cognitive science has demonstrated that re-testing oneself on material when learning, enhances and promotes greater retention of knowledge compared to re-reading the material. Learning that

is spaced out over multiple study sessions also allows for greater retention of knowledge in the longer-term compared to 'cramming' of information. A survey study with first- and second-year undergraduate students (n=135) at a university in Spain and in the UK was carried out to investigate the study strategies and habits prevalent in these cohorts and to explore the extent of their metacognitive awareness. It was of interest to explore the reported study strategies and habits among students studying chemistry courses in two distinct geographical locations. It is expected that the findings from this study in two distinct locations will apply to other chemistry teaching contexts and locations. It was found that most students endorsed self-testing but also suboptimal study methods such as re-reading, copying notes and cramming. There was evidence of a difference between UK and Spain in relation to decisions for prioritizing studying, returning to review course material and time of study. Implications of the findings will be considered in relation to curricula and teaching.

Key words:

Study habits, metacognition, retrieval practice, distributed practice

Region:

UK/Ireland

Plenary Session 1 / **47**

Development and evaluation of an assessment rubric to enhance student understanding and development of scientific writing skill

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Scientific writing encourages students to develop and support an argument and communicate their findings in a clear and concise manner (Kalman, 2011). Teaching effective scientific writing skills requires clear communication to students what is expected in relation to the structure and content of a scientific report. Assessment rubrics are tools used to accurately communicate assignment requirements by articulating the structure and components of the assignment and have been shown to increase consistency in marking (Andrade and Du, 2005). Co-construction has the potential to enhance shared understanding of an assignments learning outcomes and offer students the opportunity to be active in their own learning by engaging with the rubric to self-assess the quality of their work before submission and improve their academic performance (Bacchus et al, 2020). The aim of the study was to evaluate the efficacy of a rubric co- designed and developed to support and improve student understanding of how to appropriately structure and write a scientific report that effectively communicates the information.

Staff and student focus groups were utilised to elicit opinions and perspectives as to what to include in a scientific report rubric. The co-developed rubric was used to assess and provide feedback for a scientific report in an MPharm module and marks were compared pre and post rubric. Following the report feedback staff and student questionnaires were used to gather opinions on the usefulness of the rubric and to collect thoughts on how to further improve.

Consultation with staff and students on the rubric were overwhelmingly positive with students highlighting the rubric was 'self-explanatory' and staff stressing that 'critical analysis' and 'clarity' were important to include. Following use of the rubric the majority of students had less queries and all students agreed that the rubric clearly communicated the assignment requirements and adds to the learning experience.

References

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Key words:

Co-design, assessment, rubric

Region:

UK/Ireland

Plenary Session 1 / **85**

Developing reasoning and metacognitive skills through reflective lab reports

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In physics labs learning objectives tend to include ability for students to evaluate any difference between experimental data and theoretical models, then critique what those differences mean in terms of data collection and analysis method used, therefore developing students' reasoning and metacognitive skills. However, due to the assessment structure of a typical lab report, students tend to focus on completing the lab tasks and provide mainly superficial responses when asked to make inference from their experiment.

I will present an approach to re-designing an assessment for a physics laboratory that is aligned with a student-centred teaching approach. The new assessment includes a two-step submission process, with the second step asking students to explicitly reflect on how their answers compare to answers of an expert, given via an exemplar. This new approach motivated students to engage deeper in their learning process and work on improving their reasoning skills in their lab reports, increasing awareness of the thought process (metacognition) involved. Furthermore, the students appreciated the fact that assessment focused on asking them to demonstrate that they are in the process of learning, rather than focusing just on how much they know.

Key words:

assessment, laboratory work, reasoning skills, metacognition, reflective practice

Region:

Other part of world

Plenary Session 1 / **58**

Does moving oral presentations online affect students' performance?

Author: Stephen E. Potts[1]

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A key point in fourth-year chemistry calendar is the Symposium for Advanced Research Projects in Chemistry (SARPIC), which comprises up to two days of seminars where final-year students present their work from the past six months. These presentations are marked by staff and provide credit for their project module. The unwelcome appearance of COVID-19 last year forced the remaining teaching of 2019/20 online, and the vast majority of teaching remained online for the 2020/21 academic year. To address the challenges of pivoting online with students spread over the world, we tried two different approaches to SARPIC over the past two academic years that ensured the intended learning outcomes of the assignment were met despite remote working. The first was that students could pre-record their presentation, which would be played to the audience, and students could opt in to presenting live if they wished. The second was making presenting live the default option and only allowing students to rely on a recorded presentation as a backup (e.g., for technical problems with connections etc.). The presentation marks and qualitative student feedback were analysed for both approaches and compared with marks for previous years, where students had presented live in a lecture theatre. In this presentation, we will discuss these results and how the method of assessment can be tailored to make it more accessible to students.

Key words:

online, presentation, wellbeing

Region:

UK/Ireland

Plenary Session 2: Tuesday 17th August 2021 / **8**

Welcome

Plenary Session 2 / **9**

Keynote: Partners in learning through times of crisis

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I will draw on my own experience and research of staff-student partnership projects to reflect upon whether the pandemic has put a greater emphasis on fundamental partnership principles in learning, such as shared ownership, students' enhanced control of their own learning and inclusivity through flexibility. I will illustrate this with various examples in module design, delivery, and evaluation / educational research and finish off with a discussion of how this development may have a lasting impact upon student partnership in their own learning in the future.

Plenary Session 2 / **27**

IoP 2020 Lawrence Bragg Medal and Prize Lecture: Virtually better than the real thing: the hopes and realities of remote experiments

Author: Nicholas Braithwaite[1]

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Driven by the context of distance learning (within the OU model of supported open learning) we have been getting to grips with the practicalities of remote experiments for several years. We are interested in their effectiveness in meeting QAA benchmarks and accreditation requirements relating to practical skills in experimental classwork and projects. We are interested therefore in their effectiveness for independent learning. We have been particularly inspired by recent examples of remote experimentation from field work on Mars landings to lateral flow tests.

Over the last ten years or so we have gained practical experience of using remote experiments in the curriculum, at scale, and we have recognised the criticality of telecommunications and internet services and the limited scope for design and build activities. The aim is to provide students with access to real data via authentic interfaces. Our OpenSTEM Labs now enable students to plan and conduct experiments that provide each with their own data, obtained under their own control, individually or in teams. The cohort size ranges from tens to hundreds. The equipment accessed ranges from telescopes in professional observatories to analytical instruments in research laboratories. The scenarios include time-domain astronomy, collaborative planetary-surface exploration, relativistic electron dynamics, acid-base titration and FTIR spectroscopy.

There are pedagogical advantages to preparing general learning resources especially for online delivery rather than retrofitting 'online connectivity' to conventional resources; the benefits come at a price. In much the same way, we have found there are advantages to designing remote experiments from scratch rather than automating a traditional lab; we have found the investment worthwhile, not least because our teaching labs have remained fully functional throughout the CV-19 pandemic.

We are planning to collaborate with others in the development and use of remotely-accessible teaching labs, to enhance the social and educational experience of students through incorporating tools for collaboration and 'over-the-shoulder' support.

Plenary Session 2 / **3**

Break

Plenary Session 2 / **76**

Perceptions of Teaching Aims in Physics

Authors: Vincenz Bischof[1]; Numayr Malik[1]; Stan Zochowski[1]

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Previous studies in physics education have shown that perceptions of learning have a direct correlation on a student's understanding of their subject, and consequently the quality of their learning outcome. Also, it follows that lecturers who conduct their teaching with the same aims as the students would have a higher overall satisfaction on average. But how well do the two perceptions actually mesh? We report on the outcome of a survey on the perceptions of teaching offered to all undergraduate students and teaching staff in the UCL Physics and Astronomy department. A similar set of multiple choice and free text questions was given to both groups. Questions included those on their own overall aims in learning/teaching, their perceptions of the aims of the other group, approaches to studying, what was found useful, and opinions on online teaching. Contrarily to past research, the survey results show that a large proportion of students took a deep approach to learning. A direct comparison is done between the responses of staff and students. We report on this

comparison and on the distribution of responses and discuss potential issues that arose, focusing on the implications for the practice of teaching physics. We also look at how the COVID-19 pandemic move to an online teaching format affected attitudes towards learning and teaching.

Key words:

perceptions, teaching aims, survey, students and staff

Region:

UK/Ireland

Plenary Session 2 / **50**

Structured to open-ended at home experiments for first year physics labs.

Authors: Angela Dyson[1]; Noel Healy[1]; Tiago Marinheiro[1]

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As with many colleagues the pandemic necessitated a rapid shift to remote laboratory activities in Newcastle where we were in lockdown for almost the entire academic year. I will reflect on the experience of planning, developing and running remote first year physics labs this year. Students had already learned Matlab and had produced a portfolio with structured worksheets intended to build data plotting and analysis skills. After Christmas students received an experiment box in the post containing everything they needed to construct their own spectrometer and calibration circuit. The aim being to provide students with hands on experimental and problem-solving skills.
Students were guided through a series of build workshops in groups of ~10 via breakout rooms during 2 x 1.5 hr live online sessions per week supported by 3 academic staff and 6 PGR's for a class of ~80. Groups retained the same PGR helper throughout. Following the build and calibrate sessions students were then asked to devise their own experiment using their spectrometer; ideas were discussed in a workshop with the PGR helpers.
Despite the remote nature of these activities and a move to a more open experiment style; we saw a slight improvement in student engagement and assessment scores as compared to the previous year with in-person labs.

Key words:

at home labs, open ended experiments

Region:

UK/Ireland

Plenary Session 2 / **56**

Synoptic Physics- evolution of a problem solving, teamwork module.

Author: Annabel Cartwright[1]

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Synoptic Physics – evolution of a problem solving, teamwork module.

Synoptic Physics is a 10 credit Level 5 module which was introduced in 2013/14 and has been taught every year since. Over that period the original designer of the module has experimented with adjustments to the basic design of a different problem every week, solved by teams in real time (3 hours), over 9 weeks. The module is consistently highly rated by the students and introduces opportunities for them to develop creativity and leadership, as well as the usual 'employability skills' such as communication and teamwork. A recent graduate working in Data Science comments 'I use the skills I learned in Synoptic Physics every day'.

The Module Organiser will present recommendations on assigning students to teams, ice-breaking activities, how to build confidence in the students' leadership skills, and the sort of problems that students love solving.

Key words:

Employability, teamwork, problem-solving

Region:

UK/Ireland

Plenary Session 2 / **91**

The Development of a Maths Toolkit for Physicists

Authors: Alex Crombie[1]; Daniel Godden[1]; Kris Haverson[1]; Patrick Johnson[1]

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The physics course at Sheffield Hallam accepts a range of mathematical expertise as a prerequisite. To enable this position, we deliver a dedicated maths module (as many courses do) which provides all the foundational knowledge students will need in order to complete the course. Despite this we have consistently encountered students struggling to put this maths into practice when they move on to topics which require them to do so.
This talk discusses the steps we have taken recently to provide bespoke maths support for our students. The main output of this intervention has been a 'maths toolkit' which can be used as a self-signposting resource to enable students to troubleshoot their own difficulties.
This sort of development is not new in and of itself, however, through research into our students' attitudes to mathematics we have found that there is a distinct lack of understanding that the maths they are studying is a tool to be used in performing the science of physics rather than a series of esoteric oddities that they must learn for their own sake. With this in mind, we have intended our toolkit to act not only as a technical support resource, but also a way to change student attitudes to maths in the service of physics - to see it as a tool to be used akin to spanners for an engineer
This project has been student led at all stages. We discuss the findings of our research into student opinions of maths, as well as how they engage with the material they are provided. We then touch on the disconnect between how students compartmentalise maths and how we intend for it to be used by them can inhibit learning and increase maths anxiety. Finally we discuss the mechanics of putting this toolkit together.

Key words:

Student-led research, Mathematics, Teaching improvements

Region:

UK/Ireland

Wednesday 18th August 2021 / 8

Outreach Talk, Wednesday 18th August 2021, 18:00 (BST) / 29

Towards A Research-Informed Education: Applying Cognitive Psychology To Teaching and Learning

Author: Carolina Kuepper-Tetzel[1]

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What is the best way to study or teach? Are we intuitively already using the most successful strategies? This talk provides an overview of the most successful strategies to enhance memory that resulted from years of rigorous research in Cognitive Psychology. Cognitive Psychology is a research area that investigates how we remember information, solve problems, transfer knowledge, and obtain understanding of complex material. Consequently, it provides a range of strategies that can be applied to education and beyond. The most important research findings alongside hands-on practical tips will be highlighted.

Plenary Session 3:Thursday 19th August 2021 / 14

Welcome

Plenary Session 3 / 15

Keynote: Chemistry for All: Global, Diverse, and Fit for Purpose

Author: Katherine J. Haxton[1]

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Chemistry is often called the central science, one that enables further study across a wider range of disciplines. At the same time, chemistry can be exclusive. We don't like to think of it in those terms, but the emphasis on hands-on practical work, rigid ideas about what must be taught in our degree programmes and how we must assess learning, and certain assumptions about what chemistry graduates will go on to do, can lead to many feeling chemistry is not for them. Many UK universities are engaged in work to make their curricula more inclusive through initiatives to decolonize the curriculum, become anti-racist institutions, and other projects to increase equity and accessibility through widening participation. It can be difficult to know where to start, particularly in STEM disciplines. This work is essential: the challenges faced by humanity will not easily be solved without a global perspective, and diverse voices. This work is hard: reconsidering what is taught, who is teaching, and where we place the emphasis in our curriculum takes reflection and empathy. This work is worthwhile: reconsidering content, context and assessment can provide an opportunity to

make chemistry more inclusive and relevant, and to become a subject that is truly central to tackling global challenges. This talk will highlight some examples of what can be done to make chemistry teaching and assessment more accessible and inclusive, particularly by giving students flexibility and choice to research their own context for assessments. At the end, a challenge will be issued to make one small change to what is taught, it's amazing what you can do in 15 minutes.

Plenary Session 3 / **28**

RSC Higher Education Teaching Award 2020 Lecture: Green Chemistry education for a sustainable future

Author: Glenn Hurst[1]

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This talk will outline how, using a systems thinking theoretical framework, green and sustainable chemistry principles, activities and courses have been implemented at multiple levels by working with students as partners to drive innovative change in curricula. During the design stage, specific emphasis was placed on creating interventions that are internationally transferrable, which, as of consequence, have been integrated into the specialised manual on green and sustainable chemistry education, published by the United Nations Environment Programme in 2021. This journey together with associated examples detailing their design, implementation and efficacy will be articulated.

Plenary Session 3 / **3**

Break

Plenary Session 3 / **40**

Integration of the Chemistry^3 textbook with the first year curriculum

Author: Amber Eggleton[1]

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Chemistry has a reputation of being one of the most difficult degree programmes on offer, resulting in comparatively high drop-out rates as students struggle to adapt to independent learning and expectations of being fully autonomous learners. I therefore focused my research on creating resources for first year chemists that would support them throughout the year, and that would encourage the development of positive study habits from the outset.

Chemistry^3 is a textbook aimed toward first year chemists that incorporates organic, inorganic and physical chemistry content into one resource. My research focused specifically its integration with the first year curriculum at UEA, which was achieved via the distribution of weekly infographics titled 'getting the most out of your textbook/module'. Infographics were created each week for each

core module, detailing both structured teaching events but also pages and practice questions for students relevant to that weeks learning.

The project was evaluated primarily through semi-structured interviews, with both students and academics, to explore the relationship between students and chemistry textbooks at university. While no definitive statistical result explicitly states the impact of increased textbook integration and the infographic intervention, data showed Chemistry^3 to be the most used chemistry textbook at UEA. Qualitative data revealed students reasons for previously not engaging with textbooks, why they like Chemistry^3, and how the infographics have helped navigate their independent study. This then gave insight into how textbooks are currently used by both students and academics, and therefore how usage could be optimised for all those involved. An indirect result of the study was the surveyance of the various pedagogical methods used on the first year chemistry curriculum at UEA and the effect these have on student learning, particularly as many lecturers have changed their methods to adapt to online learning due to the COVID-19 pandemic.

Key words:

Textbook, integration, first year, resources, studying

Region:

UK/Ireland

Plenary Session 3 / **43**

Mini-projects: CURE-like lab projects to increase student learning

Authors: Philip Craven[1]; Robert Laverick[1]

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Undergraduate research is one of the most powerful pedagogical tools to educate and inspire students, especially those from diverse backgrounds.[1] Course-based undergraduate research experiences (CUREs) are excellent examples of implementing research-type problems in undergraduate courses allowing students freedom to experiment and even fail while trying to answer interesting questions. CUREs normally include setting the research question in context, providing a true sense of discovery where neither students nor instructors know the outcome of experiments and fostering student ownership over the research experience.[2] They have been shown to be successful at increasing student learning in a range of courses.[2]

This talk will detail a CURE-like course implemented over the past two years at the University of Birmingham for third-year undergraduate students. The course utilises the research developed at the University to produce one-week and two-week long research mini-projects. These mini-projects are open-ended and allow the students to explore the research area for themselves under the guidance of world-leading experts in the area. Projects range from battery synthesis to drug discovery to plastic recycling. The talk will outline details of exemplar mini-projects and the new course will be evaluated through student feedback and student outcome analysis.

References

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(2) Williams, L. C.; Reddish, M. J. *J. Chem. Educ.* 2018, **95**, 928–938.

Key words:

CURE, laboratories, mini-projects

Region:

UK/Ireland

Plenary Session 3 / **52**

Face-to-Face Lab Teaching in an Age of Pandemic: Tragedy, Triumph and the Student Voice

Author: Tom Anderson[1]

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The transition from school to Higher Education is central to the student experience. Alterations to that experience are frequently missed in the organisation of HE, leading to missed opportunities and a loss of student confidence in their course design. With recent changes to the Chemistry A-level to favour independent lab working, I employed input from students and pedagogic research in order to inform appropriate changes to the University of Sheffield's first-year Chemistry lab course. Yet no sooner was my new course deployed, a new challenge arose: the Covid-19 pandemic. Suddenly, a year group would be called upon to work more independently than ever, as I designed socially-distanced, Covid-safe lab practicals. This is the story of how vision and hard work from myself, Health and Safety, technical staff, postgrad demonstrators and the students themselves resulted in the successful delivery of over 85% of a normal year's worth of face-to-face lab practicals, all without a single case of Covid transmission. Throughout the year, surveys and focus groups were used to maintain close communication with students and head off potential crises before they could arise. The results of this student input in overcoming Covid-related challenges are discussed, good practice is shared and future plans are outlined.

Key words:

pandemic, chemistry, practical, lab, challenge,

Region:

UK/Ireland

Plenary Session 3 / **63**

Developing a systems thinking-based curriculum for catalysis education

Author: Manoj Ravi[1]

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The extension of a holistic or 'systems thinking' approach to chemical education is a recent advancement[1]. Enabling students to appreciate the broader interconnections that chemical science shares with societal issues and other disciplines of study is paramount for chemistry to be a 'central science', particularly in the context of the UN Sustainable Development Goals that will shape the next decade[2].

While the first set of scientific publications (Special issue J. Chem. Educ., Vol 96, Issue 12, 2019)

have identified ways to integrate systems thinking in general chemistry courses typically delivered to first-year University students, there is a necessity to embrace the same approach also in more advanced chemistry course modules, such as catalysis. Catalysis is undeniably an important tool in developing green and sustainable chemical processes, yet course units on catalysis have conventionally been taught through a reductionist perspective. This presentation identifies ways to transition to a systems thinking teaching style for catalysis courses. The analysis is built on the principle of constructive alignment with a focus on how intended learning outcomes, learning activities and student assessments will need to be modified to foster systems thinking[3]. Using diverse examples, the presentation will highlight how this rather seismic shift can be initiated through small incremental steps with minimal effort, eventually paving way to a full-fledged catalysis course grounded in systems thinking[3]. Furthermore, strategies to prevent disciplinary knowledge siloing and evolve beyond context-based catalysis instruction will be outlined[3]. Importantly, the presentation will illustrate how students can be stimulated to place environmental considerations at the forefront of their thinking instead of them merely acknowledging the environmental consequences of catalysis-related decisions.

[1] M.Orgill et al., J. Chem. Educ., 2019, 96, 2720-2729
[2] P. Mahaffy et al., J. Chem. Educ., 2019, 96, 2679-2681
[3] M. Ravi et al., J. Chem. Educ., 2021, 98, 1583-1593

Key words:

Catalysis, Systems thinking, University Education, Higher Education

Region:

UK/Ireland

Plenary Session 4: Friday 20th August 2021 / 20

Welcome

Plenary Session 4 / 21

Keynote: Digital practice: Blending ideas for a winning formula

Author: Vicki Dale [1]

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What does innovation mean in STEM higher education? And how can we create space for reflection to encourage innovation? Drawing on the outcomes of a recent study of STEM educators' characteristics and participation in developmental opportunities in relation to technology-enhanced learning and teaching (TELT), and examples of digital practice from chemistry and physics education, this keynote will consider not just the importance of blended learning for students in higher education, but also how educators can be best supported to engage in this space. Delegates will be encouraged to reflect on their own digital practice and how they can work together to develop their level of 'digital practitionership' to enhance student learning experience and optimise learning outcomes.

Plenary Session 4 / **3**

Break

Plenary Session 4 / **106**

RSC Women in Chemistry: Making the Difference

Authors: Malcolm Stewart[1]; Saskia O'Sullivan[1]

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During the global pandemic, the University of Oxford co-ordinated and set up a multi-institution online open-access project promoting women working in the chemical sciences. The project provides an opportunity for girls aged approx. 10-14 (Upper KS2-KS3 or equivalent) and their supporters to engage in creative and enjoyable practical challenges linked to current chemical sciences research at UK universities. Monthly challenges, research explainers and team profiles have been developed and shared and each institution hosted a number of online live Q&A events to provide opportunities for the girls taking part to engage with the team of females behind the resources. The latter act as role models in terms of academic careers and qualification routes into the chemical sciences and are available to answer questions regarding the research undertaken by the institution and the linked challenge(s).

This talk gives the background to the project, its aims, example resources (including video clips), and a selection of the responses from both institutional teams and the young people and supporters who engaged with the project. Additionally, conclusions are drawn from the first six months as well as suggestions for future adaptations.

The Universities involved include the University of Oxford, University of Wolverhampton, University of Warwick, University of Durham, Imperial College London, and the University of Bristol.

Key words:

outreach #PER #diversity #women #community

Region:

UK/Ireland

Plenary Session 4 / **41**

The relationship between a sense of belonging and well-being in male and female undergraduate physics students

Authors: Antje Kohnle[1]; Ewan Bottomley[1]; Kenneth Mavor[1]; Paula Miles[1]; Vivienne Wild[1]

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Coined ‘the social cure’, a strong sense of social support has been associated with greater health and well-being (Jetten, Haslam, & Alexander, 2012). However, recent research has suggested that women in physics undergraduate degrees report a lesser sense of belonging on their course, compared to men (Seyranian et al., 2018). Consequentially, we hypothesised that, as they are an under-represented group, women in university physics classes may report a lower sense of belonging and well-being, in comparison to men. Similarly, we posited that the link between belonging as part of the physics community and well-being would be weaker for women than it would be for men. We conducted a survey of 310 physics students (105 women, 205 men) from across all undergraduate levels at a small research-intensive university. This survey measured students’ identification with physics as a discipline, their sense of belonging, their self-efficacy (the beliefs in their ability to complete physics tasks), and their sense of well-being. Our results revealed that women reported a similar level of belonging and well-being compared to men, but men reported significantly greater physics identity and self-efficacy than women. Despite this, belonging significantly predicted levels of well-being for men, but this association was not found for women. Therefore, it seems men could be benefitting from the social cure to a greater extent than women in physics. This raises a number of questions for future research: what contexts result in belonging relating to well-being, and is the lack of an association between belonging and well-being prevalent in other under-represented groups in education?
References
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Seyranian, V., Madva, A., Duong, N., Abramzon, N., Tibbetts, Y., & Harackiewicz, J. M. (2018). The longitudinal effects of STEM identity and gender on flourishing and achievement in college physics. International Journal of STEM Education, 5(1), 1-14.

Key words:

belonging, well-being, gender, self-efficacy, identity

Region:

UK/Ireland

Plenary Session 4 / **112**

Every Chemist a Programmer

Author: Kevin Cowtan[1]

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Computing as a discipline suffers from a significant gender imbalance, with the imbalance in computer programming being particularly pronounced. I review the evolution of the way I have taught programming, from early courses which reinforced these biases, to my latest python programming course which is delivered in the first year of an undergraduate chemistry degree. In an already heavy teaching timetable we were only able to allocate 6 hours of contact time to the course. The course ran for the first time during the lockdown of spring 2021, which gave us freedom to experiment with online delivery. The resulting material was delivered as 12 short video lectures totalling 90 minutes, linked to exercises with online feedback.

The course incorporates EDI material on gender bias both implicitly in the course design and explicitly in the lecture materials. While there was no control group, student feedback on the course as a whole and on the EDI material in particular has been positive and one student explicitly reported a change in attitude arising from the EDI material.

I will discuss briefly how the inclusion goals of the course may have been enabled by my own experience as a genderqueer autistic scientist.

Key words:

computer programming, teaching, gender, inequality

Region:

UK/Ireland

Plenary Session 4 / **37**

Measuring Student Awareness of Equality, Diversity and Inclusion in the Chemical Sciences

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In order to better support the diverse needs of all students, the School of Chemistry at the University of Leicester has designed an inclusive induction programme which aims to develop a strong sense of community at the start of its undergraduate degree programmes. Developing strong learning communities has numerous potential benefits including improved student retention, enhanced student outcomes and a greater sense of student satisfaction. An important part of developing a strong sense of community involves helping students and staff alike recognise and celebrate the diversity within our subject area and to recognise the significance of developing inclusive study environments.

The induction programme includes a student-led poster conference which celebrates the diversity in chemistry research. Students work in small teams to design posters based on major research conducted by individuals (or small groups) from under-represented minority groups. Students present their posters to peers, staff and other undergraduate and postgraduate students.

A study of first year student awareness of Equality, Diversity and Inclusion (EDI) in chemistry based on pre-University educational experiences was conducted. This was achieved by inviting all first year students to voluntarily participate in a questionnaire-based study. This study also investigated the impact of the poster conference on student awareness of EDI in chemistry.

This study showed that only 51.4% of respondents (n = 72) had pre-University educational experiences that raised their awareness of EDI in the subject and 60.6% of respondents agreed that their pre-University education completely failed to address EDI in the subject. 86.1% of study participants agreed that the poster conference improved their personal awareness of EDI in the subject, 87.5% of respondents agreed that was an effective way of discussing EDI in chemistry with their peers and 71.8% of respondents agreed that this approach was an effective way of discussing EDI in chemistry with staff.

Key words:

Inclusion, Diversity, Equality, Induction & Undergraduate

Region:

UK/Ireland

Poster Sessions, Monday 16th August 2021 and Tuesday 17th August 2021 / 20

Abstracts

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Opportunities for Active Learning

Authors: Masoud Seifikar[1]; Simon Foster[1]; Stefano Vezzoli[1]; Vijay Tymms[1]; Yasmin Andrew[1]

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This presentation will provide an overview of an ongoing project to introduce active learning to the undergraduate physics curriculum through blended learning and interactive demonstrations. Flipped classroom approaches and teaching resources have been developed and used for several physics courses and modules. In parallel, over the last three years a bank of experimental demonstrations have been developed for all four years of the undergraduate physics degree, documented and catalogued. Many of these demonstrations have associated learning cycle questions and evaluation resources, developed with the course leaders for use either in person or remotely. The effectiveness of both active approaches have been measured and evaluated using surveys, focus groups, interviews, in lecture observation and Mentimeter quiz analyses.

Key words:

Physics, Active Learning, Demonstrations, Blended Learning

Region:

UK/Ireland

103

Moving Forensic Science online, how did it go?

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Due to the covid pandemic our Forensic Science courses moved to blended delivery with some face to face teaching of practical classes when permitted. For the online delivery we used a range of approaches, lectures were live via MS Teams or pre-recorded and shared via MS Teams or Blackboard. Practical classes were delivered live via MS Teams, via a data set exercise or via use of simulations. We also included live optional drop-in session via MS teams.
Here is outlined why we took the approaches to blended teaching that we did. What our students thought of the online teaching, why they preferred live online content over pre-recorded content and what the differences in perceptions of online teaching were for the different year groups.
The data was collected through questionnaires via MS Teams for students across all years of the courses.

Key words:

forensic science, online teaching, live delivery, simulations, MS Teams

Region:

UK/Ireland

86

Teaching and assessing experimental methods and data analysis in a pandemic

Authors: Alison Hill[1]; Andrew Shaw[1]; Bertram Daum[1]; Nicholas Harmer[1]

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The second year course Analytical Techniques in Biochemistry is a compulsory module for the biochemistry and chemistry students at the University of Exeter. Due to the Covid-19 pandemic, we decided to streamline the course to ensure the students were not overloaded and to embed Covid-19 into the module. One of us (AMS) had developed an antibody test for Covid-19, and ethics approval was granted for the teaching staff to be regularly tested using the Attomarker Covid-19 triple antibody test1 and for the results to be shared with the students. Developments of the test moving from a blood to saliva test were also shared during the module. During the November lockdown we ran a cryo-EM competition where students reimagined ATP-Synthase (from the cryo-EM Data Resource2) as Lego, in food, or as art.
Bespoke laboratory videos were created3, Learning Sciences simulations4 and a Smart Worksheet5 used to replace the laboratory sessions. We reasoned that while students were not able to do the experiments themselves, they could still benefit from processing data and writing a full laboratory report. We had access to many years of historical data and so data sets could be provided but we wanted to ensure the work submitted was the students' own and not the result of collaboration. In addition, the final exam would be on-line and non-invigilated meaning that if we used a single data set in the exam, there was the likelihood that students would 'collaborate' and share their answers. For both the exam and the assessed practical we used R to produce individual data packs for the students (raw data and images) and staff (plotted data and all worked answers). ANOVA (Kruskal-Wallis Test) shows no statistical differences for this year's laboratory report (compared to 2016-2020) or for the exam (compared to 2019, 2020).

1. https://www.attomarker.com/the-triple-test#AboutTheTripleAntibodyTest
2. www.emdataresource.org
3. Bitpod.co.uk
4. https://learningscience.co.uk/labsims
5. https://learningscience.co.uk/smart-worksheets

Key words:

individual data sets, covid-19

Region:

UK/Ireland

34

Mind your language! An investigation into the semantic gravity and semantic density in GCSE, A-level and university-level textbooks.

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Chemistry has a hierarchical knowledge structure, where the basics much be learnt before higher-level concepts can be mastered. Accordingly, the language used within the chemistry classroom increases in complexity as a student progresses.

Legitimation Code Theory (LCT) is a tool used to separate abstraction from complexity in oral discourse. Semantic gravity is related to how abstract a concept is; a concept with stronger semantic gravity is termed SG+ and is taken to mean something that is less abstract, for example it is factual or can be observed. A concept with weaker semantic gravity is termed SG– and is taken to mean something that is more abstract or generalized.

Semantic density relates to the degree of complexity contained within a term. Stronger semantic density (SD+) means that there is more complexity i.e. more meanings are condensed into a word or symbols, whereas weaker semantic density (SD–) condenses fewer meanings. Semantic density and semantic gravity are independent of each other.

Language used in textbooks when explaining a range of chemistry concepts at GCSE, A-level and university-level was analysed for semantic density and semantic gravity using an instrument based on that disclosed by Cranwell and Whiteside (2020). Initial results show that across all levels studied the semantic density is strong, and students are exposed to a number of new technical words and phrases at each stage. Semantic gravity weakens as a student progresses through their education, and students are expected to link more concepts and ideas and apply knowledge that is less context-dependent and uses more general laws and rules.

There are some implications from this that will be discussed further during the talk.

Key words:

Semantics, LCT, textbooks, complexity, abstraction

Region:

UK/Ireland

104

Adventures in alternative assessment

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Two courses -General Chemistry in level 3, and Integrated Chemistry in level 4- have had new continuous assessments and reflective journals added to support students' revision and performance in our honour year General Chemistry exam paper and oral exam, and to improve engagement with assessment and feedback in general. Several new assignments were added this year in light of Covid-19 alternative assessment arrangements. These include:
Peer grading using Blackboard's build in assessment tool, use of MCQ questions with follow-on written answers, student submitting a video answer of their choice of question in a written assessment, and video submission describing a key chemistry concept using Johnstone's triangle. Each assignment had an associated reflective journal entry.
Examples of the different assessments and journals will be presented.

Key words:

online assessment, feedback, student video, reflective journal

Region:

UK/Ireland

62

A simulation to support experiment design in an open ended investigation of an enzyme-catalysed reaction

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COVID social distancing restrictions and absences due to self-isolation have caused significant issues for implementation and assessment of undergraduate laboratory classes. Here we describe a pre-laboratory simulation to support an open ended undergraduate chemistry practical class. The simulation also provides students who are unable to complete the laboratory work with personalised model data so that learning outcomes relating to experimental design, interpretation and reporting can be achieved.

Ordinarily, the year 2 biological chemistry laboratory experiment consists of two dedicated laboratory sessions in which students work in small groups to conduct an open ended investigation of an enzyme-catalysed reaction using a microplate-based assay with a coloured visual readout. As well as the practical experience of pipetting small volumes in microplates, the learning outcome of the exercise include being able to propose hypotheses, plan reaction conditions and appropriate control experiments. Under COVID restrictions, the available laboratory time was reduced to approximately one third. Due to the constraints on laboratory time, it was desirable that all planning was conducted prior to arriving at the laboratory. A simulation was devised in Microsoft Excel that gives students a free choice of volumes of enzyme, buffer, substrates and cofactor and layout of reactions in the 96-well microplate. After setting time and temperature, a visual display of the predicted colours in the microplate wells is generated. Warnings of common errors such as running out of solutions or overfilling the wells are given. The simulation was used with a cohort of ~200 undergraduates. Feedback was obtained via a survey and responses were largely positive, with a majority of respondents reporting that they had found the simulation useful for planning their laboratory work. Students who missed the laboratory session were able to use the simulated data to complete their assessed report.

Key words:

simulation, practical, chemistry

Region:

UK/Ireland

42

A Chemist's View on the Multidisciplinary Perspectives of Sustainable Development

Authors: Debbie Willison[1] Anand Sengodan[1]

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This presentation will outline the development of an innovative module at the University of Strathclyde which is available to all students studying at Strathclyde. UNESCO has been promoting Education for Sustainable Development (ESD) since 1991 and is now spearheading its follow-up, the Global Action Programme on ESD. Global issues urgently require a shift in our lifestyles and a transformation of the way we think and act. We need new skills, values and attitudes that lead to more sustainable societies. Education systems must respond to this pressing need by defining relevant learning objectives and introducing pedagogies that empower learners. The new 2030 Agenda for Sustainable Development clearly reflects this vision of the importance of an appropriate educational response. Education is explicitly formulated as a stand-alone goal - SDG4 - that is why education represents an essential strategy in the pursuit of SDGs and defined the need for this module. There is no other credit-bearing University of Strathclyde class currently available that has academic input from all four Faculties, and that can be attended by all students. The educational aims of the class also make it distinctive in seeking to develop students' knowledge and understanding of some of the challenges facing the world as articulated in the SDGs.
The structure of the module and how it introduces students to the 17 SDGs will be described. Through exploration of the challenges of four particular goals: SDG3 Good Health and Wellbeing, SDG6 Clean Water and Sanitation, SDG10 Reduced Inequalities, and SDG13 Climate action, students gain an understanding of the different ways in which various disciplines can contribute to addressing these challenges. This enables students to understand that a multidisciplinary approach can be more powerful than a number of independent contributions but does the module address and support staff interactions? This will be explored.

Key words:

multidisciplinary, sustainable, online, collaborative, innovative

Region:

UK/Ireland

111

Evaluating the impact of climate change CLPL (Primary & Secondary) under the overarching theme of COP26 to enable sustainable learning.

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The climate change CLPL session has been developed to discuss the implications and possible solutions to the climate emergency on a local & global scale, alongside easily accessible but effective supporting practical's to visualise and engage.

The session will reflect on the impact of delivering this CLPL to over 200 primary & secondary teachers with a discussion on the impact that this had on teachers confidence and knowledge in delivering science, teacher empowerment and the effect this had on the pupils learning in regards to science, understanding the links between society, environment, economy, and awareness of career choices in science.

There will be further focus on the integration of cross-curricular activities, as well as attainment of science capital to encourage cooperative collective and active learning for pupils and collegiate working within schools, across authority and secondary clusters.

Key words:

Learning for Sustainability, Primary, Secondary, COP26

Region:

UK/Ireland

‘

73

Effect of Language on the effectiveness of Peer Instruction in Physics

Authors: Alison Voice[1]; Rahma Al Harthi[1]; Samantha Pugh[1]

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Peer Instruction (PI) was first developed in the United States (Mazur, 1997). Although research shows that PI contributes to a positive learning gain (Fagen et al., 2002) and improves students' attitudes and beliefs about physics and learning physics (Zhang et al., 2017), little is known about the generalizability of its effectiveness in other countries. One cannot assume that such instructional strategy, which was developed elsewhere can be effectively implemented into a unique context in terms of language i.e. when the students' first language is not the language of instruction there may be unique challenges to effective peer discussion in physics.

This study is a part of a PhD project at the University of Leeds to investigate the effect of language and culture on the effectiveness of PI. It involves two groups of students taking a first-year physics course at Sultan Qaboos University, Oman. One group is being taught using PI and the other with traditional lecturing. The rapid shift to online delivery brought extra challenge and interest to recreate these learning environments in a remote space. The effectiveness of students' learning has been evaluated by administering an online half-length force concept inventory (Han et al., 2015) and CLASS attitudes survey (Adams et al., 2006) for both groups of students. For the concept inventory, half of the students in each group took the test in English, and half in Arabic. Results will be presented to provide further insight into the effectiveness of PI.

Key words:

Peer Instruction, Physics, Language, Online Teaching

Region:

UK/Ireland

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Self-efficacy, test anxiety, and cancelled school exam experience in first year physics students.

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Summer exam cancellations have meant that, in addition to the usual secondary-to-university transition challenges, students who started university last year have had little to no recent high-stakes exam experience. Future cohorts are also affected by the continued disruption to exams. This mixed-methods study investigates the experiences of undergraduate physics students when sitting university exams and the impact that cancelled secondary school exams has had on preparation, self-efficacy, and test-anxiety.

Over 250 first year physics students were contacted in May 2021 to participate in our study. Out of 95 survey respondents, 82 had experienced cancelled school examinations. Preliminary quantitative analysis revealed that students who felt their university exams were more negatively impacted by school exam cancellations felt less prepared and had lower mean self-efficacy ratings. Students who felt their university exams were more negatively impacted also reported higher test anxiety.

Six students participated in follow-up focus groups. Initial results suggest that students felt that the cancellation of school examinations affected their university exam performance to varying degrees. Some students felt that the experience of sitting high-stakes exams would have enabled them to consolidate physics and maths concepts in preparation for university lecture courses, and would have furthered their sense of belonging at a high tariff university. Most students suggested that revision resources did not adequately prepare them for their first exam in January, in addition to feeling quite demoralised and stressed following a generally negative experience of this exam. However, following the experience of their first exam in January, some students took the initiative to change their study methods for summer exams.

Our preliminary findings suggest students find the experience of sitting high-stakes exams valuable. We therefore aim to create exam resources for current and future students to help with exam technique and performance, and also build confidence and reduce test-anxiety.

Key words:

Assessment, self-efficacy, test-anxiety, experiences, mixed-methods

Region:

UK/Ireland

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Development of educational games to improve student engagement

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Active learning puts students at the heart of their learning experience enabling them to become more engaged with their own learning building knowledge through their own experiences (Friedrich et al, 2019). Staff-student partnerships have been shown to enhance educational practice and have students taking a more active role in decision-making (Cook-Sather et al, 2014). To improve engagement of students with online modules a co-development project was conducted to develop educational escape rooms allowing students to be involved with the development of clues for a drug delivery module. Educational escape rooms are effective pedagogical tools used to develop students' knowledge and skills and have been positively received by students, increasing knowledge and serving as a platform for teamwork (Kinio et al, 2019).

This study involved third year MPharm students at Ulster University. Questionnaires and consultations were conducted to gather student opinions on online delivery and the use of educational games. Co-design sessions were conducted which involved students indicating parts of lectures they thought were important for understanding of the topics. Questions were developed by students which were then further developed by staff into clues and hints which would be suitable for an escape room requiring understanding of material and application of knowledge to progress.
Educational games have been shown to improve learning by stimulating student interest and motivation through social interactions with educational content. By developing questions the students have shown they can identify the important parts of the lecture which could be used when completing the coursework.
Ongoing development of questions/clues is continuing to ensure development of escape rooms that improve student understanding of complicated concepts and also to make them fun which should improve engagement with the lecture material.
This study fits into the theme of 'collaborating with students' and has shown that the students enjoyed the process of working with academics and understanding why certain information was included in lectures.

References
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Friedrich, C., Teaford, H., Taubenheim, A., Boland, P. and Sick, B. (2019) Escaping the professional silo: An escape room implemented in an interprofessional education curriculum. Journal of Interprofessional Care, 33(5), 573-575.
Kinio, A.E., Dufresne, L., Brandys, T. and Jetty, P. (2019) Break out of the classroom: The use of escape rooms as an alternative teaching strategy in surgical education. Journal of Surgical Education, 76(1), 134-139.

Key words:

Co-design, active learning, educational games, engagement

Region:

UK/Ireland

45

Online Teaching, Education and Outreach of Nuclear Physics and Engineering in Argentina and the Latin American Region

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For more than a decade, the National Atomic Energy Commission (CNEA) of Argentina has been developing and promoting e-learning and blended-learning actions for students and professionals in Physics and Nuclear Engineering in the country and the Latin American and Caribbean region. In 2008, one of CNEA's academic institutions, the Balseiro Institute, received the Sadosky Prize in Educational Innovation for its online education initiatives. In 2010, CNEA pioneered the creation of the Latin American Network for Education and Training in Nuclear Technology (LANENT), holding its presidency for two consecutive terms and hosting its website and educational portal. While the students at the Academic Institutes of CNEA have direct access to its five nuclear research reactors (NRRs), e-learning and blended-learning initiatives were created with remote operation of two of them for students and professionals from other countries in the region. Distance training initiatives are also carried out for teachers and intermediate level students, through slides, didactic sequences, and other on-line resources. These are just some few examples of remote nuclear education, training, and outreach (NETO) activities provided and supported by CNEA, which have become so necessary

in the wake of the COVID pandemic in a region characterized by a common language and similar social and economic circumstances that define and shape all its educational levels.

Key words:

Nuclear, Education, Training, Outreach, Latin-America

Region:

Other part of world

33

Student perceptions of, and engagement with, a pandemic enforced blended approach to learning

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The benefits of a blended approach to learning are widely documented, where improvements in either student outcomes, understanding or engagement have been identified. In response to the current pandemic, most educators and students have had to adapt to an online blended learning approach. This presentation investigates the student experience and engagement observed by the academics facilitating the learning for two chemistry modules, one at foundation level and one at year 1 undergraduate level, in response to the pandemic. The foundation module structure is based on a flipped learning methodology involving online activities for students to access independently followed by online workshops structured around the challenge activities set and questions raised by the students. The undergraduate module applied a similar flipped learning approach incorporating several types of activities to promote active learning alongside video lecture content. The results of student performance in these activities were evaluated alongside the opportunity for students to ask questions anonymously, and these formed the structure of the live interactive workshops. For the foundation chemistry module, module feedback for particular activities will be presented along with an analysis of the interaction of the students with the independent activities, with a specific focus on engagement with lecture content versus application activities to test understanding of the content. The first-year experience of the undergraduate chemistry module forms part of a final-year student project focusing on the blended/flipped approach to learning. As part of this project, the cohort of students was surveyed regarding the activities they preferred/enjoyed, the ones they thought supported their learning, and the ones they thought improved their confidence in the concepts met. Interestingly, the initial findings suggest that the students are very aware of the difference between enjoying an activity and one that supports their learning best.

Key words:

blended learning; flipped learning; student engagement; active learning; remote learning

Region:

UK/Ireland

Key words:

95

Bringing Chemical Biology to First-Year Organic Chemistry: Adapting Workshops to Remote and Online Contexts

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From the perspectives of students, introductory courses, focusing on core concepts and problem-solving approaches, can feel disconnected from the global challenges and fundamental questions that inspired them to pursue science generally, and chemistry more specifically. Particularly for those students majoring in the biological sciences, organic chemistry can seem tangentially related to their subject. This talk will present an example of practice that addresses how organic chemistry enables the unraveling of biochemical puzzles. A series of workshops were developed to accompany a first-year organic course that serve a dual purpose of emphasizing the utility that first-year concepts have for contemporary and cutting-edge research, while consolidating material at key points throughout the academic year. Each workshop includes exercises similar to "typical" introductory course questions, but also ones that challenge students, while working together in small groups, to answer the same questions approached by researchers. By centering each workshop on a biochemical research endeavor, the students readily recognize the relevance of organic chemistry to their course. Initially developed as classroom sessions, these workshops have been adapted to a remote format over the past year. This talk will discuss the adaptations and online tools used to preserve the key aspects of the original workshop design: (1) synchronous student collaboration; (2) research-centered questions; (3) student-led discussion and peer-to-peer teaching (with the instructor in a facilitator role). More generally these workshops present an avenue to integrate aspects of topics that are typically considered advanced such as chemical biology, materials, and others into introductory courses in a scaffolded and accessible way.

Key words:

Workshop, Organic Chemistry, Chemical Biology, First-year, Pivot to Online

Region:

UK/Ireland

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Investigating the reasons why students within the University of Kent study Chemistry

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The research aims to explore the reasons why undergraduate Chemistry Students (studying Chemistry in 2021) within the School of Physical Sciences (SPS) at the University of Kent, Canterbury Campus (UKC) study Chemistry. The Royal Society of Chemistry (RSC) have reported that the number of Chemistry undergraduate applications have decreased in recent years (Turner, 2020). There is an assumption that the marketing of Chemistry does not appropriately target a diverse range of prospective students, as Turner (2020) found that to an 'uneducated outsider' Chemistry appears to be a vocational training programme for a 'job within a lab' (Turner, 2020). The research focused on why UKC students chose Chemistry, exploring the influencing factors and the ways in which future students could be encouraged to study the course. An online questionnaire was sent out to all UKC students studying Chemistry in March 2021. There was a total of 27 responses with a ratio of 2:1 female to male, respectively. The results showed a need for more exposure of Chemists who do not identify as a White male with heteronormative values as suggested by Carlone and Johnson

(2007). Further, participants noted the importance of working with school-aged students to encourage their interests in Chemistry by appropriately representing the subject and not just teaching out of a textbook.

Key words:

Undergraduate, Underrepresentation, BAME, Chemistry, Gender

Region:

UK/Ireland

65

Boosting student pre-lab engagement using LabBuddy

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In this session I will discuss the use of LabBuddy to prepare students for a second-year investigatory Chemistry practical, and how this fits with a programme of blended learning. LabBuddy allows a student to prepare their own script for a practical; effectively forcing them to think about what they will do at every step, including if unexpected outcomes are encountered.

Staff and student feedback on the use of LabBuddy is overwhelmingly positive. 96% of student respondents agreed that they were better prepared for the practical than usual, 70% said that they preferred using LabBuddy to our usual pre-lab activities, and 80% said that they would like to see it used it in other modules.

I will also discuss the process of setting up a LabBuddy activity, how it has benefitted our students, and how it fits with our pedagogical goals.

Key words:

Learning technology, LabBuddy, practicals, preparation, pre-lab

Region:

UK/Ireland

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Modelling Epidemics Using the Toolkit of Chemical Kinetics

Author: Tamas Bansagi[1]

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Extracurricular workshops were offered to undergraduate students at the University of Birmingham on modelling the spread of infectious diseases. The MATLAB-based exercise exploring the classic S-I-R epidemic model drew upon and extended the students' knowledge of chemical kinetics. Rate equations of the Consecutive Reactions Scheme and the changes in the concentrations of the reactant,

intermediate and product were examined as a starting point for exploring the changes in the numbers of susceptibles, infected and recovered within a population. Positive feedback present in the growth of the number of infected – identified as the key difference between the two mechanisms – was also discussed as the phenomena called autocatalysis seen in some chemical reactions. During the workshop, the students explored the effect of the reproductive number and the recovery rate, and how reducing the former through means like social distancing resulted in 'flattening the curve'. The solution guide given out after the sessions contained the answers to all questions on the worksheet and an additional model script for fitting the S-I-R equations directly to observed data.

Key words:

epicemic modelling, rection kinetics, transferrable skills

Region:

UK/Ireland

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Comparing Student Use of Technology in Remote Teaching Activities

Author: Dylan Williams[1]

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The COVID-19 pandemic has resulted in a significant increase in the use of online teaching approaches as part of blended or entirely-remote learning strategies in Higher Education. This increased use of online approaches has resulted in some debate over how students engage with these remote activities and the technologies used to support them.

The Chemistry programmes at the University of Leicester use a variety of learning approaches including Problem Based Learning (PBL), small group tutorials, large group lectures as well as laboratory- and project-based activities. This variety of teaching activities combined with the sudden switch to online teaching provided a unique opportunity to analyse how students use technology to engage with different types of remote learning activities.

First year Chemistry students were invited to participate in a questionnaire-based study that investigated their use of technology in and between live sessions. Two questionnaires were used to compare technology use in PBL (n = 46) and live lecture sessions (n = 30). Questionnaire responses revealed that a greater proportion of respondents reported turning their cameras on in PBL sessions (54.3%) than live lectures (30%). There was a similar difference in use of microphones: 82.6% of respondents used them in PBL sessions whereas 60% used them in lectures. There was high engagement with text chat functionality in both types of live sessions: 82.6% of respondents used this in PBL sessions and 93.3% in live lectures.

The findings suggest that use of some live session functionality depends very much on the format of the session. The use of instant messaging to support learning between these sessions is also important (95.7% of respondents used this between PBL sessions and 89.7% used this between live lectures) and in both cases was more widely used than the support mechanisms formally provided by instructors (e.g. discussion boards).

Key words:

Remote learning, student engagement, induction

Region:

UK/Ireland

101

The factors that affect the retention of BAME and female students in postgraduate Chemistry

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Despite best efforts of initiatives that seek to increase participation within Chemistry and its related fields, BAME and female students are seen to be less present at the more elite stages of study and career. The Aspires 2 research project acted as a launchpad into the educational and wider experiences of BAME and female students aged 10-19, within the context of STEM. The research suggests that there are points throughout the academic study of STEM, where the retention of some minority sects by the field can dramatically decrease - especially compared to their majority sect counterparts. The project tracked students no further than the first year of undergraduate study.
Across higher education, there is evidence that there is a higher ratio of female to male students at the undergraduate stage, but the rates of progression by female students in STEM dwindles and does not always reflect this. Similarly, BAME students are also less likely to progress than their majority group counterparts, and significant inequalities persist.
This study explains the need for the inclusion of pedagogical factors (intersectionality, sense of belonging) within STEM, whilst presenting insight into the complexities of relating barriers to diversity that may contribute to the lacking retention of BAME and female students in postgraduate Chemistry. A survey with a combination of qualitative and quantitative methods that probed into how feelings of representation may influence student intentions after graduation with the sample and population of Chemistry students at The University of Kent is discussed. The findings indicate that BAME and female undergraduates generally feel underrepresented and that this can affect how, if at all they consider postgraduate study in Chemistry. Strategies to improve both BAME and female chemistry student feelings towards postgraduate progression, and thus retention, within The University of Kent are outlined.

Key words:

CHEMISTRY BAME GENDER INTERSECTIONALITY UNDERREPRESETATION

Region:

UK/Ireland

93

Adaptable online Team-Based Learning in a capstone simulation “Hit-to-Lead” Drug Discovery exercise

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Drug discovery, particularly at the early stages, involves an understanding of both the chemistry of the potential drug molecule and the biological environment with which it interacts. This exercise pulls together all these different components that they have been taught across their degree programme into one capstone coursework exercise over eight weeks. The simulation allows students to

synthesise and use material from all years of their degree to experience how this fits together in the pharmaceutical industry. The work is entirely open-ended allowing teams to address the problem in very different ways. The students also develop skills in use of PyMol and GOLD to visualise x-ray structures of target proteins and dock their potential leads. The simulation uses Team-Based Learning (TBL) exercises in the early stages of the coursework to help cement the team environment and peer-to-peer learning. Teams give justifications for modifications for compound modifications and interpret those data they receive from their changes. They then must propose a synthesis of their lead compound searching chemical databases and literature, to plan a route bearing in mind cost, efficiency, scale-up concerns, and green chemistry principles. The assessment has a team component, a peer mark, and an individual mark for the report. Students also include a reflection on their own development during the exercise. In the pandemic the exercise was carried out entirely online, using Teams to facilitate separate areas for the groups to work in. The exercise has been developed using computational modelling, however it can be run entirely as a paper-based exercise and we are currently working with colleagues at the University of Leicester who have been trialling this. We will describe how to run the exercise and how it can be modified for differing circumstances.

Key words:

Drug Discovery, Team-Based Learning, Remote Teaching

Region:

UK/Ireland

55

A self-determination theory approach to a stereochemistry educational escape activity utilising augmented reality

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Engagement is frequently correlated with student success. However, this alone does not imply causation. The abiding educational challenge is to engage everyone in an effective and academically credible fashion. To this end, we have created a synergic combination of digital technologies in the form of a flexible escape activity hosting social problem-solving activities appealing to the principles of gamification and utilising both intrinsic and extrinsic motivational drivers. In our most recent example, the narrative environment serves as a context for stereochemical concepts in coordination chemistry and thus dovetails perfectly with our work on augmented reality.

The cognitive challenge of conceptualising the three-dimensional nature of chemistry, encountered by the novice student, is compounded by the arcane symbolism of hashes and wedges so familiar to the expert teacher. No longer does the educator need to make arbitrary judgements about the most effective representation to carry the learning objective to the otherwise passive student. This initiative liberates molecules from the two-dimensional constraints of the page or screen and places active control over the scale and orientation at the fingertips of the individual student. ChemFord was not the first to display molecules. However, it has been built by chemists who understand the value of being able to render multiple molecules to explore superposition or intermolecular packing. We are responsive to suggestions from the user base for additional content.

Herein, we have outlined an engaging, role-based, scalable digital learning experiences that utilises the cognitive benefits of augmented reality technology and context-based problem-solving. This digital learning experience can be easily delivered to large student audiences, with minimal additional facilitation, using our established protocol. Following the success of our pilot study at UEA (which hosted over 80 concurrent students), we hope to introduce educators to the potential of this exercise.

Key words:

Augmented Reality, Stereochemistry, Educational Escape Activity, Gamification, Higher Education

Region:

UK/Ireland

51

Engaging first year students in Biochemistry in co-design of module delivery

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As student cohorts become larger and more diverse, there is a need to comprehend how to engage students. This can be done by encouraging the 'students as partners' attitude, placing them in a more active role, considering them as 'co-producers'. This study involves collaborating with students in co-designing of module delivery with the aim to make it more engaging and involves a first year MPharm and MSci module in the School of Pharmacy and Pharmaceutical Sciences at Ulster University. Feedback from first year student cohorts has shown that the topic of Biochemistry is a "dry" subject area and is long and laborious to learn. In this study, the academic partnered with first year and second year students with the aim to making the subject area more engaging. Consultations took place during class and also on an individual basis using a questionnaire as a guide. This collaboration resulted in the following plan:
• Traditional lectures in class and recorded with optional supplementary reading.
• Active learning activities in class such as quizzes/MCQs.
• Optional use of technology in class to ask/answer questions.
• All materials available on Blackboard learn.
This experience of 'inclusive partnership' has brought a better mutual understanding which should see positive results with student engagement and the overall experience and performance in the long term.

Key words:

Co-design, student engagement, first year biochemistry

Region:

UK/Ireland

44

'Narrowing the Gap' – Supplementary Chemistry Tutorials for non A-level students of Pharmacy and Pharmaceutical Bioscience

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As student cohorts become larger and more diverse, there is a need to comprehend how to engage and support all students. MPharm and MSci students entering on the non-traditional route of A levels, i.e. Leaving certificate, Access Courses, BTEC or an international qualification can struggle with the Chemistry content in the first semester of first year. This has been reflected in the exam results and feedback from students.
The aim of this work was to implement supplementary Chemistry Tutorials for students struggling with the Chemistry component of a first semester first year module
Subject areas within the A level syllabus were identified and aligned with the first year, first semester module chemistry components. A questionnaire was devised to determine what the needs were and distributed to all first-year students at the start of semester. A PhD student with a strong background in Chemistry took the tutorials. The academic staff member met with the PhD student twice a week to discuss material to be covered and any feedback from students. The academic also worked closely with students to understand the problem areas through informal discussions, minute papers at the end of each of the tutorials and teaching assessment questionnaires at the end of semester.
Based on the feedback from students, the PhD tutor and the exam results, the extra Chemistry Tutorials were deemed a success. The fail rate for the Module exam decreased significantly from 21.3% to 6.1% in the academic year after implementation. Due to the success of the tutorials, they have become part of the practice within the first-year cohort. This practice is transferrable as Chemistry in another School or as a different subject area such as Mathematics which is frequently seen as a challenge in teaching first year students across numerous disciplines.

Key words:

widening access, first year MPharm/MSci, supplementary Chemistry tutorials

Region:

UK/Ireland

84

Quiz and Workshop Moodle Activities As Tools of Learner Engagement

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One of the main issues in the online delivery of modules during 2020/21 academic year was to create asynchronous materials that would keep students engaged. These materials were also supposed to be valuable for students, help them gain the necessary knowledge and grasp the syllabus.
On King's International Foundation Programme, in Mathematics for Natural Sciences and Foundation Physics modules, "unlocking" Moodle quizzes were extensively used throughout the academic year. Students needed to pass weekly quizzes in order to gain access to materials for subsequent weeks. After the attempt, any question that was not solved correctly was flagged and feedback given. Students had three attempts and quizzes were not counted towards the final grade for the module. We also used Workshop activity in these modules and the 1st year Undergraduate Laboratory module where students were assessing their peer's work on problems from exercise sheets, past papers, graph plotting and problem classes. Students' participation in these activities will be discussed as well as positive impact these activities had on students' learning experience. Weekly Moodle Discussion Forums were set as well. They were not very popular amongst foundation students, but they generated lots of discussion amongst 1st year students. Workshop worked better contrary to only verbal discussion students were having in previous years in labs as it "forced" everyone to try and participate.

Key words:

Engagement, Quizzes, Workshop, Discussion Forum, Participation

Region:

UK/Ireland

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How much do students really learn in traditional synthetic laboratory classes? When following a typical practical procedure, do they become fully competent in the skills required to be a successful synthetic chemist? Inspired by the teaching methods used in practical cookery courses, this talk describes a new method of teaching classic laboratory skills, and their application to student's experimental work.
UCL's Drug Discovery MRes attracts students from a wide variety of disciplines, with varied levels of practical chemistry experience. A module was designed for postgraduate taught Masters students (PGT) to overcome these differences and raise all students to an appropriate level before entering the research laboratory.

Students gain an understanding of classic synthetic techniques, learning them in isolation by performing small focused practicals in a low pressure, formative environment. This is then followed by a more traditional laboratory class where they follow an experimental procedure that incorporates the skills they have assimilated in the formative sessions.

Although originally conceived for PGT students, following positive student feedback, the strategies have now been employed for undergraduate students. Due to the COVID-19 pandemic, many students in years 2, 3 and 4 will be undertaking advanced practical work without the experience they would normally have gained in their previous academic years. This had led to the inclusion of practical skills "boot camps" within the degree programmes, where these formative methods have been applied to ensure students are fully prepared for their assessed laboratory courses. There is also the potential to adapt these sessions for outreach and widening participation activities.

This work will be evaluated, and some practical methods for educators shared.

Key words:

Laboratory, synthesis, practical, chemistry, postgraduate

Region:

UK/Ireland

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Effect of Remote Learning on Academic Coursework Attainment in First Year Physics Students

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We examine the coursework attainment of two cohorts of around 170 first year physics students each: one group from before the pandemic and one who were taught remotely during the crisis. We

compare like for like results on comparable weekly set work over a 20 week academic year, how engagement with coursework changed over the course of an academic term and fatigue set in, and how increasing the amount of coursework needed to be done changed attainment. Although many variables were altered between the two groups, we look for patterns and evidence of the impact certain pedagogical changes had on the attainment of the students, and conclude on the basis of this what might be good practice for remote teaching in the future.

Key words:

Physics Coursework Remote Attainment

Region:

UK/Ireland

82

Chemistry Is For Everyone – A Co-Created Website Showcasing the Work of First Year Undergraduate Chemistry Students

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Positive attitudes and feelings towards chemistry have been shown to correlate with student persistence and performance[1-3]. Students who enthusiastically join the chemistry community when they enter Higher Education will understand and value its knowledge and practices. To do so, they should have the confidence to participate in its scientific discourse, which could include discussions with their peers and academic staff, but – as in this case – also includes communicating their subject knowledge with a wider, non-scientific audience. Nothing has demonstrated the importance of good science communication skills more powerfully than the Covid-19 pandemic.
The aim of this project was to provide an opportunity for first year undergraduate chemistry students to develop and demonstrate their skills as effective chemistry communicators. Originally planned as a face-to-face outreach event supported by the RSC Outreach Fund [4] in which students would present chemistry topics to a lay audience of family and friends, the event was redesigned to develop the Chemistry Is For Everyone [5] website. Undergraduate students not only created the content for this showcase, but also played a key role in developing the website itself, with two students working alongside the website developer.
Chemistry Is For Everyone is a website that currently hosts 30 unique exhibits in the form of posters, infographics, games and art work on a range of chemistry themes. Produced by 44 first year students, each exhibit is inspired by their reading of a popular science book. Alongside the exhibits themselves, the meaning or purpose and science are explained by the students in their own words. A short survey carried out after examinations had only 30 % response rate but was overwhelmingly positive. The website received more than 1200 views over "launch week" including interactions from as far afield as Canada and Bangladesh, and represents a legacy on which to build.

1. Villafañe, S.M. and Lewis, J.E., 2016, Chem EducRes Pract, 17(4), pp.731-742.
2. Xu, X., Villafane, S.M. and Lewis, J.E., 2013, Chem EducRes Pract, 14(2), pp.188-200.
3. Kahveci, M. and Orgill, M. eds., 2015. Affective dimensions in chemistry education. Springer Berlin Heidelberg.
4. Many thanks to the Royal Society of Chemistry Outreach Fund.
5. https://chemistryisforeveryone.com/

Key words:

Co-creation, Website, Student showcase, Communication skills.

Region:

UK/Ireland

108

Thermodynamics education for energy transformation: a Stirling Engine experiment

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We present a thermodynamics experiment suitable for first-year undergraduate students employing Stirling Engines to create a demonstration of energy transformation and to measure the mechanical efficiency of such engines. Using an inexpensive transparent chambered Stirling Engine, students can connect concepts such as the theoretical pressure-volume diagram with the physical movements of the engine's pistons and the resultant useful output work of a spinning wheel. We found the majority of students successfully complete this experiment obtaining results similar to when performed by the authors. In addition to the core thermodynamics lesson, this experiment incorporates DC circuits, oscilloscopes, and data analysis so it can be integrated into a wider undergraduate physics course to combine the teaching of multiple subjects.

Key words:

thermodynamics, heat engine, energy, DC circuits, oscilloscopes

Region:

UK/Ireland

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Developing Career Supports for Chemistry Students from Minority Ethnic Groups through Cocreation

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It had been noted that our chemistry graduates from under represented ethnic groups often had greater difficulties gaining relevant employment. This observation is supported by national and international studies.(1,2) Increased diversity of backgrounds and ideas in the workplace is recommended as it brings a broader range of perspectives and expertise into play.
It was concluded that there was a need to develop appropriate career supports in our institution for our minority ethnic chemistry students. It was decided to do so in partnership with students and graduates from under represented ethnic groups to ensure that the resources were fit for purpose.
The first component of the supports is a careers toolkit that maps out career journeys of minority

ethnic chemistry graduates from our university. The second component, not yet begun, will be a mentoring scheme.
Five undergraduate students from minority ethnic backgrounds were recruited as hourly paid assistants to contribute to developing the career profiles. They were then each introduced to a graduate who had agreed to contribute a career journey profile for our website. The undergraduate students discussed between themselves which questions would be used in the interviews with the graduates about their career journeys. They then arranged a time for the online interview with the graduate they were working with. The next stage is that the undergraduates will draft career profiles based on their interviews and these will be edited by the author and reviewed by the relevant graduate.
The career profiles prepared will have been completed by August and a short evaluation from the graduates and undergraduate students on their experience of the career journeys project will be presented, along with any lessons learned and guidance on on how a similar initiative could be implemented elsewhere.
1.Ethnicity and Nationality in the Irish Labour Market, McGinnity, Grotti, Groarke & Coughlan, 2018
2.The Science of Effective Mentorship in STEMM, Dahlberg & Byars-Winston, 2019

Key words:

Cocreation Careers Diversity

Region:

UK/Ireland

36

Development of a 3D printing workshop to aid student comprehension of shape and isomerism

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Development of a 3D printing workshop to aid student comprehension of shape and isomerism
Molecules and reaction transition states aren't 2D, yet we continually expose our students to 2D representations of these chemical concepts in textbooks, presentations and lecture notes. This can result in students experiencing difficulty in mentally "translating" these 2D representations into their correct 3D arrangements. For example, translating bond angles and representations of bonds in-perspective (i.e. the use of wedges and dashes) into the spatial distribution of atoms and bonding is often challenging for many students. Traditionally, this has resulted in a shortfall in the ability of students to draw molecules in set orientations and assign their stereochemistry. We have created a workshop activity that allows students to draw a molecule, which contains a stereogenic centre, of their choice and then have it printed during class. This computational session is complemented by a manipulation and worksheet activity to link the task to their previous studies of shape and isomerism. This intervention has led to improvements in student understanding of molecular representation and the assignment of stereochemical labels. The majority of students enjoyed the activity and wished to see more 3D-printing in their education, with the integration of steps that require students to draw the structures and prepare the printing files being found important and highly beneficial. Comparing data collected before and after the workshop highlights that this activity has led to improvements in student confidences in drawing chiral centres and increases in perceived competences in understanding, representing and assigning chirality.

Key words:

Hands-On Learning/Manipulatives, Molecular Modeling, Organic Chemistry, Chirality/Optical Activity, Stereochemistry, First-Year Undergraduate/General

Region:

UK/Ireland

107

Self-determination theory and motivation in chemistry during blended learning

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This undergraduate student led project looked at student motivation in undergraduate chemistry during blended learning due to Covid-19.
A survey was developed using self-determination theory and the science motivation questionnaire (SMQ II).
The motivating factors studied were intrinsic motivation, self-determination, competence, autonomy, relatedness, and extrinsic motivation. In addition, information was collected based on students' year of study, whether they were blended or full-online in the first term when lockdown measures were less strict, and study status (UK or non-UK student). Free-text responses were also collected.
In general students possessed an equal level of intrinsic and extrinsic motivation. However, self-determination of students appears to be low, and this is related to low levels of autonomy, relatedness, and motivation. Variations were found between year groups. Workload, time-management, and clearer direction and structuring of online material, were highlighted as areas where improvements could be made to support students.

Key words:

self-determination theory, motivation, blended learning, students

Region:

UK/Ireland

105

Assessing assessments: Initial reflections on a tool for analysing how effectively our assessments measure student understanding

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Higher education Science Departments aim to produce graduates that are comfortable with assessing multiple sources of information and applying their understanding to solve complex problems. This is reflected by graduate employers who often deem problem solving to be an essential skill. This Faculty funded collaborative project between the Departments of Chemistry and Physics aims to analyse how we assess students' critical thinking skills, their ability to "unpack" information and

make connections across the curriculum. Two frameworks (Legitimation Code Theory and three-dimensional learning) were combined to create a tool to analyse open book online exam questions for how effectively they question the level of understanding. This analysis was done at a module, year group and program level. In the Summer of 2020, with students as partners, a tool was created and applied to analyse the 2018/19 May exams of both departments. The results of this analysis were interpreted to produce guidance for staff on how to adapt the assessment to better assess student understanding. The results, the guidance, and the reflections of those designing and using the tool are presented here.

Key words:

Assessment, Understanding, LCT, 3D-Learning, Students as partners

Region:

UK/Ireland

100

Developing Online Virtual Laboratory Kit

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Following the onset of the COVID-19 pandemic, virtual versions of a number of the Durham University Level 1 Laboratories were developed during the course of the 2020-21 academic year using LabVIEW, a systems' engineering software [1]. The kit that was developed focuses on some of the circuit laboratories undertaken by students at the start of the module, which have the dual purpose of developing confidence working in a laboratory environment, and to teach good and correct data and error analysis.

Previous work has shown that students show increased confidence and laboratory efficiency having undertaken simulations in advance, and are more likely to ask questions about the science rather than experimental set-up [2]. At Durham, virtual equipment was developed to supplement undergraduate learning, for use either in advance of the practical session or to consolidate learning afterwards, but with the additional goal of providing a more realistic experience for any students who are unable to attend a session due to isolation or online working. As part of the work, Durham students were surveyed to find out which aspects of the practical experiments, earmarked for development into virtual instruments, which they struggled with the most.

The two experiments developed virtually looked DC circuits and AC circuits respectively, with the latter also including making of correct measurements with oscilloscopes. In each case, the virtual experiment followed closely what students would do during an in-person laboratory session, allowing individual sets of measurements to be made. The virtual laboratory kit will be deployed during the 2021-22 academic year, and its effectiveness measured via recording and coding of student interactions, both peer/peer and peer/instructor.

[1] National Instruments (2021) What is Labview? https://www.ni.com/en-gb/shop/labview.html
[2] Blackburn R. et al (2018) Preparing students for Practical Sessions Using Laboratory Simulation Software, Journal of Chemical Education, 96(1) 153 - 158

Key words:

Physics Laboratories; virtual equipment

Region:

UK/Ireland

99

An inquiry-based 'at-home' experiment to maximise the practical experience of undergraduate chemistry students during the COVID-19 pandemic

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Co-authors: Carla Jones [1]; Kayleigh Daglish [1]; Hattie Barrington [1]; John Snaith [1]; Philip Craven [1]

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During the COVID-19 pandemic, universities across the world have been forced to adapt their undergraduate degree courses. This has been particularly challenging with practical STEM subjects such as chemistry. Approaches have included the use of online videos, virtual reality or 'dry' laboratories and the reduction of teaching laboratory capacity to enable social distancing. The reduced ability to host students in undergraduate teaching laboratories presents a large challenge of how to provide them with sufficient practical experience.

At the chemistry department of the University of Birmingham we created and implemented an at-home laboratory experiment for the first-year undergraduate chemistry course. The activity, spanning over 2 weeks, focused on data collection, statistical analysis, inquiry-based learning and project planning. This meant that the limited hours available in the teaching laboratories due to social distancing requirements could be focussed on skills that require specialist equipment. The experiments were designed to only utilise safe household items and any additional necessary equipment was provided.

In the first week of the experiment students explored how sodium chloride solutions of different concentrations affect the germination and growth of cress seeds, and used their data to plot a dose-response curve. The second week of the experiment focused on students working as a group to investigate their own hypothesis based on the results obtained in the first week.
In this poster we describe the design of the practical, the results the students obtained and their feedback for the experiment, while also providing a discussion on how similar activities could be integrated into a standard first-year undergraduate chemistry course.

Key words:

Chemistry, Practical, At-home, Lockdown, Experiment

Region:

UK/Ireland

98

Use of ManyCam in delivering high quality remote laboratory demonstration

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In intensive undergraduate courses marred by Covid-19 the use of technology can aid delivery of effective laboratory demonstrations. Finding innovative ways to deliver laboratory content to a student cohort relying on remote access was a challenge and at the University of Birmingham we employed the use of ManyCam. ManyCam software can be used live in streaming platforms such as Zoom to allow multiple-angle viewpoints of fume cupboards for demonstrations of lab procedures.

The design of our Collaborative Teaching Laboratory's wet lab (opened 2018) ensured every student had a multi-screen computer opposite their fume cupboard – allowing easy delivery of such demonstrations over a networking software such as Zoom whilst still accounting for safe social distancing. By having multiple cameras available our demonstrators were able to highlight key set ups and still talk directly to a camera – creating an early personalised connection with the student body. Overall, the implementation of ManyCam has been very successful and its use will be continued in future years, allowing us to upgrade our demonstrating potential to allow for more detailed briefings clearly observable by all.

Our poster demonstrates the use of ManyCam in conjunction with Zoom to deliver live labcasts during lockdown months to aid students in their understanding of coursework and the use of such software to improve lab demonstrations to students as course practicals were allowed to restart.

Key words:

Remote, Virtual, Demonstrating, Laboratory, Camera

Region:

UK/Ireland

97

How do students prepare for assessment?

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Learning strategies are techniques commonly used when attempting to understand, learn or retain material. Spanning a range of lower and higher order approaches, the learning strategies chosen by students within a single undergraduate cohort can vary significantly [1]. A variety of factors can affect the learning strategies an individual uses, with personal motivations being one such factor [2,3]. For example, for many undergraduate students, assessment and attainment remain two key reasons to engage with and study course material. However, the influence of specific types of assessment task on observed study habits and employed learning strategies is less clear.

Being interested in understanding such relationships, our poster shares preliminary research to probe the learning strategies used by undergraduate chemistry students when preparing for a range of assessment tasks. These include a combination of both traditional and alternative assessment methods (e.g. closed vs open book exams), which have increased in popularity across the higher education sector in response to the need for remote assessment. As presented, our initial analysis highlights that the types of learning strategies reported most commonly by students may indeed vary based upon the nature of the assessment task given to them.

1. Lastusaari, M.; Laakkonen, E.; Murtonen, M. *Chem. Educ. Res. Pract.* **2016**, *17* (4), 723–730.
2. Lynch, D. J.; Trujillo, H. *Int. J. Sci. Math. Educ.* **2011**, *9* (6), 1351–1365.
3. Chan, J. Y. K.; Bauer, C. F. *Chem. Educ. Res. Pract.* **2016**, *17* (4), 675–684.

Key words:

assessment, learning strategies, study habits, undergraduate chemistry

Region:

UK/Ireland

90

RSC Women in Chemistry: Making the Difference

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During the global pandemic, the University of Oxford set up and co-ordinated a multi-institution online open-access project promoting women working in the chemical sciences. The project provides an opportunity for girls aged approx. 10-14 (Upper KS2-KS3 or equivalent) and their supporters to engage in creative and enjoyable practical challenges linked to current chemical sciences research at UK universities. Monthly challenges, research explainers and team profiles have been developed and shared and each institution hosted a number of online live Q&A events to provide opportunities for the girls taking part to engage with the team of females behind the resources. The latter act as role models in terms of academic careers and qualification routes into the chemical sciences and are available to answer questions regarding the research undertaken by the institution and the linked challenge(s).

This poster gives the background to the project, its aims, example resources, and a selection of the responses from both institutional teams and the young people and supporters who engaged with the project. Additionally, conclusions are drawn from the first six months as well as suggestions for future adaptations.

The Universities involved include the University of Oxford, University of Wolverhampton, University of Warwick, University of Durham, Imperial College London, and the University of Bristol.

Key words:

outreach PER diversity women community

Region:

UK/Ireland

88

Bridging the Gap between DT and Physics: Stress Testing Materials

Authors: Andrew Smith[1]; Charlie Murphy[1]; Kate Baxter[1]; Liam Jordan[1]; William Lee[1]

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Design Technology, as a subject in secondary school, has a variety of scientific thinking, content and approaches that are not fully appreciated or successfully linked back to the more 'academic' subjects. As a somewhat early application of engineering at a pre-higher education level there are a significant amount of opportunities to cross link both maths and physics to the practical and, sometimes more exciting, design technology classroom. The poster outlines a workshop and lesson plan specifically designed for a Kent school to use more physics based lesson planning and scientific methods and approaches to engage design technology students in their curricular specified subject matter. This uses common science classroom tactics such as experiment demonstration, practical testing, creating and testing hypothesis' and graphical comparison. All this centred around and linking the key concepts and technical language involved in stress testing material; something which is covered in most design technology and physics national curriculums.

Key words:

Design-technology, workshop, physics, stress-testing, demonstrations

Region:

UK/Ireland

83

Student views of Decolonising the Chemical Sciences Curriculum at Keele University

Author: Katherine Haxton[1]

Co-authors: Iulia Iftimie [1]; Lauren Heskey [1]

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In response to an institutional initiative aimed at Decolonising the Curriculum, a small research project was conducted to obtain the views of undergraduate students in Chemistry and Forensic Sciences (Chemical Sciences). This comprised a short survey and semi-structured interviews. The survey was circulated to all undergraduates in Chemical Sciences and three interviews were conducted.
In our poster we reflect on who is represented by the responses received and how that relates to the broader student population it draws from, and present contextualised analysis of the responses obtained. Analysis of the responses indicate various definitions of what decolonising means and whether it is specific to an education context or has wider implications, how it compares to the broader idea of the inclusive curriculum, and ideas about what should be done to address these issues. While the sample size is small, the impacts of teaching chemical sciences with a 'traditional Eurocentric' view were clearly articulated as were the potential benefits to all students of developing our curricula to be more globally inclusive.

Key words:

Decolonise the curriculum, Chemistry, Forensic Science,

Region:

UK/Ireland

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Survey of Life Science degree students' perception of how disability influences scientific skills

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13-17% of students studying for a Life Science degree at university have a disability. Of these students, about 30% have a learning disability (AdvanceHE 2020). Inclusion across education contexts is critical to acknowledge and inspire the full potential of people with learning disabilities (Gilson, 2020). These group of students are given extra support by the University. However, how effective is this support? To explore this question, a preliminary study was carried out to compare the perception of students on how learning disability influences scientific skills. A survey of university students studying Life Science degrees in the UK was carried out. Analysis of the result was carried out using SPSS with a chi square test comparing the responses of students with a disability to those without a disability.
Of the 32 responses, 34.4% (n=11) acknowledged having a learning disability. The results showed that whether a student has a learning disability significantly contributes to their perception of their competence in scientific skills ($p=0.007$). However, the perception about the skills that students with a disability will be able to execute was not dependent on whether the respondent has a disability ($p>0.05$).
Summary: the outcome of this study brings to question the efficacy of the support for students with learning disability, provided by the University.

Key words:

learning disability support, inclusion, student perception, scientific skills

Region:

UK/Ireland

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Some observations on the use of analogies in teaching of undergraduate physics

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We present a summary of work carried out principally as an undergraduate summer project in July – August 2020 to investigate the use of analogies in physics teaching in the undergraduate course at Imperial College London. As a background, we first compare and contrast methods for classification of analogies and provide literature review highlights relevant to practitioners of university level physics education. We follow this with a summary of a study done on the undergraduate course at Imperial involving scrutiny of physics course materials, surveys on the prevalence and efficacy of analogies with staff and students, and interviews with teaching staff. To summarise and conclude we provide advice, guidance and points for consideration for science communicators on best practice for use of analogies in their work.

Key words:

analogies

Region:

UK/Ireland

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Reviewing the use of bespoke lab skill videos – stage 1 of creating a flipped lab

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With increasing student numbers, limited lab space, and restricted access due to COVID-19, it has been more important than ever to make sure programmes that include core practical modules (such as Chemistry) are maximising the use of the lab time available to them. Inspired by the flipped classroom model, we aim to create a 'flipped lab' where students can use synchronous lab sessions most efficiently by arriving fully prepared (using a combination of pre-lab quizzes, simulations and skill videos). In Summer of 2020, a collection of bespoke skill videos, for use by years 1-3 in the 2020/21 academic year, was created based on student feedback of current resources. Now that these videos have been available to all students for the full academic year, the usage data, as well as staff and student reflections and feedback have been collected to review the effectiveness of the resources and to help direct the next stages of the project.

Key words:

Chemistry Practical Lab Skill Videos

Region:

UK/Ireland

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Team Based Learning: in-person or online collaborative active learning that enhances problem solving skills

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Team Based Learning (TBL) is a structured, small group, collaborative form of learning where learners combine their knowledge to solve problems. TBL has been found to be highly effective at facilitating active learning as learners are required to prepare in advance of sessions and discuss potential solutions to problems with their peers. Despite being relatively underused in the physical sciences, at Keele we have embedded TBL into our chemistry teaching at all levels.[1] The move online during the Covid pandemic has shown that the highly structured set-up, the pre-class preparation and instant feedback mechanisms, as well as the small group peer discussions make TBL an excellent active learning format for online learning. This was facilitated by the introduction of a new free to use online scratchcard, developed at Keele, which can be simply integrated into learning platforms. Both staff and students have found TBL to be an effective way of promoting active collaborative learning, leading to enhanced problem-solving skills.

https://www.keele.ac.uk/tbl/

Key words:

TBL, active learning, online education, problem-solving

Region:

UK/Ireland

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A student-led approach to introducing the principles of Green Chemistry into undergraduate lab classes.

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Reducing our environmental impact and increasing sustainability are of ever increasing concern to society and these ideals are also important to many of our students. The principles of Green Chemistry1 provide guidance on how to make chemical processes more environmentally friendly and embedding these principles into undergraduate teaching will raise student awareness of how we can continue to make a positive difference in the area of Chemistry and related subjects. Undergraduate practical classes present a great opportunity in which to demonstrate changes that can be made in small scale experiments to reduce environmental impact. Before changes can be made, however, we need to assess the impact of our current experiments and identify areas where small changes could improve overall sustainability, whilst still teaching students the key skills required for practical chemistry. We are currently undertaking a student-led project in which a Reading University summer student performs their own research, supported by academics, with the aim of developing a method by which we can assess our current impact and suggest changes that can be made to make our lab classes align more closely with green chemistry principles. Materials such as infographics and posters will be produced with the aim of introducing students to green principles and bringing awareness of what we as chemists can do to move towards a more sustainable future.

1. 12 Principles of Green Chemistry, https://www.acs.org/content/acs/en/greenchemistry/principles/12-principles-of-green-chemistry.html, (accessed June 2021).

Key words:

Green Chemistry, organic chemistry, Undergraduate laboratory course, student-project, environment.

Region:

UK/Ireland

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How student confidence has been impacted by online learning in a first-year undergraduate Chemistry course.

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Since its emergence and spread across the globe, COVID-19 is continuing to impact higher education. As instructors, it has forced us to adapt, to accommodate national lockdown restrictions and diversify the way teaching can engage students. This has meant that the inclusion of online teaching methods and tools into undergraduate Chemistry modules has been necessary for content delivery and student engagement. The research presented in this poster looks at how first-year students' confidence has been impacted by the new module designs of an undergraduate Chemistry course which incorporates asynchronous lecture videos supported by synchronous workshop sessions, with a particular focus on the first semester Organic Chemistry module. In order to probe how student confidence has progressed, data was collected at different points throughout the academic year. This involved a survey looking at how students rated the importance of the online methods implemented and how comfortable they were with using them at the start of the academic year, a questionnaire on student confidence in Organic Chemistry topics at the end of the first semester, and an in-depth focus group with students nearing the end of the academic year. Through the lens of student confidence, we can see that more focus is needed on helping students consolidate their knowledge and understanding, and that working in an online environment has led students to favour asynchronous tools over synchronous sessions.

Key words:

Online Learning, Confidence, Undergraduate Chemistry

Region:

UK/Ireland

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Taking Teamwork Online: A tale of two assessment items

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Our medicinal chemistry teaching involves two team-based assessment items: a Drug Design Exercise (level 5) and Drug Action Presentations (level 6). This poster explores how we adapted and delivered these in an online only environment during the COVID-19 era of 2020-21.

We discuss the decisions involved in which elements of teamwork to maintain, the practicalities of moving online, and modifications to the assessment to ensure the main learning outcomes were maintained (or improved) despite restrictions. We describe how gamification (Top Trumps) was used to improve engagement with online presentations and how we introduced reflective analysis into assessment items to prevent freeloading.

We evaluate the new approaches introduced this year, commenting on additional observed benefits including consolidation of learning and a deeper appreciation of the context of individual topics in our students, and identify aspects that we will now incorporate into our assessment of our modules long term.

Key words:

Teamwork, Assessment, Online, Reflections, Top-Trumps

Region:

UK/Ireland

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Approaches to introductory coding in undergraduate physics degrees

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Coding has become a highly sought-after skill in STEM careers over recent decades [1]. Consequently, the Institute of Physics recommends that undergraduate physics students enhance IT skills, such as coding and becoming familiar with a programming package [2]. While some undergraduate students will have encountered coding during their secondary school education, for many students, their first experience with coding often occurs in their first years at university [3]. The research study explored the opinions of pre-honours level physics students regarding the coding tasks they undertake as part of their laboratory sessions at the University of Glasgow. By accumulating data through the use of surveys and a focus group, information relating to the difficulties that students face whilst learning to code, as well as suggestions for future teaching methods were able to be identified and analysed. The main difficulties that students encountered were understanding the coding language, writing syntactically correct code and correcting errors. Students without prior coding experience were subjected to these difficulties more than their peers with experience. Furthermore, second year students expressed that their experience of coding in Year 1 had not prepared them well for Year 2. It was therefore found that a more comprehensive introduction to the basic concepts of coding should be provided in first year, with no prior coding knowledge assumed. Additionally, students found that there was a lack of formal teaching which could be mitigated by introducing coding lectures to the physics courses. Likewise, students expressed a need for more guidance by means of coding demonstrations and tutorials.

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[1] Aho K et al 2014 Introducing programming into the physics curriculum at Haverhill High School using the R Language *Proc. Am. Soc. Eng. Educ.* (Bridgeport, April 2014)
[2] Institue of Physics, 2011. The Physics Degree: Graduate Skills Base and the Core of Physics. [online] Iop.org. Available at: https://www.iop.org/sites/default/files/2019-10/the-physics-degree.pdf
[3] Martin R F 2016 Undergraduate computational physics education: uneven history and promising future *J. Phys. : Conf. Ser.* **759** 012005

Key words:

Introductory coding, Barriers, Pedagogy, Undergraduate physics, Python

Region:

UK/Ireland

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Belonging and Engagement for a Successful Transition to Higher Education

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Belonging and Engagement for a successful Transition to higher education, was a final year undergraduate physics project carried out at the University of Glasgow. This study aimed to identify factors impacting a student's sense of belonging and engagement as they transition to higher education, as well as emphasizing any common trends identified from students. For undergraduate students, one of the most crucial points in their journey through higher education is a successful transition (Parker et al., 2017, Strayhorn, 2012). The transition period for students occurs in their first few weeks as they are adjusting to the new and different world of higher education. Studies have shown that most students who leave higher education early do so at the beginning of their course (Thomas et al., 2017) as well as indicating that students that do not have a successful transition are more likely to drop out of higher education than their peers who had successfully adapted to university life (Kantanis, 2000, McInnis et al., 2000). This highlights the importance of a successful transition and making it a crux of higher education (Thomas et al., 2017). Data was obtained via questionnaires distributed to two different first-year physics cohorts over two consecutive years. Each cohort received one survey in the first few weeks of their transition period and another at the end of their first semester. An additional survey was also issued to second-year students with the aim of identifying any changes in their belonging and engagement since their first year. The key findings from the study performed at the University of Glasgow included that female students initially entered higher education with lower self-confidence in their academic abilities than their male peers. Additionally, social integration and students' relationship with staff were highlighted as crucial factors during students transition period.

Kantanis, T., 2000. The role of social transition in students': adjustment to the first-year of university. Journal of Institutional Research, 9(1), pp.100-110.
McInnis, C., James, R. and Hartley, R., 2000. Trends in the first year experience: In Australian universities.
Parker H, Hughes A, Marsh C, Ahmed S, Cannon J, Taylor-Steeds E, Jones L and Page
N 2017 Understanding the different challenges facing students in transitioning to university particularly with a focus on ethnicity

Key words:

Belonging, Engagement, Transition

Region:

UK/Ireland

61

A peer-mentoring programme for all students: PANDA

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PANDA is a new peer mentoring programme established at the start of the 2020 academic year for all students in the School of Physics and Astronomy at the University of Glasgow. In this scheme, current students from Level 2 or above are matched up to new students to mentor, buddy-up with, or otherwise provide an additional layer of pastoral support to them. All new students who are

either entering 1st/2nd year as undergraduates or entering one of the School's taught postgraduate degree programmes are welcome to join. A mentoring scheme will help mentors develop their communication, coaching and leadership skills and self-confidence – all important personal assets for employability. Mentors may build long-lasting networks with other mentors and mentees. This mentoring scheme will also help mentees in their transition to studying at university and develop their self-confidence. It helps to alleviate stress and fears, increase the sense of belonging to our community, and build relationships. Finally, it fosters a sense of belonging in our department, enhances the development of a solid community spirit, facilitates sharing knowledge and experience across academic years, and strengthens the mental wellbeing of our students. While the benefits of a peer mentoring programme are numerous for mentors, mentees, and for the department, the circumstances of this academic year made the need for such a programme even more obvious and urgent than before. More than 100 students chose to take part at the start of the academic year. In this presentation I will describe how the programme was set up, with a focus on good practice that can be shared across disciplines, and I'll discuss the first impressions after less than a year. Is it working? What do our students say? How will we be taking this further?

Key words:

Mentoring; Transitions; Students wellbeing; Peer-to-peer; Personal development

Region:

UK/Ireland

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Multimedia design in chemistry teacher training – a new teaching concept on evaluating one's own teaching material trough eye-tracking

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In chemistry and science in general, instructions are often presented with multiple external representations, such as texts and pictures in static or dynamic ways. Several well-established theories, for example, the Cognitive Theory of Multimedia Learning (Mayer, 2009), the Cognitive Load Theory (Chandler & Sweller, 1991), or the Design-Functions-Tasks Framework (Ainsworth, 2006) help designing learning and teaching materials, arranging multimedia elements in terms of coherence, highlighting, contiguity, and minimizing extraneous processing (Mayer, 2009). Multiple design principles for learning materials have been confirmed by eye-tracking data (Desjarlais, 2017; Alemdag & Cagiltay, 2018) and are often taught as guidelines to design instructional materials in student teacher training courses – however, they can only be limitedly verified by students. In order to put student teachers in the position of testing their own teaching materials, a new course was developed in which the student teachers use eye-tracking to determine the effects of differently designed learning materials on the learner's perception.
Within the context of a small empirical study, the seminar participants first design tasks with and without respecting multimedia design principles. Afterwards they track the eye movements of learners during problem solving and analyze the attention, perception and strategy when working with these learning materials in order to reflect on the design principle and the usability of the designed teaching material.
First experiences and evaluations of the seminar are presented and implications for teaching are discussed.

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Desjarlais M., (2017), The Use of Eye-gaze to Understand Multimedia Learning, in Eye-Tracking Technology Applications in Educational Research, Was C., Sansosti F., and Morris B. (eds.) Advances in Educational Technologies and Instructional Design. IGI Global.
Mayer R. E., (2009), Multimedia Learning, 2nd ed. Cambridge University Press.

Key words:

Chemistry Education, Higher Education, Teacher training, Multimedia Learning, Eye-Tracking

Region:

Other part of world