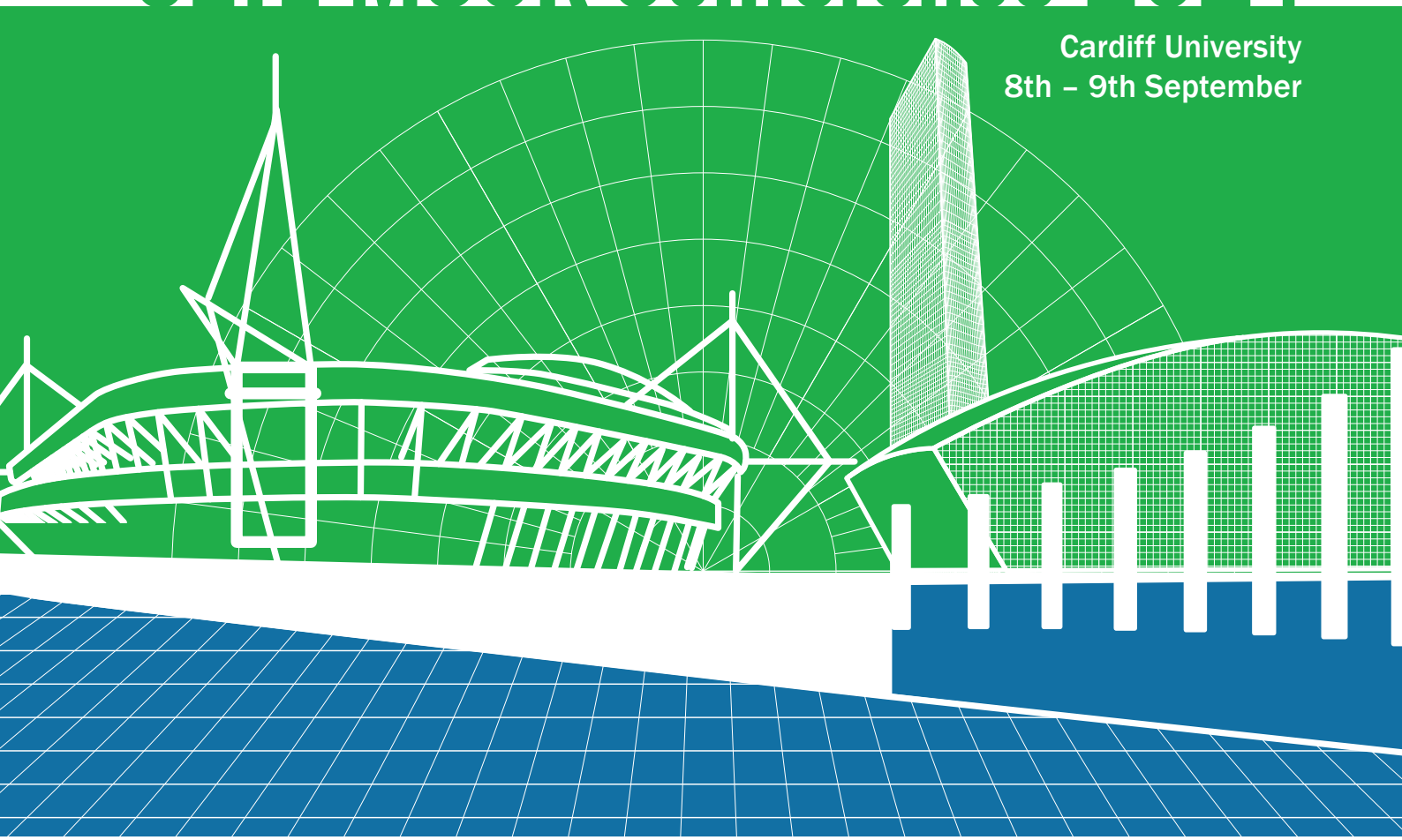
CETL-MSOR Conference 2014

Cardiff University
8th – 9th September



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The Higher Education Academy STEM

Contents

Organising Committee and Sponsors

CETL-MSOR 2014 Organising Committee

- Tony Croft – Loughborough University
- Daryl Davies – University of Birmingham
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- Duncan Lawson – Newman University
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- Alun Owen – Loughborough University
- Moira Petrie – Loughborough University
- Rob Wilson – Cardiff University

The Organising Committee would like to thank our sponsors:

Day 1 – Monday 8th September				
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	An update on statstutor and the statstutor communities project – Alun Owen & Janette Matthews *(35)*	**Enhancing learning of mathematics using screencasts** – Dr Helen Busby *(36)*	**The effect of an online adaptive learning maths tool on Access to Science & Engineering students** – Dr Anthony Cronin *(37)*	**Traditional lectures with 21st century students** – Ruth Fairclough *(38)*
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Day 2 – Tuesday 9th September

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	'Getting a grip on mathematical symbolism' – the Loughborough MOOC experience – Janette Matthews *(47)*		**Gender equality in mathematics support** – Eabhnat Ní Fhloinn, Olivia Fitzmaurice, Ciarán Mac an Bhaird & Ciarán O'Sullivan *(48)*	**What is the value of mathematics?: Encouraging meaningful participation in mathematics for engineering courses** – Paul Hernandez-Martinez & Merilyn Goos *(49)*
11.45 – 13.00	**Keynote Session I – Staff–Student Partnerships in Teaching and Learning: Hearing from the students themselves! – Morgan Evans, Kingsley Webster, Tom Hobson, Matt Wheatley, Brodie Burton, Gemma Clarke & Hannah Bartholomew** *(13)*			
13.00 – 14.00	Lunch, Posters and Exhibitions			
14.00 – 15.30	**Parallel Session V**			
	S1.22	**S1.23**	**S1.24**	
	Understanding mathematics in a chemistry context: Just what is the problem? – Samantha Pugh & Michael Grove *(50)*	**APP-lying mathematics – developing interesting digital content to support student learning** – Richard Lissaman & Stephen Lee *(51)*	**The IMA is 50 – IT enabled student engagement is key to the next 50** – Sam Kamperis *(52)*	
	Back to basics – helping learners overcome their fear of numerical reasoning tests – Eleanor Lingham & Ann Baughan *(53)*	**Individualised formative worksheets to encourage small group discussion of method** – Peter Rowlett *(54)*	**Face-to-face interaction: All creatures great and small** – Sarah Parsons *(55)*	
	Helping BTEC students to prepare for university: mathematics-based activities for non-mathematics students – Emma Cliffe, Cheryl Voake-Jones, Luis Rodriguez & Jane White *(56)*	**Using technology in module delivery of mathematics** – Dr Alison Hooper, Dr Rhys Gwynllyw & Dr Karen Henderson *(57)*	**The secret's in the mix: using OR and technology to enable organisational change** – Professor Jo Smedley *(58)*	
15.35 – 16.00	**Closing Plenary – led by Joseph Kyle**			
16.00	Close & Depart (Tea/Coffee available)			

For more details on each session please see the abstracts section of this booklet (page number in brackets) Abstracts are listed in session date/time order.

Plan Your Personal Conference Timetable

Day 1 – Monday 8th September		
09.30 – 10.00	Registration and Tea/Coffee	
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11.30 – 12.30	**Session**	**Room**
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15.35 – 16.00	**Closing Plenary – led by Joseph Kyle – Room S1.32 (MLT)**	
16.00	Close & Depart (Tea/Coffee available)	

Day 1 – Conference Welcome

Dr Rob Wilson

Director of Learning and Teaching, Cardiff School of Mathematics, Cardiff University

Professor Amanda Coffey

Head of Social Sciences, Cardiff University

Day 1 – Conference Welcome (10.00)

Professor Amanda Coffey is currently the Head of Social Sciences, having previously held the post of Dean for Education and Students for the College of Arts, Humanities and Social Sciences. Prior to that, she was the Deputy Director (with responsibility for teaching and learning) in the School of Social Sciences. Amanda was the Director of the Cardiff Node of the ESRC National Centre for Research Methods (NCRM) *Qualitative Research Methods in the Social Sciences: Innovation, Integration and Impact* (http://www.cardiff.ac.uk/socsi/qualiti/) (2005-8) and a founding co-director of the Wales Institute for Social and Economic Research, Data and Methods. She was elected as as Academician of the Academy of Social Sciences in 2011.

Amanda joined Cardiff University in 1990 and has been a Professor in the Cardiff School of Social Sciences since 2006.

Day 1 – Keynote Speaker

Colin Jones

University of Tasmania

Beyond pedagogy content knowledge: Retrofitting heutagogy to mathematics

Day 1 – Keynote Speaker I (10.25-11.25)

Mathematics and science education more generally have been the leaders in the development of pedagogical content knowledge, or the identification and application of domain specific knowledgable. In this talk I intend to provocatively challenge everyone to reflect upon what it is they do as an educator. Further, to contemplate upon what is it our students do as learners. Finally, to reflect upon what we shouldn't be doing as educators, and therefore, what our learners shouldn't be doing as learners. The aim is to see if we can collectively redefine the respective roles we as educators vis-a-vis our underlying expectations of the learners we engage with. Such a realignment of roles would lead us towards the development of academagogy, or scholarly leading. Thus, it will be argued that we must do more than become content experts, we must also embrace an equal consideration for context and change. We must account for the context of our students' learning and the actual nature of cognitive change we are trying to assist.

Colin Jones has developed the current entrepreneurship program at the University of Tasmania. He has been recognised nationally and internationally for his research and teaching and learning achievements. He has published more than 80 peer-reviewed journal and conference papers and published two research monographs 'Teaching Entrepreneurship to Undergraduates' and 'Teaching Entrepreneurship to Postgraduates'. Colin has contributed to several United Nations initiatives related to entrepreneurship education as an expert in his field. He is a current member of the global think tank at the World Entrepreneurship Forum and regularly acts as a consultant to government and private organisations seeking to creatively solve problems and exploit emergent opportunities. One of his current research interest relates to the relationship between pedagogy, andragogy and heutagogy, the focus of this talk.

Colin's twitter handle says that he is an entrepreneurship educator and reformed failure who is practising the art of perpetual failure so that he might one day succeed. Colin will share with you his lifelong failure at mathematics, quantifying his foundations to demonstrate his qualifications to speak on this topic that he remains utterly confused by.

Day 1 – Keynote Speaker

Professor Dame Celia Hoyles DBE

Institute of Education

The potential and challenges for mathematics teaching & learning in the digital age

Day 1 – Keynote Speaker II (13.30-14.30)

There is widespread acceptance that mathematics is important, even vital, for an individual and for society. Those who disagree tend to argue that the subject is boring and irrelevant. It is therefore crucial that mathematics teaching strives to engage all learners at all levels, but without sacrificing the rigour of the subject. In this talk, I will argue that one way to achieve both rigour and broader access to mathematics lies with using appropriately designed digital technology.

Celia Hoyles has been Professor of Mathematics Education at the Institute of Education, University of London since 1984, following teaching in London secondary schools. She was awarded a first class honours degree in mathematics from the University of Manchester and holds a masters and doctorate in mathematics education. She was the U.K. Government's Chief Adviser for Mathematics, 2004- 7, and the Director of the National Centre for Excellence in the Teaching of Mathematics, 2007-13. She was the first recipient of the Royal Society Kavli Education Medal in 2011 and was awarded an OBE also in that year. In 2014, she was made a Dame Commander of the Order of the British Empire.

Day 2 – Keynote Speaker

Professor Paul Harper

Cardiff University

Maths saves lives!

Day 2 – Keynote Speaker III (09.15-10.15)

A recent paper by Freeman *et al* (2014) "Active Learning Increases Student Performance in Science, Engineering and Mathematics" evidences the benefits of active student learning as opposed to traditional lectures. To quote from the paper "Active learning engages students in the process of learning through activities and/or discussion in class, as opposed to passively listening to an expert. It emphasizes higher-order thinking and often involves group work".

This certainly resonates with my own experiences, as both a student and teacher, and in this talk I will describe the ways in which I am trying to provide active learning opportunities, especially on the MSc programmes on which I teach and have overall responsibility for. One particular module is healthcare modelling where the students seem to particularly enjoy and benefit from group activities, visiting speakers from the health service, and case studies that stimulate discussion and engage students by allowing them to observe how mathematical principles may be applied in real-life situations.

Certainly the healthcare modeling research of the OR group here in Cardiff is making an impact in the real-world, and is literally helping to save lives; and now perhaps we can also claim helping to save students' lives by encouraging higher-order thinking!

Paul is Professor of Operational Research and Deputy Head of the School of Mathematics, Cardiff University. He is also Director of the Health Modelling Centre Cymru (hmc2), a pan-Wales centre for modelling in healthcare, Director of Engagement for Mathematics, and Director of MSc programmes in OR, Applied Statistics and Risk. His research interests are primarily in mathematical modelling and stochastic methods applied to healthcare systems, and Paul has been an investigator on in excess of £5m of funding from various research councils and direct from the health service. More recently Paul was appointed as an Editor for the journal *Health Systems* (Palgrave Macmillan).

Paul is particularly passionate about mentoring and working with early career researchers (PhD students, Post-Doctoral Researchers and Lecturers), and for the MSc programmes in OR and Statistics which he helped to establish several years ago.

www.profpaulharper.com

Day 2 – Keynote Session

Morgan Evans[1], Kingsley Webster[2], Tom Hobson[3], Matt Wheatley[3], Brodie Burton[3], Gemma Clarke[3] and Hannah Bartholomew[3]

[1]University of Bath, [2]Nottingham Trent University and [3]Sheffield Hallam University

Staff – Student Partnerships in Teaching and Learning: Hearing from the students themselves!

Day 2 – Keynote Session I (11.45-13.00)

Building on the success of last year's student-led keynote session, students from the universities of Bath, Nottingham Trent and Sheffield Hallam, who have been working with staff on a wide range of teaching and learning projects, will describe aspects of their work, its outcomes and the personal benefits for them of engaging with staff in this way.

This session is likely to be of interest to all delegates as it sheds light on the value and potential of staff-student partnerships, but particularly for those who are interested in exploring ways in which they too might take this strategic agenda forward for the benefit of all students.

Day 1 – Parallel I

Dr Iain Weir, Dr Rhys Gwynllyw and Dr Karen Henderson

University of the West of England

An innovative use of technology to aid the service teaching and assessment of statistics to a large cohort

Day 1 – Parallel I (11.30-12.00)

We report on our experiences of and innovations used in the teaching and assessing of statistics within a new Level 2 research skills module delivered to over 650 Business School students. The module contains a short course on statistics covering a challenging amount of material together with learning to use SPSS, and is designed to provide a solid foundation for students to undertake Level 3 project work. The statistics assessment comprised a contribution from each computer lab to a Learning Journal and two e-Assessments.

Lectures delivered the material in the provided notes but without reference to the sections containing use of SPSS to gain the presented output. Prior to the ensuing computer lab students performed preparation tasks requiring them to recreate the SPSS output for the examples in the notes. They were supported through access to a suite of videos, which enabled students to self learn SPSS output creation and allowed staff to concentrate in labs on giving statistical understanding and interpretation advice.

In each computer lab students were given a set of questions that covered various data outcome scenarios. The first question was designated for the student's Learning Journal.

For each Learning Journal question a pre-written complete analysis template was provided that had the SPSS output removed, numerical values blanked out and inserted multiple choice interpretation decisions to make. Setting it up in this way enabled students to concentrate on the mechanics of the creation of output and interpretation of results.

We present the first e-Assessment which concerns the data dependent choice of the application of either the oneway ANOVA or Kruskal-Wallis test. The e-Assessment system used was DEWIS as it can communicate with the R statistical package which was employed to generate bespoke student data and generate answers that would match SPSS screen output; implement continuation marking for a large number of inputs; run staged assessments; provide dynamic feedback specific to student inputs.

The e-Assessment is in three stages which relate to the three activities that are required when performing the analysis. Each student downloads their unique Excel data file via DEWIS that needs to be transferred and coded into the format required in SPSS; Stage 1 checks this has been achieved correctly. Students may enter this stage as many times as they like, but they will not be allowed to proceed to Stage 2 until they have successfully completed this task. Stage 2 involves exploratory data analysis including ANOVA assumption testing. At the end of this stage students are asked which test they should employ for the main analysis in Stage 3. If they choose the wrong test they are told so and the test continues requiring them to use the correct test in Stage 3.

Results have been excellent. Teaching and assessing in this way has made the challenging task of delivering and assessing this material in a short space of time achievable. The fact that students can refer to their Learning Journals and access "how-to" SPSS videos will be beneficial to their further studies.

Day 1 – Parallel I

Dr David I Graham

Plymouth University

Fluid Dynamics Blogs

Day 1 – Parallel I (11.30-12.00)

This paper reports on the use of blogging as a means of assessing coursework in a final-year module in Fluid Dynamics. The blog has been used as an alternative to traditional coursework assessment with three main aims in mind: firstly to develop timely engagement with the module and weekly exercises; secondly to get students to reflect upon their studies in the subject and thirdly to encourage students to read around the subject. The emphasis is upon assessing how students go about studying rather than their grasp of the technical details. The paper will report upon the implementation and modification of the blog and outcomes from the first two years of the scheme.

Day 1 – Parallel I

Mary McAlinden

The Higher Education Academy

The Higher Education Academy STEM project: Skills in Mathematics and Statistics in the disciplines and tackling transition

Day 1 – Parallel I (11.30-12.00)

Skills in Mathematics and Statistics play an important role in many disciplines. The Higher Education Academy (HEA) STEM project sought to provide a strong evidence base to inform dialogue between the higher education and the pre-university secondary sectors about the requirements for mathematical and statistical skills in undergraduate degree programmes across a range of discipline areas. The disciplines considered in the project include: Chemistry, Business and Management, Economics, Geography, Psychology and Sociology. A particular focus of the work was on the transition into higher education study in these disciplines.

This presentation will describe the methods used in the project and provide information on key finding and recommendations.

Day 1 – Parallel I

Rhys Jones

Cardiff University

Creation of a new A level in Social Analytics for Wales

Day 1 – Parallel I (11.30-12.00)

Q-Step is a £19.5 million programme designed to promote a step-change in quantitative social science training in the UK. Q-Step was developed as a strategic response to the shortage of quantitatively-skilled social science graduates. Stronger links between Higher Education Institutes and FE colleges/secondary schools will enable Pre University students to realise the value in applying for new and exciting undergraduate programmes, to be developed and delivered at the Q step centres. The resulting expertise and resources will be shared across the higher education sector through an accompanying support programme which will also forge links with schools and employers (Nuffield Foundation 2014).

The Q step Centre for Excellence in Quantitative Methods is based in the Cardiff School of Social Sciences (SOCSI). In the past four years the School has made significant investments to develop the quality of undergraduate skills in quantitative methods. This centre will consolidate and significantly develop this work and enable Cardiff to be a leading centre of quantitative pedagogy.

A major strand of the Cardiff Q step centre work will focus on the development of a new A' level in Social Analytics. This new advanced level course will encompass learning outcomes of statistical thinking and analysis to explain various social phenomena such as, for example, health inequalities, differential educational attainment and achievement and the role of religion in society. This new A' level course is scheduled to be launched in September 2016.

The development of an A' level qualification in Social Analytics will be in partnership with schools and colleges in South Wales, the Welsh Joint Education Committee and the Royal Statistical Society Centre for Statistical Education. Students who complete the new qualification will be encouraged to apply for the BSc Social Analytics in September 2018, although the new degree course will enrol its first cohort and launch in September 2015 at Cardiff University's School of Social Sciences. This new and innovative undergraduate programme will build upon and augment the content delivered throughout the A' level in Social Analytics.

On a national level, standards of numeracy in Wales are a cause for concern, with 51% of 16-19 year olds having numeracy skills that are at or below entry level (WG, 2011). These worrying levels place Wales at the bottom of countries within the UK, suggesting current initiatives are inadequate to address these poor levels of mathematical skills (Tanner and Jones, 2013). The development of an A' level in Social Analytics will aid in addressing the numeracy deficit in Wales, fostering the development of statistical thinking to tackle sociological problems that exist within society

It is hoped these initiatives and stakeholder collaboration within the Cardiff University Q step centre will help to address the deficit not only in quantitative social scientists within the UK, but will expand to tackle and ameliorate the poor numeracy standards identified within Wales.

References

Nuffield Foundation (2014). Available from: http://www.nuffieldfoundation.org/q-step. Accessed on: 14/04/2014.

Tanner, H., and Jones, S. (2013). Developing Mathematical Literacy in Welsh Secondary Schools. University of Wales Journal of Education; 16: 21-26.

WG (2011). Welsh Government – National Survey of Adult Skills. Available from: http://wales.gov.uk/statistics-and-research/national-survey-adult-skills/?lang=en. Accessed on: 14/04/2014.

Day 1 – Parallel I

Larry Krause

London South Bank University

Back To Basics! The lasting value of face-to-face interaction

Day 1 – Parallel I (12.00-12.30)

In 1996 Dr Sue Starkings began a Student Maths Support Service at London South Bank University (LSBU) with herself as the only tutor and in a remote location detached from the main part of the university's campus. The aim was to help students with lower mathematical/ statistical knowledge comprehend the subject to the levels required for success in Higher Education. The service grew organically to be taught now by the Maths Support Team of three part time staff that she developed, moulded and enthused with an ability to conduct face-to-face tutorials both individually and with cohort size classes.

The valuable work of the service at LSBU will be illustrated through a case study of a young homeless person, Tony (not his real name) who, through intensive support, and attending face-to-face tutorials on an almost daily basis, eventually achieved his goal, graduating and now working in Product Design.

Over the years there have been hundreds of Tony's and the face-to-face maths interaction they received at LSBU improved their lives making a difference by being different, giving students who want to turn their lives around through the gaining of a better education the opportunity to do it through face-to-face support tuition and the development of conceptual understanding. From Tony who was homeless to asylum seekers seeking a better life away from persecution and single parents wanting to give their family a better future LSBU's Maths Support Service, https://my.lsbu.ac.uk/page/maths-support, continues to help change those willing to help themselves.

The service Sue began was often observed by other HE Institutions determined to instigate their own support service for many of the same reasons; the service she began still exists, it is still very much needed. The epistemology is simple; everyone likes a personal service – teaching face-to face is giving students what we would all like – teaching with the adaptability and ability to make it personal. What this presentation will attempt to convey is a brief outline of the face-to-face maths support available to LSBU students.

Footnote:
Sue Starkings has now retired from teaching at university level to teach a different cohort of students as she is now the Reverend Sue Starkings, a fully ordained priest in the Church of England.

Day 1 – Parallel I

Dr Nicola Wilkin

University of Birmingham

Revolutionising mathematics examples classes: from demonstrator to facilitator

Day 1 – Parallel I (12.00-12.30)

First year mathematics is a cornerstone double module within Physics degrees. A deep understanding of the concepts and techniques presented is a key to success in all the physics modules.

It is run, at the University of Birmingham, as a combination of lectures (200+ students) and examples classes, where the students work on problem-based learning. The lectures are delivered, by student preference, on the visualiser and blackboard.

At last year's end of session feedback session students expressed dissatisfaction with the compulsory examples classes associated with the module. Non-attendance correlates strongly with poor attainment in examinations.

Students arrive with very good grades (typically an A* or, at worst, an A in A-level Mathematics, and often in Further Mathematics). However, despite this success, they have taken a wide range of possible modules within A-level Mathematics which vary in their utility in preparation for University physics.

They will all have been top (or close to top) of their cohort pre-University, thus some find it difficult to acknowledge that they would benefit from help compared to their University peers.

Discussion with the demonstrators indicated that they found it hard to prise questions out of the students, which were often improperly associated with the assessed questions.

Concluding that the issue was a lack of constructive dialogue, I decided to change the tenor of the examples class. The question style was altered to one that required group discussion (2-4 people ideally) and input from a demonstrator. (Based on the premise that a group asking for help would feel less intimidating.)

This talk will explain the effectiveness of the new style sessions, as evidenced by the results of a questionnaire for both undergraduates and demonstrators. Fine-tuning will occur in response – but it is clear this is a major improvement to our mathematics delivery within the School.

Day 1 – Parallel I

Shazia Ahmed and Sarah Honeychurch

University of Glasgow

Providing academic support and improving transition into university life through Facebook groups

Day 1 – Parallel I (12.00-12.30)

In this talk we will present an overview of the initiatives undertaken within the Student Learning Service (SLS) in order to ease transition into the numerate disciplines at the University of Glasgow. We will discuss how we make use of social networking tools in order to communicate with students and support virtual Peer Assisted Learning type activities. In particular, we will show how we are using Facebook groups as a mechanism for students to support each other both academically and socially, and explain how we have introduced pre-entry support and offered advice for new entrants in the College of Science & Engineering using these groups.

We will also discuss how our real and online groups complement each other: for example we have a thriving SLS knitting group which meets weekly and has a lively Facebook group, and we host regular mathematical film showings which we advertise by setting up Facebook events and sharing them via our Maths Facebook groups.

We will end by giving examples of student comments and feedback, and outlining our plans for the future.

This session will be co-presented by Caelum Davies, a student at Glasgow University who has first hand experience of these groups.

Day 1 – Parallel I

Paul Wilson and Ruth Fairclough

University of Wolverhampton

Reflections on introducing mature students to mathematics

Day 1 – Parallel I (12.00-12.30)

Over the years I have had great experience teaching both mathematics and statistics to "mature students". In particular, from 2000 - 2010, I was involved in the development and delivery of a "Foundation" Mathematics course aimed at people who were considering entering NUI, Galway, in the Republic of Ireland, as mature students to study for degrees in either science or engineering subjects. This course was a tremendous success, and is still running. In the region of 350 people who came through the course a have since graduated with degrees in Science or Engineering, a few students having completed PhD's. Many of the reasons for the success of the course are surprising. These include such things as recruitment of students not being the prime objective, and the level of the course going far beyond the "basic maths" of many such courses - topics covered included basic to mid-level differentiation, integration, matrices, trigonometry and complex numbers. Over the years that I was involved in the course, the style of delivery evolved from being totally "chalk and talk" based at the start, to incorporating increased use of the virtual learning environment "blackboard", and towards the end of my involvement technology based techniques such as "clickers" and "Camtasia" videos, the latter being especially popular.

We will explore what made the course so successful, as well as analysing the course objectives and content. We will reflect upon issues pertinent to teaching "mature" students: they have a fear of mathematics, they tend to look at what they can't do rather than what they can, they ask lots of questions, they expect you know everything, and consider how these traits may be used to advantage.

Day 1 – Parallel II

Dr. Mark Feltham

Liverpool John Moores University

Doing statistics differently: creative learning with Facebook

Day 1 – Parallel II (14.35-15.05)

I teach a year-long, first year undergraduate module (Fundamentals of Scientific Research) across six programmes in the School of Natural Sciences & Psychology at LJMU. A large part of this module comprises learning about statistics, something that students have in the past found exceptionally 'dry' and difficult to understand. The diversity of programmes and learning styles this module needs to cater for and its timetabled slot of 9am on a Monday morning presents unique challenges regards stimulating students' curiosity and interest in ways which inspire a commitment to learning. To overcome this, the module design enables students to choose how, when and where they study by picking one of two entirely different modes of study: didactic ('traditional' lectures, workshops) and creative (social media, creative projects). Students study via both modes in semester 1, and choose one to pursue exclusively in semester 2 (see below). Not only is this approach so easy to do, but it's also great fun! Here's how it works.

Semester 1 - students alternate between weekly lectures followed by either (a) SPSS workshops or (b) problem-based learning in closed Facebook groups. SPSS workshops comprise traditional exercises, support and feedback. The social media work, however, is quite different. Every fortnight I post a TASKPROD (a fun creative learning activity) that is designed to encourage students to solve problems as imaginatively as they wish. Students then post up their respective solutions to their Facebook groups in whatever format they like (files, images, videos) using whatever devices they like (phones, tablets, laptops, PCs) and at any time they like (day or night). The key thing is for them to be able to demonstrate their learning how and when THEY want to (…uploading photos of their work from their mobile phones is popular). I answer any questions they have during the task and give them feedback on their work by liking / commenting / personal messaging / or podcasting.

Semester 2 - students choose either a 'traditional' learning path of timetabled lectures, workshops and phased individual assessment or a creative learning path mediated entirely through Facebook. 'Creatives' are required to meet exactly the same learning outcomes as the Didactics but are NOT required to attend any timetabled classes (everything is done on Facebook at times that suit them), can work on their own or in groups of 2-5 and can demonstrate their learning in whatever way they wish through one of six Creative Projects. This year these were: (1) produce a stats guide (2) produce a stats Video guide (3) generate and analyse data by building and testing a Rube Goldberg Machine or (4) an ornithopter or (5) carry out DIY experiments or (6) collect their own observational data. Students post up progress on their creative projects as they go along and all Q&A and feedback takes place on Facebook. The final assessment is submitted online and the students' work showcased at a Stats Expo in which prizes are awarded for the best work.

Day 1 – Parallel II

Paul Rice and Rob Farmer

University of Northampton

Tell me what you want, what you really really want

Day 1 – Parallel II (14.35-15.05)

Open Educational Resources (OERs) are becoming a prominent tool to raise the profile of universities. Millions of pounds are being invested in Higher Education to enhance the quality of resources (Nikoi et al., 2011). However, it is debatable if this time and money is well spent (Littlejohn *et al.*, 2008). It takes time for academics to learn the necessary skills to produce OERs, but are these fit for purpose from a students' perspective? Richter et al., (2012, p.171) have argued that 'one of the main barriers identified by professionals, policymakers, and learners for (re) using OERs is the uncertainty as to whether higher education and adult education resources are appropriate and match the learners' own educational contexts'.

At the University of Northampton, we have a very small maths/statistics support unit, (1 full time tutor). Therefore it is important we have an online presence to complement the face to face interaction. The majority of our online provision takes the form of educational videos.

This paper will disseminate the results of research collaboratively undertaken on what students at the University of Northampton actually want from, and think about Educational videos. Essentially, our primary goal was to determine what makes educational videos appealing to students to support learning development, and in particular, SPSS/statistics support. Specific aims included:

- Do students engage with these resources?
- Do they impact on the learning / confidence of the student?
- What are the key features (e.g. content, presentation, humour, music, production quality etc.) of 'good' educational videos?

Data was collected initially from a questionnaire and subsequently from a focus group and, therefore, was analysed both quantitatively and qualitatively.

Examining what made videos appealing to students, and equally, investigating what disengaged students provided an insight to improve our current offering, and what should/should not, be included in the production of future statistic/SPSS videos at the University of Northampton.

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Day 1 – Parallel II

Dr Jonathan Gillard and Dr Robert Wilson

Cardiff University

Student feedback: What do students really rate when they fill out questionnaires?

Day 1 – Parallel II (14.35-15.05)

At the end of a module or programme of study students are typically asked to review their experience by giving numerical responses to questions posed in an often lengthy questionnaire. However, what do students really evaluate? This talk will describe statistical analyses performed on student feedback received from undergraduates at Cardiff School of Mathematics to try to unpick the latent factors which have motivated students to respond in the way that they did. The primary tool used is Factor Analysis. Factor analysis is a statistical method used to describe variability among observed, correlated variables in terms of a potentially lower number of unobserved variables called factors. For example, it is possible that variations in twenty questionnaire questions mainly reflect the variations in two or three unobserved variables. The module questionnaires used at Cardiff School of Mathematics are heavily based on those used for the National Student Survey (NSS). Therefore, further discussion will also be presented on how the conclusions of this work may be translated to the responses of the NSS.

Day 1 – Parallel II

P J Walker

University of Leeds

Are you **sure** you're sure? Assessing certainty in a mathematics foundation course

Day 1 – Parallel II (14.35-15.05)

Certainty-based marking is a scoring mechanism, designed initially for multiple-choice questions, but applicable to a broader range of questions. The mark scheme requires students to report their prior probability of being correct, and by construction the student's expected mark is optimised when they accurately report their certainty. The intention is that, by improving their calibration, students reflect more deeply on their thinking, learning the distinction between a lucky guess and sound knowledge and diagnosing areas where knowledge is weak. Certainty-based marking, though of course theoretically applicable to paper-based assessment, is most easily implemented in an e-assessment environment as the computer takes the strain of applying the calculations.

In this talk, I will address the questions of why and how to implement certainty-based marking. I will report some classroom experience of its use and reflections from that experience. Finally, I will discuss further development, particularly the use of certainty-based feedback as an alternative, or a supplement, to certainty-based marking.

Day 1 – Parallel II

Meena Kotecha

London School of Economics

Enhancing student engagement with statistics through Facebook

Day 1 – Parallel II (15.05-15.35)

Abstract. This presentation will report the outcomes of using Facebook to improve student engagement and to enhance undergraduates' learning experience.

Background information and context. The discussed initiative endeavours to enhance students' learning experience and their engagement by using Facebook on a statistics undergraduate level course designed for a variety of degree programmes such as actuarial science, mathematical economics and econometrics, management science, accounting, finance and related fields. Students on this course have a range of learning requirements as a result of diversity in their academic and cultural backgrounds. A multi-dimensional student focused teaching model, developed by the author during 2010 to 2012 is used to address academic and cultural diversity. It mainly focuses on formative assessments and spontaneous feedback for creating interest and promoting interaction. This teaching model is also effective in capturing students' attention, maintaining their interest, promoting student engagement and interaction, and enhancing students' learning experience.

Student engagement can be disrupted as the ubiquitous iPads, smart-phones and Tablets increasingly distract students. This requires an additional feature to be incorporated into the original teaching model in order to maintain students' interest and engagement.

Facebook feature and rationale. A new feature was introduced by offering students the option of joining a Facebook study group at the start of the course. The rationale was to use a platform students can relate to as a tool for enhancing student engagement.

Hypothesis. The extended teaching model will enhance students' participation on the course.

Expected outcomes. Students will engage with greater commitment and enthusiasm in and beyond statistics teaching rooms.

Research Methodology. Five-point Likert scale questionnaires are conducted periodically to gauge/monitor students' course participation, academic progress and changes in their attitudes towards statistics. Further, the author uses students' responses to optional open-ended questions combined with their informal, unprompted and spontaneous feedback.

Approach. Interest is created by regular postings of links to videos on Facebook, aimed at demonstrating how accessible and enjoyable statistics can be. Further, links to videos and articles on the practical applications of theoretical concepts from the course syllabus are regularly posted to maintain students' interest. Students are encouraged to post their queries and engage in discussion.

Outcomes and findings. These will be shared in this presentation which will be followed by discussion and questions.

Day 1 – Parallel II

Mo Rehman and Pete Chapman

Newman University

Developing educational applications for mobile devices using open source tools and technologies

Day 1 – Parallel II (15.05-15.35)

Peters (2007) identifies a range of devices that can be considered under the definition of mobile technologies, including PDAs, mobile phones, laptops, and PC tablets. Berking (2012) offers a broad definition of mobile learning as "leveraging ubiquitous mobile technology for the adoption and augmentation of knowledge, behaviours or skills through education, training or performance support while the mobility of the learner may be independent of time, location and space".

The mobile platform offers an opportunity for learners to access content at literally any time and place. Given the ubiquitous nature of mobile devices amongst the UK population, including young people, educators should arguably be taking advantage of this direct line to students by developing apps that can be deployed across a range of devices and provide students with feedback as well as educational content.

The initial problem with such app development is the platform itself. Creating a 'native' (downloadable) app for all platforms requires multiple versions of the app and the developer to have multiple programming skills.

This presentation and discussion (including a demonstration) will discuss the creation of a mobile app that teaches the concept of percentages, repurposing content from the mathscentre website. This app was developed using a universal code base based on web technologies. This code base was then deployed to various platforms using open source tools.

As well as providing learning content, the app provides an interactive self-test facility. Key lessons learned during the development process will be outlined, in terms of the design decisions made and the limitations placed on developers by the vendors of the various tools and platforms employed.

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Day 1 – Parallel II

Nuala Curley and Dr Maria Meehan

University College Dublin

Identifying mathematical "trouble-spots" - the challenge of collecting useful qualitative data on students' visits to a Maths Support Centre at a university in Ireland

Day 1 – Parallel II (15.05-15.35)

Since September 2008, there have been approximately 19,500 visits in total to the UCD Maths Support Centre (MSC). Over this time the MSC has seen an increase in visits by students from access level all the way through to PhD level and an increase in visits from students who may not be studying a mathematics module, yet encounter mathematical difficulties in other subjects. For each visit, there is an electronic record of the mathematical topic that the student sought support for and the module the student is studying in addition to other information. To date this information has been used to guide service provision in the short term and evaluate student satisfaction.

A precursory glance at the MSC data suggests that there are certain basic mathematical topics and concepts that cause persistent difficulties for students. Diagnostic testing, as carried out in many third-level institutions, has been effective in identifying and highlighting widespread areas of mathematical weakness. We believe that the data gathered by the MSC, particularly the comments entered by tutors on students' difficulties, is also a very valuable resource. However our first look at initial data collected proved disappointing as we found the tutors' comments too broad in nature and lacking in the detail necessary to effectively identify and diagnose the basic mathematical difficulties that were underlying some of the queries and topics that students presented to the MSC with.

Our challenge in 2013-2014 was to develop a process of qualitative data collection. For our first step in the process we undertook a six-week pilot study starting in October 2013 with the aim of developing suitable categories for the basic mathematical problems that students presented with in the MSC. In speaking to the manager and the MSC tutors we emphasized the importance of recording not just the mathematical topic that students presented with, but more importantly, identifying and recording the basic mathematical difficulties that the students encountered while working through problems.

In February 2014 we met again with the MSC tutors before the commencement of data collection in the second semester. At first we asked if they were willing to act as participants in the research process and all agreed. We then discussed how we might be more specific in our topic entries and at the same time find ways to ease the work involved for the tutors. Their enthusiastic support for the research led to some very useful modifications to our data recording. We have now completed our first semester of qualitative data collection using the above procedures.

In this talk we will describe in detail the data collection process and take a first look at the qualitative data gathered.

Day 1 – Parallel II

Catherine Byrne[1] and Dr Michael Carr[2]

[1]CDETB, Education Service to Prisons and [2]Dublin Institute of Technology

Mathematics in Prison

Day 1 – Parallel II (15.05-15.35)

This work presented here is based on practitioner research in a Dublin remand prison, in particular results from the Prison Literacy and Numeracy Assessment pack. This pack was devised by teachers from the prison education service for use in prison education centres across Ireland to assess, at the point of entry, the literacy and numeracy levels of prisoners starting education.

The data resulting from these assessments is presented giving an overview of the numeracy and literacy levels of prisoners.

In addition results are presented of a survey of the prisoners' attitudes and experiences. This survey was first conducted in 2001 in a Dublin prison (Morgan M, Kett M 2003. The Prison Adult Literacy Survey: Results and Implications. Irish Prison Service, Dublin) and has been re-distributed to a sample of prisoners in 2014. The survey reflects on the prisoners' school experiences of reading, writing and mathematics and the impact it had on their life and work since. It is short and informal and was originally distributed via teachers in classes to their own students. This method was used again.

Thirdly data is presented on the results of a mathematics competency test from the Department of Education Professional Development Service for Teachers. It is given to students leaving primary school and entering post primary. This is the first time this survey has been applied in prison education and allows us to benchmark the mathematical level of prisoners with the wider population.

Day 1 – Parallel III

Ellen Marshall[1], Alun Owen[2] and Scott Smith[1]

[1]University of Sheffield and [2]Loughborough University

Scenario based training of statistics support tutors

Day 1 – Parallel III (16.00-16.30)

The provision of mathematics support in the context of mathematics learning centres in HE institutions has developed significantly since **sigma** first began. The provision of statistics support in particular has grown rapidly. However, it is acknowledged that providing statistics support in this context differs from maths support. This is due to the fact that requests for statistics help are often in the context of an individual problem to be solved with a data set that can sometimes be messy and complex rather than support with course material. Statistics support is often given by PGR's and maths tutors who may struggle to move from theoretical methods to the practical application of statistics to real data. In larger centres, some on the job training is possible but limited. Anecdotal evidence, in the form of discussions at **sigma** workshops and hub meetings, suggests that there is demand not just for initial training but also for further and ongoing training and skills development for staff that offer statistics support. This talk will discuss a project that has been funded by the **sigma** resource development initiative that aims to develop a pack of "scenario-based" training resources to be used for developing statistics advisory skills.

These resources will consist primarily of edited videos of actual statistics advisory sessions combining video recordings, PC screen captures and strategically placed pauses with questions and issues for consideration and discussion. One of the key challenges for statistics tutors is making sense of the students' research in order to ascertain the correct analysis so listening to actual students explaining their data is an important learning tool. The videos typically contain elements such as the student discussing their problem with a statistics advisor, screen captures of any data being discussed and/or statistical software being used in the session. These resources were designed with a workshop environment in mind; to allow the workshop audience to consider and discuss the issues raised during the viewing of the videos but may also be used by individuals where workshop attendance is not possible. Eventually these videos will be available on request from the talks' authors. The resources will also include additional paper based (pdf) materials for new and experienced tutors which will be available on www.statstutor.ac.uk.

All of the resources that have been developed to date will be showcased in this talk and details of planned one-day workshops that will make use of these resources will also be discussed. These workshops will be of particular interest to staff who would like to run similar workshops themselves in their own institution (or **sigma** hub) in order to train their own staff.

Day 1 – Parallel III

Dr Maria Meehan and Dr John McCallig

University College Dublin

Online videos – are they a complement or a substitute for the live lecture in a first year university Mathematics for Business module?

Day 1 – Parallel III (16.00-16.30)

Maths for Business is first year module offered in University College Dublin (UCD), Ireland and is a core module for approximately five hundred business students. Given the large number of students it is not surprising that there is great diversity in terms of prior mathematical achievement present in the cohort. In an attempt to address this, the class is split into two groups, Group A and Group B, based on mathematical achievement prior to entering UCD. Traditionally Group B (the group with lower achievement) has been offered additional support in the form of an extra live lecture each week. (Group B has three lectures each week as opposed to the two weekly lectures offered to Group A.) Dedicated *Hot Topics*, tailored specifically for Group B students, are also been offered by UCD Maths Support Centre (MSC).

In the academic year 2012-2013, a number of short videos were produced by the lecturer of Group B (and primary author of this paper) using an app called *Explain Everything* on an iPad. The specific purpose of these videos was to provide additional worked examples as a learning support for students experiencing difficulties in the module. She received such a positive response to these videos from the students, that she decided to produce videos of all the content of the module, and make it available on *Blackboard* - the university's virtual learning environment – in the academic year 2013-2014. In total 67 videos, with average length of seven minutes, were produced by the lecturer.

With the focus of the videos now changed from being an additional support to being a possible substitute for the live lecture we were keen to monitor students' engagement with the various learning resources on offer to them in 2013-2014. To this end the following data was collected: attendance at the live lectures; number of times each video was accessed by each student, and date of access; attendance at weekly workshop; attendance at weekly continuous assessment quiz; attendance at MSC; in addition to prior mathematical achievement and each student's final grade in the module. In this talk we will discuss the patterns of engagement of Group B students with the variety of learning resources on offer. We will also discuss the impact on learning depending on whether students actively engaged with live lectures and/or the videos. Finally we will also consider the impact that the availability of the videos had on student attendance at the MSC, and how tutors at the MSC could use the videos to leverage the support on offer.

Day 1 – Parallel III

Madonna Herron and Catherine O'Donnell

University of Ulster

Technology-enhanced learning and teaching in mathematics; enhancing feedback and promoting self reflection (CLARITI)

Day 1 – Parallel III (16.00-16.30)

The CLARITI project utilises technology to enhance the learning and teaching of mathematics. Its overall aim is to enhance student learning using technology by actively involving students in the assessment and feedback process. The project encourages self-assessment and reflection of marked work, provides rich, varied and meaningful feedback to improve student learning, and diagnoses efficiently and effectively areas in which students are having difficulties.

Traditionally coursework is submitted, marked with annotated feedback, and returned to the student with a grade and a model answer. The difficulties with this approach are that there is no efficient and effective mechanism in which a tutor can know whether a student has reviewed their work, understood their feedback and took action to improve their work. Also, with this approach there is no method for determining whether students' perceived judgment of their submitted assessment was the same as the tutor, or for advising if they need further support.

This presentation will share the journey and findings of an action research project endeavouring to address such difficulties. In the first instance, a paper-based "feedback and progress review" form was used, in which students outlined actions that needed to be taken to improve their learning or continue achieving in the topic being assessed. The form was handed back to the tutor, who copied it, annotated it and returned it. The positive outcomes of this cycle were that students were able to reflect and identify errors in their work and by writing this reflection down they had some record of their reflection. However, from an administration point of view, the process was difficult and time-consuming to manage. There were still the problems of uncollected work and work not being reflected upon.

A further research cycle to address this challenge was implemented in collaboration with Technology Facilitated Learning (TFL) as the research project was successful in a bid to receive support from the 2012-13 TFL Development Programme <http://www.ulster.ac.uk/centrehep/tfldevprog.html>. In this new approach, students submit as normal and are given corrective feedback and model solutions using the University of Ulster's Blackboard VLE, FAN system and a new bespoke application.

The project has been evaluating the benefits of initially withholding students' marks while students are asked to reflect and indicate what score they think they deserve and what action they think they need to take to improve their learning. The student scores, reflections and action plans are collected electronically via a "Learner Score" quiz on the VLE. A new application creates a template of the "Coursework Feedback and Summary Progress" report; automatically retrieves and merges the learner score and comments data from Blackboard; allows a tutor to engage with the student feedback and return a tutor score; and automatically generates an advisability for further support response, depending on the tutor's scores. Each student receives an email with a link to their individual "Coursework Feedback and Summary Progress" report.

During this paper the researchers will demonstrate the new approach developed, share evaluation findings and benefits from both the learner and tutor perspectives.

Day 1 – Parallel III

Samantha Pugh

University of Leeds

Building a community of peer support in mathematics

Day 1 – Parallel III (16.00-16.30)

Peer Assisted Learning (PAL) was introduced to the School of Mathematics at the University of Leeds in 2010, as a successor to the pastorally-focussed peer mentoring. Over the past four years, PAL has become a key feature of the school, and is often positively highlighted by students in surveys such as the National Student Survey (NSS) and the University's Undergraduate Programme Survey.

The benefits to the school have been multi-faceted. The transition to PAL has meant that first year students have had the benefit of both pastoral support from their more senior peers, in terms of orientation at university and integration into the life of the school. However, PAL has gone beyond supporting induction to provide students with guidance on all aspects of university study, such as making the most of lectures, tackling coursework, making module choices for future years and seeing the connections between the various aspects of the syllabus.

Of equal importance are the benefits for the students who act as mentors. They develop a wide range of skills, such as communication, organisation, and leadership. They also visibly grow in confidence during their time as a mentor. Revisiting first year material also helps them to understand their own course material more deeply.

Student demand led to the extension of PAL to students beyond year one. PAL for year 2 has been successfully implemented and largely managed by the students themselves. This has, in turn, led to better engagement, enhanced relationships with staff and, an increased sense of ownership for the students.

Finally, the school and faculty benefit from a much greater sense of community between year groups within the school, and between students and faculty, as they discuss the outcomes of the PAL sessions, allowing faculty to receive relevant and real-time feedback on their course as it progresses.

Day 1 – Parallel III

Alun Owen and Janette Matthews

Loughborough University

An update on *stats*tutor and the *stats*tutor communities project

Day 1 – Parallel III (16.30-17.00)

The *stats*tutor online resources (available at www.statstutor.ac.uk) began around five years ago as a pilot project by staff from Loughborough and Coventry Universities with support from the **sigma** Network. The aim of the project was to develop an online statistics resource to complement the very popular *math*centre site (www.mathcentre.ac.uk) which provides a wide range of support materials in mathematics. The aim was that the *stats*tutor site would become a popular worldwide first port of call whenever anyone is looking for online post-16 learning resources or information relating to teaching and learning in statistics.

This talk will offer an update on progress, reporting for example, that in the last 12 months *stats*tutor has had over 12,000 users view over 60,000 pages with 50% being from the UK and 50% being international users. In addition a significant new set of resources have recently been submitted via the *stats*tutor communities project, and so the talk will focus on demonstrating some of these new resources, how they can be adapted to suit the needs of particular students by other statistics teaching staff, and indeed how colleagues can themselves can submit their own new or modified resources to statstutor via the same *stats*tutor communities project.

Day 1 – Parallel III

Dr Helen Busby

Coventry University

Enhancing learning of mathematics using screencasts

Day 1 – Parallel III (16.30-17.00)

This study has trialled the use of 'screencasts' to aid students' learning in mathematics. Short videos were produced of selected worked examples showing the tutor's penstrokes with an audio commentary. Students were able to see the example as it unfolded, and hear the language that goes with it, both of which have been proven to be beneficial in learning mathematics. The screencasts could be watched as often as the students wished, allowing them to revisit examples from class or to catch up if absent.

The screencasts were produced to supplement teaching and learning for a second year undergraduate calculus module, in which several 'threshold concepts' have been identified in the literature. One feature of such concepts is that they are 'troublesome' for students, and therefore likely to need to be revisited a number of times. It was envisaged that the screencasts could be particularly beneficial for these threshold concepts.

Feedback was collected via a short online questionnaire. All who responded felt the videos helped a lot in their understanding of the topic and would like to see more. Overall, the screencasts combine benefits of technology with the proven value of traditional 'chalk-and-talk' methods for teaching mathematics. They are popular with students and straightforward for staff to produce.

Day 1 – Parallel III

Dr Anthony Cronin

University College Dublin

The effect of an online adaptive learning maths tool on Access to Science & Engineering students

Day 1 – Parallel III (16.30-17.00)

This year (2013/14) at the Maths Support Centre (MSC) at UCD we piloted an online adaptive learning platform with Access to Science and Engineering students (n=30). These mature (& non-traditional) students were also offered a suite of extra academic supports in the MSC including 9 hours of pre-course foundational mathematics and late night openings on Monday and Wednesday nights (to coincide with their lecture slots). The students were initially interviewed and given a diagnostic test to examine their basic algebraic, arithmetic and statistical skills including mental math and calculator work. The students were then given 40 days access to the maths learning and e-assessment platform RealizeIT (developed here in Dublin). The students were then given a post-test (similar to the pre-test they had taken 40 days earlier). The students' performance on these pre and post tests as well as their qualitative feedback on the online support tool will be discussed here.

In the coming academic year of 2014/2015 this pilot will be extended to include both traditional and non-traditional students at UCD including:

(i) 1st Science students on an *Introduction to Mathematics* Level 0 module (n=92),

(ii) *Higher Education Access Route* (HEAR) students, (n=80),

(iii) *Disability Access Route to Education* (DARE) students, (n=10)

(iv) *Mature Students* (any student not included in the above groups who is over 23 years of age on January 1st of their year of University entry), (n=39)

(v) *International Students* (typically from China and the Middle East), (n=15), as well as the

(vi) *Access to Science & Engineering* cohort again (n=35).

These student cohorts will include students from 8 colleges and 12 distinct degree programmes and it is envisaged that we will examine (a) the differences with how students engage with the online tool both outside of and inside the "classroom" as well as (b) extending the strength of the adaptive tool as a remediating factor. This study will incorporate a larger and statistically more significant sample (N=260 (approx.)).

Day 1 – Parallel III

Ruth Fairclough

University of Wolverhampton

Traditional lectures with 21st century students

Day 1 – Parallel III (16.30-17.00)

The phrase 'traditional lecture' stirs memories of chalk dust and an aching hand. Typically, an academic talked into the board with their back to the class, scribbling mathematics and occasionally referring to some yellowed old notes. It was a feat for students to write everything down before the dreaded board rubber materialised to wipe away what they were so desperately trying to copy down. At the end of term there was a long queue of students waiting for the library photocopier, armed with the notes the most diligent had taken, discussing what might be in the next set of examinations.

A traditional lecture now involves the whirr of electronic equipment, the academic stands at the front facing the class, with a slide presentation going on behind them. The students do not seem to expect to write very much down and ask where the hand-outs are. The use of VLEs has eliminated the queue to the photocopier at the end of term, and increased the number of questions received about the dazzling variety of assessments we set.

What is worth saving from these modus operandi? Old School chalk and talk certainly did make the students take notes, and they were quick and easy for the academics to deliver. Students knew what to expect with assessments as they were nearly all examinations. However it is questionable about how this prepared students to the world of work after graduation, and were at a time when there was less emphasis on 'good honours' outcomes for students.

The Maths staff at the University of Wolverhampton use tablet PCs to assist the delivery of their lectures. A pilot was run many years ago with one member of staff, and using tablet PCs was deemed so successful this has been adopted as the main piece of equipment used for teaching by the team. The presentation will discuss what has been learned by the team to use this equipment effectively. A demonstration of a variety of different ways of using a tablet pc to facilitate the delivery of lectures and supporting student learning outside the class will also be conducted.

This presentation will assess how 'chalk and talk' can be brought into the 21st century with the use of tablet PCs, so the traditional lecture can be evolved for the 21st century student rather than wither and die.

Day 1 – Parallel III

Francis Duah, Arkaprava Bokshi, Josephine Gunns and Jiajun Yang

University of York

Mathematics in economics education: a review of research, mathematics support, and online learning resources

Day 1 – Parallel III (17.00-17.30)

In this session, we present data that shows that the majority of students who seek learning support at a mathematics learning support centre are those studying for a Bachelor of Science or a Master of Science degree in economics and related disciplines. Typically these students seek support for mathematics and/or statistics modules. However, an increasing number of these students also seek learning support for *economics* modules whose content involve applications of algebra and calculus (e.g. *mathematical economics*). These students express consistently a need for *mathematics* resources (e.g. notes, problem examples, and help sheets) that are discipline specific. By this they mean that the resources should have economics context and applications, and should be presented as the economics community do. Against this background, we posed two questions for a review of *research on learning mathematics for economics and online resources for mathematics support* of economics students. These questions were: 1) What is known and unknown about *learning mathematics for economics*? 2) What *online* resources are available for mathematics support practitioners?

To answer these questions we undertook two activities. First, we searched the *mathematics* and *economics education* research literature for the evidence base on *learning mathematics for economics and related disciplines*. We searched the *Journal of Economics Education, International Journal of Mathematical Education in Science and Technology, Educational Studies in Mathematics, Mathematics Education Research Journal, Journal for Research in Mathematics Education, Teaching Mathematics and Its Applications,* and *MSOR Connections* using the following keywords and their combinations: Economics, Mathematics, Achievement, Calculus, Support, and Skills. Our search revealed 15 relevant studies which we reviewed to inform the wider mathematics support community. From our review, we found that a small number of studies focused on the relationship between: 1) achievement in mathematics, economics, and gender; 2) alternative approaches to teaching mathematics for economics; and 3) the mathematical needs of economics students. The literature is silent on how economics students *engage with* and *learn mathematics* as non-specialists. We therefore argue that there may be a need for research that focuses on how economics students learn and engage with mathematics.

Second, we searched and found a large number of *online resources* on mathematics for economics. We reviewed some of these online resources in order to share with the mathematics support community. We felt that this activity was important because there is no existing website that has reviewed and catalogued the diverse range of online resources for ease of access by staff involved in learning support.

Day 1 – Parallel III

Noel-Ann Bradshaw

University of Greenwich

Using MP4 mathscasts to develop mathematical thought processes and reflective skills

Day 1 – Parallel III (17.00-17.30)

When teaching a second year Operational Research module I was concerned students were following worked solutions without understanding the thought processes involved. To address this I produced videos of myself working though the solution with audio commentary. This enabled the students to hear the thought processes involved, which led to increased engagement and subsequently raised attainment.

Since then I have also provided similar recordings to help final year maths student understand how to reflect and write reports on school placements. Again this has had the effect of raising attainment.

This presentation will show how easily such recordings can be made demonstrating this both on pc and iPad. Feedback and results from the modules where these recordings have been used will be presented and discussed. Further work involving to-camera videos will also be discussed.

Day 1 – Parallel III

Vincent Knight

Cardiff University

Embedding entrepreneurial learning through the teaching of programming in a large flipped classroom

Day 1 – Parallel III (17.00-17.30)

Should the modern mathematician know how to code? This is a question that has been answered positively by the School of Mathematics at Cardiff University. This talk will describe the pedagogic approaches used to deliver a first year programming class to 160+ first year students.

Delivered over two terms, the first term uses a flipped classroom pedagogic approach to enable students with programming knowledge and tools. This approach was used to ensure an active and student centred learning experience. Further evidence for the benefits of this will be given during the talk. In the second term, entrepreneurial skills are embedded in the course as students form companies to make use of their coding skills and mathematical knowledge.

The talk will describe the scaffolding put in place and the different types of formative and summative assessment used to ensure a well rounded student centred learning experience.

This module has enabled students at Cardiff University to not only obtain programming skills relevant to the subject benchmarks but also to experience entrepreneurial education embedded in the subject.

Day 1 – Parallel III

Dr Janet M Bonar

Southampton Solent University

Increasing support to increase engagement and achievement

Day 1 – Parallel III (17.00-17.30)

Producing engineers competent in the mathematical skills needed for the discipline continues to be a challenge. The benefits of the Southampton Solent University's widening participation agenda are the inclusion of students who might not otherwise participate in HE. The challenges of getting all students to the standards required by our IET-accredited BEng degree programme are considerable. In recent years pass rates on first year maths units have been lower than the University benchmark. Action has been taken to address this issue by iterative increase in support offered to students, as well as by detailed monitoring of engagement. The teaching and learning structure for maths consists of 1 hour lecture + 2 hours tutorial each week. During each tutorial session there is a quiz to provide the students with formative feedback. There are also problem sets, on which the students may work in groups if they prefer—thus providing opportunities for both group and active learning. Additional maths sessions are provided during personal tutor sessions, although these are not obligatory. Assessment has a classwork component in terms of phase tests, which cover one topic immediately after it has been taught, with the best 4 tests from 5 phase test scores contributing 40% of the unit mark. The end of year exam covers all topics and contributes 60% of the unit mark.

Engagement is monitored through attendance at lecture and tutorial sessions, and by participation in tutorial sessions on weekly quizzes, and attempts at homework. The correlation between engagement data and phase tests scores has been found to be $R^2 = 0.555$ or 0.353 for two different tutorial sections. One tutorial section consists of part-time students employed by local engineering companies released one day per week to attend units leading to an HNC, while the other group consists of full-time students. The difference in student populations is likely to explain the difference in correlation, although whether the part-time students are better at maths or just more motivated has not been determined. For all engagement criteria and attainment on phase tests, the part-time students scored much more highly than the full time students.

Engagement data is monitored across the engineering subjects, allowing identification of students with less than ideal engagement in maths or other units. Students are invited for interview during weeks 6 and 12, and tutors create a personal action plan for students with less than ideal engagement. Once the marking of the final phase test and end-of-year exam has been completed, it will become clear whether the additional face-to-face support offered during this academic year has improved the pass rate, and demonstrated that we are able to develop our students to the required level of mathematical ability.

Day 2 – Parallel IV

Noel-Ann Bradshaw[1], Paula Philpott[2], David Pratt[3], Piers Saunders[3] and Seb Schmoller[4]

[1]University of Greenwich, [2]South Eastern Regional College,
[3]University of London and [4]Citizen Maths Project

Citizen Maths: development of a maths skills MOOC

Day 2 – Parallel IV (10.45-11.15)

This presentation will discuss the development and implementation of the first phase of a new online maths course, Citizen Maths (Ufi, 2013), aimed at those wanting to improve their mathematical skills whether they are in or seeking education or employment. The curriculum was designed by maths educators from the Institute of Education (Professors David Pratt and Richard Noss, and Piers Saunders) and the development of the course is being funded by the Ufi Charitable Trust. This first phase is expected to be available to students from September 2014.

The presentation will show clips from the course and discuss the process involved in producing the material and assessments and presenting them within a Google's "Course Builder" MOOC platform. Much of this will be relevant to anyone thinking about the logistics of designing and implementing a Maths MOOC at any level. In particular the issues associated with filming written mathematics will be discussed.

It is anticipated that those involved in maths support of non-mathematics students in HE might find some of the content useful for those learners attending maths support centres. American political scientist, Herbert Simon (Simon, 1998) asserted that, "Learning results from what the student does and thinks and only from what the student does and thinks. The teacher can advance learning only by influencing what the student does to learn." In Citizen Maths, learners engage in contextualised problems in such a way that the power of mathematics is revealed. The first phase of the course looks at the powerful idea of proportion and teaches this in the context of sharing, scaling, ratios, inverse proportions and making comparisons. The material is delivered by Noel-Ann Bradshaw (Greenwich University) and Paula Philpott (South East Regional College, N. Ireland) through tutor-to-camera videos, pen and paper calculations and screencasts demonstrating activities using spreadsheets, Geogebra and the programming language Scratch.

The use of Scratch is perhaps the most unusual aspect of the course (Pratt & Schmoller, 2014) and emerges from Seymour Papert's notion that enabling learners to create products (in this case programs) facilitates learning (Harel & Papert, 1991). As well as teaching and supporting, the course aims to challenge, intrigue and above all to motivate learners to think. For example, using Scratch, learners are shown how to create a drawing and then enlarge and reduce it, they are also shown how to draw a pie chart with part of this activity left to the learner to investigate for themselves.

This is an exciting and challenging project to be a part of and we believe that our experiences and lessons learned so far will be of value to the CETL-MSOR community.

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Day 2 – Parallel IV

Leslie Fletcher and Mark Feltham

Liverpool John Moores University

Use of social media in mathematics and statistics support

Day 2 – Parallel IV (10.45-11.45)

Social media is not just about sharing jokes and pictures of kittens. It is being increasingly used by academics to expand their professional networks, and to enhance the range and scope of support that they can provide to their students. We will begin with a report on a **sigma**-sponsored event at Liverpool John Moores University on 20 June 2014 entitled "Creating and sustaining a social media presence". This event provided an authoritative overview for those who are still "relative novices" in this area, as well as highlighting ways to maintain and sustain this within a teaching and learning context. The particular focus was on the needs and experiences of those working in mathematics and statistics support centres or otherwise supporting students in mathematics and statistics. From an extremely eclectic range of inputs – beginning with global perspectives and progressing via hands-on learning tasks to individual experience – participants were able to take away valuable suggestions about the use of Twitter and Facebook. Vigorous discussion amongst participants and others has continued about the more effective use of social media across the **sigma** Network.

The workshop will present some of these with the aim of sustaining the momentum created by the LJMU event by gathering a wider range of experience from across the sector, from participants in the workshop and conference attendees. Proposals for adopting common approaches – to the use of hashtags for example – will be made for debate. The need for, and provision of, further training and staff development will be examined and, if time allows, trialled with workshop participants.

Day 2 – Parallel IV

Noha Nahari, Eabhnat Ní Fhloinn and Bryan MacDonald

Dublin City University

The impact of a new approach to mathematics in post-primary level on first-year higher education engineering students in Ireland

Day 2 – Parallel IV (10.45-11.15)

A major overhaul of the approach to the teaching and examination of mathematics in post-primary school, as well as to the syllabus itself, has taken place in Ireland in recent years. "Project Maths" was first rolled out in pilot schools in September 2008 and nationwide in September 2010. It is being introduced on a phased basis over a number of years, with all changes to be implemented and examined by June 2015. Project Maths aims to improve mathematical thinking and problem-solving skills, and so should be the ideal preparation for higher education.

Engineering as a discipline relies heavily on mathematics, yet we consistently see students entering higher education with poor core mathematics skills which cause difficulties for them in a number of engineering areas. Therefore, our study aims to answer the question: "Has the introduction of "Project Maths" at post-primary level affected the mathematics skills and attitudes of first-year engineering students in higher education in Ireland, and if so, how?" We hope to address this research question by highlighting the key changes introduced by Project Maths and what the possible impact of these changes could be for first-year engineering students, considering these on a year-by-year basis over a number of years, as Project Maths is phased in. One aspect of this study involves running mathematics tests, focusing on the areas in which the syllabus has been reformed in post-primary level. The tests are run at the beginning and the end of first semester every year since the beginning of 2012/2013 academic year to give comparative data, with the ultimate aim of observing if any changes in understanding or mathematical literacy are evident.

The results of this test showed that first-year engineering students were having significant difficulties in some areas of mathematics. The test was designed using pairs of questions on each topic, along with a certainty-based marking sceme, where students ranked their level of confidence in each of their answers as low, medium or high. This design highlighted a lack of knowledge and confidence in a number of areas, notably integration, for example. Furthermore, the Algebra section displayed a significant lack of the basic mathematical skills vital to a discipline so heavily reliant on mathematics as engineering is. However, it must be remembered that our study is in its early stages, and these students had only experienced two years of the first phase of Project Maths (so two out of five topic "strands" had been changed, but only for their final two years in post-primary school). In the coming years, it will be of interest to compare whether students with greater exposure to Project Maths perform better in the test, and to find out whether Project Maths has made any improvements to their skills, especially with the subtopics that were changed in the new syllabus.

Day 2 – Parallel IV

Madonna Herron

University of Ulster

A renaissance of pen-and-paper in a digital age

Day 2 – Parallel IV (10.45-11.15)

The learning and teaching of mathematical methods can be significantly enhanced with the use of a low-cost paper-based computing platform. Within this platform a smartpen and special dot paper is used in the same way as an ordinary pen and paper to provide step-by-step solutions to mathematical problems, but, with the additional, and significant benefit, in that an audio synchronized explanation of a mathematics problem can also be recorded. The recordings, once digitally published, are called pencasts, and have the further benefit that they can be paused and replayed as many times as desired.

First year undergraduate students studying mathematical methods in either mathematics or engineering programmes were given access to more than 60 pencasts throughout the year. The average size of a pencast is 5 MB, each with duration of 3 to 30 minutes. A student survey indicated that 82% of students found that the pencasts helped them identify where they could improve. To quote from one student "it is one thing reading a textbook, but actually seeing it carried out, with talking, really makes things easier to pick up and learn." This presentation will also discuss the art of pencasting and discuss lessons learnt.

The research has demonstrated that pencasts can be an effective reusable learning resource and that pen-and-paper can be brought into the digital age.

Day 2 – Parallel IV

Janette Matthews

Loughborough University

'Getting a grip on mathematical symbolism' – the Loughborough MOOC experience

Day 2 – Parallel IV (11.15-11.45)

In April 2014, '*Getting a grip on mathematical symbolism*' [1], a Massive Online Open-access Course (MOOC) developed by Tony Croft and Janette Matthews from the Mathematics Education Centre at Loughborough University went live on the FutureLearn platform.

MOOCs comprise a different teaching and learning model to on-campus and distance learning. Students experience self-study teaching with minimal interventions from the course educator. In this paper, we will describe our intentions and experience in developing and delivering this course. We will explore the different FutureLearn platform components used to deliver learning and offer interaction for and between learners. We will show, through analysis of learner responses and survey data, insights into learners who studied this course and their learning journeys.

The presentation will appeal to those who are interested in developing a MOOC or those involved in blended learning in a campus-based setting.

[1] https://www.futurelearn.com/courses/mathematical-symbolism-2

Day 2 – Parallel IV

Eabhnat Ní Fhloinn[1], Olivia Fitzmaurice[2], Ciarán Mac an Bhaird[3] and Ciarán O'Sullivan[4]

[1]Dublin City University, [2]University of Limerick, [3]National University of Ireland Maynooth and [4]Institute of Technology Tallaght

Gender equality in mathematics support

Day 2 – Parallel IV (11.15-11.45)

In 2011, a major nationwide survey of first-year higher education students was undertaken in Ireland by the Irish Mathematics Learning Support Network. Although the original aim of this survey was to ascertain students' evaluation of mathematics support, preliminary analysis of the data showed significant differences in engagement with mathematics support by male and female students. Given that there were 1633 responses from nine different HEIs, which offer a range of different supports in various ways and deal with a wide mix of students, this was an unexpected outcome and it was decided to further investigate this. Therefore, the data was further analysed with a view to looking at the engagement levels of male and female students in different disciplines, as well as the reasons they gave for either using or not using mathematics support during their first year of higher education. The impact of mathematics support reported by male and female students was also studied to determine any differences. Finally, the suggestions given by non-users of mathematics support, when asked what might encourage them to engage with the service if needed, are analysed to see if gender differences emerge. The aim of the investigation as a whole was to find out if current models of mathematics support seem to favour female students more than males and if there are any adjustments that could be made to optimise the support services we offer in order to provide the best service to all students who may need it.

Day 2 – Parallel IV

Paul Hernandez-Martinez[1] and Merrilyn Goos[2]

[1]Loughborough University and [2]University of Queensland, Australia

What is the value of mathematics?: Encouraging meaningful participation in mathematics for engineering courses

Day 2 – Parallel IV (11.15-11.45)

We report on a case study of an engineering mathematics course where previous attempts to engage the students had failed. In spite of introducing a mathematical modelling approach to teaching with the intention of showing students the use-value of mathematics, attendance rates remained poor and most students continued to be indifferent and highly strategic about assessment. Students saw mathematics mainly for its exchange-value.

In order to address this problem, we re-designed the module by introducing employability skills. The intention of this re-design was to convince students of the value of engaging in mathematically meaningful activities. By participating in activities such as discussing ideas, working in group, presenting oral and written work, et cetera, students could see a practical and tangible outcome: they were developing relevant and transferable expertise that could make them more employable in a very competitive world. In this context, the use-value of mathematics lays in its potential to produce informed graduates that are able to critique, understand and express complex ideas using mathematics and at the same appealing to students' aspirations and to the exchange-value of mathematics as an important subject that might enhance someone's CV.

We evaluated the results of this practice by collecting data from student feedback questionnaires, teaching observations (the second author would observe while the first author taught the module) and the module's assessment (coursework and final exam). Results were very encouraging: attendance rates remained high (75% on average) throughout the course but more importantly, we gathered evidence of substantial participation of most of the students in the different activities designed to enhance their learning. For instance, throughout the module students were asked to work in groups outside of lectures to solve some modelling problems and to hand in an individual report of their solution. Most of them handed in well-structured reports even though these did not carry any marks towards the module's assessment. When asked to comment on the report of another peer, most students wrote thoughtful and supportive feedback. When asked to produce a (non-assessed) group presentation of the results of a substantial problem, 7 out of 10 groups produced and presented well-thought, well structured presentations. In most of the lectures, student input was common and many of them engaged in "healthy debates" during group discussions. Students' willing engagement in these mathematically meaningful activities showed that most of them believed that these tasks could be useful to their future and that developing these skills was worth investing time and effort.

Certainly, the exam-driven mentality was still very much present in these students but the data show that it can co-exist with a genuine sense that mathematics can somehow be useful.

In the conference presentation, we will discuss the challenges that we faced in introducing this form of teaching, and how these efforts could be sustained and extended to other courses, as well as more general implications for teaching and learning mathematics in Higher Education.

Day 2 – Parallel V

Samantha Pugh[1] and Michael Grove[2]

[1]University of Leeds and [2]University of Birmingham

Understanding mathematics in a chemistry context: Just what is the problem?

Day 2 – Parallel V (14.00-14.30)

The *Measuring the Mathematics Problem* report, published in 2000, succinctly defined the issues facing departments of mathematics, physics and engineering in relation to the mathematical skills and abilities of learners as they made the transition to university study. As a consequence, activities were undertaken, many at a national level, to help learners address their mathematical difficulties through curriculum change, resource development and the provision of additional support, and at the same time to increase the number of learners studying mathematics to A-level and choosing to study mathematics, physics and engineering at university. In recent times, there is an increasing body of evidence that a mathematics problem exists within a range of disciplines, however, as the exact nature of this problem is not well defined, it is difficult for departments to begin tackling the issues in an appropriate manner.

In a 2008 review of UK chemistry undertaken by the Physical Sciences Subject Centre indicated that 90% of staff who responded to their survey considered mathematics to be a primary requirement of a modern chemistry course, but for most departments the formal teaching of mathematics only took place within Year 1. Furthermore, with 25% of students beginning the study of chemistry with only a prior GCSE mathematics qualification, the challenges faced by staff in supporting their learning of mathematics were clearly documented with many complaining that their students were ill-prepared. The students themselves also acknowledged concerns with their mathematical ability, with just under 50% of those surveyed indicating they felt their prior mathematical experience left them unprepared for university study; a particular cohort where this feeling was greatest was amongst those in Russell Group universities where the mathematical demands upon chemistry learners are perhaps the greatest.

While the 2008 review identified there existed a mathematics problem within chemistry, it did not identify exactly how it manifests itself within higher education, how this is impacting upon departmental approaches to teaching mathematics within a chemistry context, and how we might begin to tackle it. In Summer 2014, the Universities of Birmingham and Leeds embarked upon a programme of research, led by student interns, to update the data collected in the 2008 review and most significantly to better define the exact nature and extent of the mathematics problem within chemistry in UK higher education. This presentation will review the findings of this initial scoping study and outline future plans for establishing a longer-term programme of action research to better support the learning of mathematics within a chemistry context; it will also highlight some of the resources that have been developed over this summer as a starting point for supporting chemistry learners.

Day 2 – Parallel V

Richard Lissaman and Stephen Lee

MEI

APP-lying mathematics – developing interesting digital content to support student learning

Day 2 – Parallel V (14.00-14.30)

Student use of mobile phone/tablet 'Apps' is widespread. Educators are realising that there is opportunity to build learning into these platforms through interactive maths games. Most of the work that has been done in this area has involved basic numeracy. This session will look at emerging work from MEI on maths gaming in the context of A level Mathematics and Further Mathematics.

This will include games/apps that are designed to enable exploration and practice of concepts, games that are designed to promote small group discussion and games that are designed to be used by a teacher as a resource in place of a standard presentation.

The underlying software used to create the apps will be introduced and suggestions for how those in HE could develop and use this technology along with how students could be 'involved' in the process, i.e. via final year projects etc., will be given.

Day 2 – Parallel V

Erica Tyson[1], Sam Kamperis[1] and Stephen Lee[2]

[1]The Institute of Mathematics & its Applications and [2]MEI

The IMA is 50 – IT enabled student engagement is key to the next 50

Day 2 – Parallel V (14.00-14.30)

The Institute of Mathematics and its Applications (IMA) is the UK's learned and professional society for mathematics and its applications. It is a member organisation and incorporated by Royal Charter enabling it to award Chartered Mathematician, and more recently, Chartered Mathematics Teacher status. Over the last 2 years the IMA, through IT enabled communication has doubled its participation. Whilst a web-site provides general information to members and a dedicated careers site developed under the More Maths Grads HEFCE funding supports and encourages future mathematicians the challenge of engaging more of the mathematics community with the IMA remained.

Opening up a free route of student participation, supported electronically at marginal additional cost has proved hugely successful. The electronically delivered newsletters draw on the resources produced for fee paying members, feature career development resources specifically prepared for maths undergraduates to support the development of their employability skills and include articles and reports from undergraduate mathematical societies. There is now a thriving community of undergraduate e-Students, and using a similar newsletter approach with appropriately tailored contents branded e-16plus, a developing population of post 16 students. To address the needs of postgraduate students, virtual research topic groups connecting students with common mathematical interests undertaking their research in geographically dispersed communities are being established, facilitated through Moodle.

Strategic use of LinkedIn, Facebook and Twitter promote physical events such as conferences and talks as well as adding to the virtual networking. Whilst technology is critical to providing the offering to attract and maintain these student communities, face to face contact through careers talks and workshops has been critical to engaging initial interest. In this session the collective strategy used to bring about the increased participation, involving using the technology, will be outlined; specific 'tools' used will be discussed so as to enable colleagues to determine if they may be of relevance to their institution.

Day 2 – Parallel V

Eleanor Lingham and Ann Baughan

De Montfort University

Back to basics – helping learners overcome their fear of numerical reasoning tests

Day 2 – Parallel V (14.30-15.00)

Do you know that the majority of graduate recruiters use numerical reasoning tests to screen applicants? Do you have many students looking for numeracy test support? What sort of support do you offer? Many university students have not used mathematical skills such as calculating percentages, fractions, ratios and exchange rates in several years. Many have not interpreted mathematical information such as graphs, pie charts or bar charts in several years. Many students become anxious at the thought of taking a numerical reasoning test. Mathematics support for these students, when sought, is often last-minute. Mathematics support for such students, when provided, tends to be urgent individual teaching. This is an inefficient and possibly ineffective use of maths support resources.

A proactive workshop approach to numerical reasoning support has been trialled at De Montfort University. Numerical reasoning workshops run regularly, are open to all DMU students, and participation early in the graduate recruitment process is encouraged. The workshops are HEAR-accredited and are jointly run by the Maths Learning Centre and the Careers & Employability Service. During the workshops, background information and preparation tips are provided. Students then tackle a short numerical reasoning test individually and in groups. This process develops numeracy skills, as well as providing an opportunity to develop and demonstrate other employability skills such as team-work, communication, leadership, decision-making and assertiveness.

Participants self-assessed their knowledge and confidence before and after the workshops, and feedback forms were used to gather comments and suggestions. Findings indicate that the workshops have a positive effect on both knowledge and confidence, with average rises of 2.9 and 3.5 respectively (on a ten-point scale). The workshops were popular and feedback comments will be shared.

Plans for extending this support will be detailed, including: in-faculty workshops; learning resource development; and a staff-student partnership to facilitate these workshops and extend their reach. These workshops are easily replicable. Advice for other HEIs and collaborative opportunities will be described.

This links to the conference theme of *"Back to basics! The lasting value of face-to-face interaction"* as this session provides an innovative solution to the new challenge of supporting large numbers of students seeking mathematics support to refresh their numerical reasoning skills. These workshops are based on face-to-face interaction, but are designed in a way to maximise the effectiveness of limited support staff time.

Day 2 – Parallel V

Peter Rowlett

Nottingham Trent University

Individualised formative worksheets to encourage small group discussion of method

Day 2 – Parallel V (14.30-15.00)

Few would disagree that "students best learn mathematics if they are actively engaged in the process of doing mathematics" (Cox, 2011; p. 149). In exercise classes, students are encouraged to work in small groups on formative assessment questions and learn by doing. In practice, weaker students can be observed simply 'copying along' with their peers; perhaps such students are not actually learning much from the process. An approach was trialled when teaching maths to forensic science students where computer-generated questions are used to provide each student with an individualised, printed sheet of exercises. Each student is given similar but different questions, encouraging discussion of method rather than copying of answers.

Individualised worksheets were generated using the system Numbas, principally a mathematically-aware e-assessment system (Foster, Perfect and Youd, 2012) that can also generate printable question sheets and corresponding answer sheets (Rowlett, 2014). This arrangement was used for nine weeks in topics from basic algebra to basic calculus.

This session will present the Numbas printable worksheet system, examples of the generated worksheets and student feedback on experience of the approach. In feedback, students are distinguished in two groups based on self-reports of how difficult they found the module content.

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Day 2 – Parallel V

Sarah Parsons

Harper Adams University

Face-to-face interaction: All creatures great and small

Day 2 – Parallel V (14.30-15.00)

Mathematics Support at Harper Adams University, which has been operating since 2001, is run as small group tutorials, drop-ins for specific modules, and individual appointments with the Mathematics Support Tutor. This presentation will describe a selection of the support provided to a broad range of students and highlight the benefits of face-to-face interaction.

In many cases face-to-face appointments of one or two hours have helped students with whole modules, successfully preparing students for assignments and examinations, and raising student confidence. Face-to-face interaction enables students to receive immediate personal feedback on their progress and assistance, also providing the necessary reassurance for anxious students. This generally prepares the student to be a more independent learner in the future, once the need or impediment has been addressed. If a student doesn't know or understand what to do it is difficult for them to assess and address their own needs remotely. Some students have even reported that they felt more able to work on problems on their own just knowing that the support was available if they got stuck, and that in other situations where support was not available they had given up trying.

Statistics support for student final year projects is considered a particular case where individual tailored support is necessary; each student project is unique and carries a high mark weighting, making the project outcome and the advice given so crucial to the students' overall success on their course.

The opportunity for group discussion on the benefits and disadvantages of face-to-face interaction will also be included.

Day 2 – Parallel V

Emma Cliffe, Cheryl Voake-Jones, Luis Rodriguez and Jane White

University of Bath

Helping BTEC students to prepare for university: mathematics-based activities for non-mathematics students

Day 2 – Parallel V (15.00-15.30)

Since 2011, the University of Bath has provided support for vocational entry students who have difficulties with the mathematical content of their course. This has included: provision of pre-sessional material, additional small group support and alternative teaching arrangements. Development of this support has been informed by current students entering through the BTEC route in three subject areas: Sports and Exercise Science, Electronic and Electrical Engineering and Computer Science. Full details were presented at CETL-MSOR 2012 and CETL-MSOR 2013.

This provision will now be embedded in the *'On Track to Bath'* scheme, an initiative to encourage students from widening participation backgrounds to apply for selective universities. This targeted support aims to motivate current BTEC students to consider university and to enable them to build their mathematical skillset over a more practical timescale.

In this session, we will discuss the *'On Track'* BTEC programme. We will motivate the creation of the programme and draw upon experiences so far. The importance of this early interaction between Further Education and Higher Education will be highlighted. In particular, we will present a reflection on a summer school, including student feedback, and focus on the advantages of providing this timely and sustained face-to-face interaction prior to students applying to university. Moreover we will highlight how technology is integrated into the programme and will discuss the important roles that both technology and face-to-face interaction play in this programme.

Entry onto the *'On Track'* programme is selective and begins towards the end of students' first year in FE. There are four main subject-specific components of the programme, completed in the following order: preparatory mathematics tutorials, a three day residential summer school, a series of tutorials running throughout their second year in FE and a problem-solving day at the university. Individual project work follows both the summer school and the problem-solving day. Additional generic application support completes the *'On Track'* package. Elements of this scheme have been piloted previously but the 2014-15 cohort, comprised of students from the three subject areas, will be the first group to complete the full *'On Track'* programme.

Day 2 – Parallel V

Dr Alison Hooper, Dr Rhys Gwynllyw and Dr Karen Henderson

University of the West of England

Using Technology in Module Delivery of Mathematics

Day 2 – Parallel V (15.00-15.30)

At UWE, the mathematics staff has pioneered the use of different technologies to deliver and support lectures. These include annotation of projected lecture notes using a Tablet PC using handwriting annotating software, lecture recording using screen-capture technology, voting system technology used to question the lecture cohort and on-line assessments tests delivered via the web outside module contact time. The advantages and difficulties encountered with each of the different technologies are discussed. We give evidence which shows that students are very positive with respect to the new lecture delivery and support and we discuss further plans to improve student engagement and deepen their understanding.

Day 2 – Parallel V

Professor Jo Smedley

University of South Wales

The secret's in the mix: using OR and technology to enable organisational change

Day 2 – Parallel V (15.00-15.30)

Using Operational Research to inform the best way to achieve the maximum impact from limited resources is a well-known application. The challenge comes in implementation to engage and work with an audience with a fear and suspicion of new approaches in a period of substantial organisational change.

An appreciative enquiry approach with teaching and learning at its heart was used to enhance the professional support provision from two organisational areas with complementary skill sets with the goal of enhancing group outcomes and achievements while providing individual support and developing a strong community of practice. Discussion focused on the problem to be solved, expected outcomes followed by key points from the OR methodology expressed in non-mathematical language. The use of an appropriate mix of traditional and modern technologies as learning vehicles reflected the respective strengths and experience of the learning community. Opportunities for staff development and renewal were highlighted with the focus on strong communication of the benefits to individuals and the impact of the effective and efficient use of resources to the group.

Progress has been in two parts. The methodological solution used OR critical path and networking approaches to provide a solution to a support challenge which needed to be flexible and agile over time. As anticipated, implementation was more of a challenge. With challenging resourcing, the theoretical thinking was useful in demonstrating the reasoning across hierarchical levels of the University to progress a positive and workable solution which enables developments and enhances user experiences for everyone. Explanations highlighting practical applications of the theoretical model have helped to ensure that all are aware of the strategic and operational perspectives of the changes. Throughout, technology has been a valuable common denominator with the use of pictures, diagrams and colour as cultural language enablers within an environment where staff are cautious about any new approach.

Outcomes to date have demonstrated the importance of ownership, engagement and support from various staff perspectives. Practical approaches often differ from theoretical thinking. The OR approaches provided valuable guidelines to enhance learning through technology among a mixed community with theoretical and practical experiences to support continuing professional development through technology and enable change.

This work has provided an invaluable case study in applying operational research alongside technology to enhance practice. It also enabled staff across the department to become more self-aware of their individual learning approaches using technology as well as enhancing the community through closer working together on a defined yet challenging initiative providing benefits across the organisation.

Posters

Mark Hodds, Coventry University

Self-explanation training improves proof comprehension

Janette Matthews, Loughborough University

Developing mathematics resources for *math*centre

Poster

Mark Hodds

Coventry University

Self-explanation training improves proof comprehension

In this poster, I report three experiments from my PhD thesis demonstrating that a simple booklet containing self explanation training, designed to focus students' attention on logical relationships within a mathematical proof, can significantly improve their proof comprehension. Previous investigations involving the use of self-explanation training had, on the whole, been successful (e.g. Chi et al. 1989; Ainsworth and Burcham, 2007) but had not been tested with proof. The first experiment demonstrates that students who receive the training generate higher quality explanations and perform better on a proof comprehension test. Experiment 2 demonstrates that self-explanation training increases students' cognitive engagement and the frequency with which they move their attention around a proof, as measured through eye-tracking technology. The final experiment demonstrates that an in-lecture self-study intervention through the use of a training booklet improves students' proof comprehension, and that the effect persists over time.

Poster

Janette Matthews

Loughborough University

Developing mathematics resources for *math*centre

Online open access mathematics and statistics resources are a valuable resource for both students and academic staff. For more than ten years ***math***centre [1] has offered a variety of resources for students at the transition to university and for the staff that support them. New resources have been developed expanding the resource bank and ***math***centre has become a portal for resources developed elsewhere such as HESTEM funded project reports and formative assessment resources (Maths e.g,, Numbas and DEWIS). Since 2009 and the inception of the Communities project, additional resources have been contributed under a creative common licence. In this presentation we will discuss the ***math***centre Communities resources in detail and highlight some of the issues that present themselves when creating resources. We will also discuss usage statistics and requests, which provide some insights into the type of learning resources that are most used and where there are gaps in provision.

[1] http://www.mathcentre.ac.uk

Index of Contributors

Notes