



CETL-MSOR 2018 : Evidencing Excellence in the Mathematical Sciences

5-6 September 2018
University of Glasgow

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Conference welcome

Professor Tara Brendle

University of Glasgow

Tara Brendle is Professor and Head of Mathematics at the University of Glasgow, and has previously held positions at Cornell University and Louisiana State University. She is an elected member of the Royal Society of Edinburgh's Young Academy of Scotland, and for the past four years has been a Member-At-Large of the Council of the London Mathematical Society. She is currently serving as a member of the REF2021 Mathematical Sciences panel at both the Criteria and Assessment phases. Through her role in the Scottish Government profile-raising group Making Maths Count, she helped to launch Maths Week Scotland, an annual event established in 2017. She is also an HEA Senior Fellow.

Keynote Addresses

Wednesday 5 September 13:50-14:50

Professor Gavin Brooks

Pro-Vice-Chancellor (Teaching and Learning)

University of Reading

Professor Brooks has a first class honours degree in Pharmacy and a PhD in the areas of organic chemistry and pharmacology from the University of London. He registered as a pharmacist with the Royal Pharmaceutical Society of Great Britain in 1985. Following a post-doctoral fellowship at the Imperial Cancer Research Fund Laboratories in London, he joined the Department of Cardiovascular Research at the Rayne Institute, St Thomas's Hospital, in 1992 as a Group Leader. In 1997, he joined Prolifix Ltd as head of their cardiovascular programme and in 1999 returned to academia. In 2001, he was elected a Fellow of the American Heart Association. He is Professor of Cardiovascular Research at the University of Reading and in 2011 was appointed Pro-Vice-Chancellor (Teaching and Learning) having served as Dean of Science and Head of the Schools of Pharmacy and Biological Sciences. He is co-convenor of the HEA PVC Network, Chair of the HEA Teaching Excellence Framework (TEF) Working Group, a member of the Office for Students TEF Project Board and a Principal Fellow of the HEA.

Recognising and Rewarding Teaching Excellence

Teaching and learning is the bedrock of every higher education (HE) provider. This core academic activity has received renewed focus recently as a consequence of significant changes to the HE landscape, including the introduction of the Higher Education and Research Act 2017 and the establishment of the Office for Students. This presentation will outline the valuable contribution of teaching and learning to the success of a university, describe ways in which we can measure success and impact of teaching and learning, and provide an update on developments to the Teaching Excellence and Student Outcomes Framework (TEF), including subject-level TEF, and the possible impact of TEF on the mathematical sciences.

Thursday 6 September 9:15-10:15

Dr Noel-Ann Bradshaw

Data Scientist and Operational Researcher

Argos

Noel-Ann undertook her degree as a mature student before taking up a position as a lecturer of Mathematics and Operational Research at the University of Greenwich. She instigated several projects designed to increase retention, promote mathematical thinking and maximise graduate outcomes. She was appointed Admissions and New Arrivals Tutor for the School of Computing and Mathematical Sciences and finally became Faculty Director of Employability when the University reorganised four years ago. In this role she saw DLHE scores for graduate outcomes increase by 10% across the Faculty. She has been an external examiner at several universities and is currently Vice President: Communications of the Institute of Mathematics and its Applications. Her work with industry led to her being offered a job as a Data Scientist and Operational Researcher with Sainsbury's Argos which she started in January 2018. She is currently involved in recruiting graduates and is keen to retain links with HE.

Making maths graduates more employable: what does industry really want?

How employable are your graduates; are they 'job-ready'? Do they know what skills they have obtained during their degree and can they articulate them? Should we design the mathematics curriculum to equip them for the workplace and anyway, how do we know what employers really want?

Using my contrasting experiences, gained firstly whilst working as Faculty Director of Employability at the University of Greenwich and subsequently as a Data Scientist and Operational Researcher for Sainsbury's Argos, I will seek to answer these and other questions related to improving employment outcomes for mathematics graduates.

Closing Plenary

Dr Joe Kyle

University of Birmingham

Dr Joe Kyle teaches mathematics at the Open University, UK. Formerly Director of Undergraduate Studies, School of Mathematics at the University of Birmingham, UK, he led the School through Subject Review by QAA in 2000, which became the first mathematics department to achieve the maximum score possible. He was formerly subject lead for mathematics within the LTSN Maths, Stats & OR Network and co-editor of *Effective Learning and Teaching in Mathematics & its Applications* (Kahn & Kyle, 2002).

Wednesday 5 September – Parallel Session I

10:45-11:45

Supporting Postgraduate Taught Students Through Tailored Maths Workshops and Q&A Sessions **Morgiane Richard**

Maths Support at the University of Aberdeen was established in 2012, and has been offered to all students, whatever their discipline and level. Early on, interest was raised amongst the Postgraduate population, which represents about 20% of the whole student population at the University of Aberdeen.

Maths Support for Postgraduate students, however, will necessarily take different shapes to Maths Support for Undergraduates. Their time constraints are different; their timetable is often very full, with little opportunity to fit in potential extra sessions for Maths Support during the semester; they need to clarify their maths queries quickly in order to be able to keep up with the pace of study. In addition, a significant proportion of Postgraduate students are mature students, coming back to studying a Masters a number of years after completing their first degree, who may also be part-time, having to balance between study, work and family time.

In this presentation, I will discuss the range of tailored Maths Support services that I have designed for PGTs on Business, Engineering and Geosciences Masters programmes, in collaboration with relevant Academic staff, and whilst taking into account the constraints mentioned above. I will also give anecdotal evidence that the service has had a positive impact on the students.

Problem Solving in Undergraduate Mathematics: A Thematic Approach **Alison Megeney and Matthew Jones**

Specialist mathematics, statistics and operational research (MSOR) programmes are recognised as intellectually demanding, and require students to formulate, abstract, and solve mathematical problems in a rigorous way. The process of developing the skills to do this well and communicate results can be challenging for learners as it requires a deep understanding of themes in mathematics as well as methods for solving problems.

In this session we'll demonstrate how elements of Freudenthal's Realistic Mathematics Education (RME) can be applied to teaching problem solving in undergraduate mathematics programmes. The aim of the talk is to describe an approach that moves away from standard practices to go beyond problem solving methods and develop an understanding of common themes in mathematics. We begin with Polya, and Burton et al.s toy problems, and demonstrate how, using guided problem solving workshops, we can lead to students' achieving insightful understanding of advanced themes in mathematics.

Our approach applies ideas from RME and scaffolded learning that lead to a sense of ownership of knowledge that more didactic approaches fail to inspire. As an example we will demonstrate how the answering why prime numbers are almost never even can lead to the fact that every pair of prime numbers $p, q > 3$ satisfies $24 \mid p^2 - q^2$, and use this to describe a common theme to solving problems in number theory – that finite fields are easier to deal with than the integers.

Games and recreational mathematics and their use in education

Peter Rowlett and Edward Smith

There is a long history of games and puzzles supporting the development of mathematics. Indeed, much 'serious' mathematics originated in games and recreations. Evidence is presented from the research literature of the role of game play in the development of mathematical thinking and skills. Recreational mathematics is defined, which is not as straightforward as it may initially seem. A discussion is offered of the use of recreational mathematics in developing mathematical thinking and supporting the study of mathematics concepts throughout the higher education curriculum. The presentation then outlines the design and development of a new final year, optional module 'Game Theory and Recreational Mathematics'. This aims to develop an appreciation of the historical development of game theory and recreational mathematics and their relation to mathematics in general, as well as developing problem solving skills and understanding of mathematical topics (combinatorial game theory, graph theory, combinatorics, computation and complexity) through games and recreational mathematics. We argue that games and recreations are a suitable mechanism to develop these topics that is popular with students.

Importance of Quantitative Skills in Higher Education

Mohamed Mehbali and Tracey Celestin-Radix

The session tends to stress the importance of quantitative and statistical skills in higher education.

With the exponential growth of data and its use, an adequate supply of data skills becomes crucial. The data analysis is becoming increasingly important for any industry or business. Within an increasingly competitive global economy, UK must meet the growing demand for people equipped with valuable quantitative skills.

Universities play an important part in the data agenda and a key role in overcoming challenges related to it. Therefore, it is essential to review their quantitative skills provision, considering the type of skills graduates need to succeed in a range of sectors.

There is therefore a need to raise awareness and highlight the importance quantitative skills in Higher Education. Maths Support centres can contribute in embedding these skills in disciplines curriculum other than STEM. Graduates who have gained these skills can produce good quality projects as they make them more employable. If we want our economy to compete at the highest level, our graduates need to be equipped with strong quantitative skills.

The session could be helpful for Maths and Statistics support staff, lecturers, module leaders and course directors.

How to Build a Learning Community

Pamela Docherty

In the National Student Survey 2017, the School of Mathematics was ranked first in the learning community category of all Russell Group Mathematics and Statistics departments. I'll explain how (I think!) we got here – what actions the School has taken to build a learning community among students and staff, what has worked well and what hasn't, and why a strong learning community is so important in higher education.

Maths support centres from a socio-cultural view: providing access to communities of mathematical practice

Kirsten Pfeiffer

Mathematics support centres provide opportunities for students to work in groups or explore mathematics with some guidance, which is often difficult to achieve in large lectures or tutorials. In this talk I will discuss the role of mathematics support centres from a socio-cultural point of view. In this view learning takes place as participation in a community of practice. Providing access to such a community is seen as crucial for the transition from school to university, however it is particularly challenging to provide opportunities of mathematical practice in a university environment. I argue that mathematics support centres have potential to provide such opportunities for students and are therefore significant for the progress of newcomers in the practice.

Discussion and sharing of experience with people from a variety of support centres will lead to ideas how this aspect can be fostered in the centres and also ideas on how to provide evidence for such a phenomenon.

There is no doubt that maths support centres are valuable resources for weak students, however this session focusses on benefits of MSCs for students of all levels including high achievers as worthwhile means to provide opportunities for mathematical practice.

Back to basics!

Morag McFadyen

As an educator, my teaching practice is ever evolving to ensure I fully engage and support my students. Over recent years a perceived weakness in Arithmetic manipulation has become increasingly apparent within the Master of Pharmacy (MPharm) course at RGU. This unfortunately, has also been reflected on students' numerical performance during the MPharm and subsequently in their pre-registration training. To alleviate concerns and develop the students' basic skills in data manipulation I created a numeracy tutorial using IPAD. This took numerical data from an initial laboratory session and focussed on clarifying and enhancing students understanding of basic arithmetic. This was embedded within a 2nd years Biochemistry orientated module and was situated on the virtual learning environment (Moodle).

The resource was evaluated by students' both anecdotally and via a questionnaire on Moodle. Moodle analytical tools were also used to develop feedback on the resource and further analysis on the evaluation will be available for the conference. All who responded found it of value and indeed asked for more skills specific exemplars. This approach is currently being expanded into other parts of the School to support not only the students but also practice colleagues.

Approaches to feedback in the mathematical sciences: just what do students really think?

Michael Grove

Assessment and feedback is an area where mathematical sciences departments have invested significant effort in recent times. A key driver for this has been the National Student Survey (NSS) where particular challenges have been identified relating to both timely and detailed feedback, both of which are important given the widespread use of formative, and typically weekly, problem sheet assessments to aid and structure the mathematical development of learners. Here we report on a first cycle of action research, linked to the implementation of a revised curriculum for 2013/14 in a large research-intensive mathematical sciences department, which was designed to enhance the feedback received by students and their subsequent engagement with it. Whilst we draw up on the results of a survey of 74 undergraduates undertaken in the summer of 2016, we also (briefly) describe the piloting of a method for providing video-based marking and feedback. Following this work there are a number of suggestions or recommendations for adapting feedback practices that will be discussed.

Maths Support for Science: a Reflection of a Blended and Online Development Project

Beth Paschke, Shazia Ahmed, Adrian Lapthorn, Sue Milne and Christina Cobbold

The diverse range of backgrounds that students bring to university has many advantages, but also some challenges such as a wide range of mathematical experience and ability. A particular issue identified by staff teaching mathematics to this cohort was lack of engagement due to the material being presented being too easy or too difficult, with the main concern directed towards students who are weak at maths and others who lack some of the basic skills necessary for a successful undergraduate experience at Glasgow.

Our experience from the Science Fundamentals course is that traditional lectures are a poor way to motivate the weaker students and the more collaborative models of teaching such as online and blended learning may be more appropriate.

We are now coming to the end of a two-year project, where:

- 1) a suite of online resources were developed to supplement material presented in lectures
- 2) students completed a 'Maths Confidence Test' in order to determine the level of support required
- 3) the number of maths lectures were cut down and replaced with tutorials aimed at the weaker students

In this talk, we will discuss our experiences during the two years of running this project, describe the resources developed, reflection based on feedback collected and further plans for supporting the Science Fundamentals cohort next year.

Workshop: Embedding Numeracy and Statistics in Biomedical Science Practical Teaching

Anne Savage, Scott Cameron and Janet Horrocks

In 2016, Abertay University reformed the eight, 15-credit modules per year curriculum to a six, 20-credit module per year model. During this reform, Technique and Skills modules where the statistics teaching resided, were removed from the Biomedical Science (BMS) programme. However, data analysis and numeracy remain essential scientific skills and are required for BMS accreditation. The solution was to embed numeracy and statistics teaching in biology and chemistry laboratory classes. The rationale was to train scientists to incorporate numerical and statistical thinking into all stages of their research from experimental design through to presentation of research findings. This workshop will address challenges such as teaching numeracy and statistics in modules shared with other programmes and working with cohorts who have different mathematical backgrounds. Engaging students through choice of experimental design and delivering material via the 'flipped classroom' and on-line self-assessment will be considered and developing skills in visual, oral and written presentation of scientific data will be discussed.

This workshop will interest those who teach or support practical and laboratory classes and will use group-work to plan a teaching activity; scenarios can be provided or participants may have one in mind.

Wednesday 5 September – Parallel Session II

11:50-12:50

Embedding and assessing statistical problem solving in the undergraduate mathematics curriculum Ellen Marshall

Traditional approaches to learning and teaching in statistics often involves the passive absorption of information through lectures and testing mastery of procedures through exams, which often results in students struggling to apply their statistics knowledge in practical and authentic contexts. Recent research and guidelines (GAISE) for statistics educators recommends shifting the focus of teaching and assessment to statistical problem solving, application based statistics using real-life scenarios, and effective communication of statistics, in order to improve engagement and better prepare students for research and employment.

This session discusses how these recommendations were implemented within an introductory statistics module for mathematics undergraduates at Sheffield Hallam University, along with the challenges and benefits of shifting the focus to statistical problem solving and project based assessment. The statistical problem solving approach, active learning and real-life case studies were embedded within the teaching and assessment of the module. Assessments included a final group presentation which allowed students to work cooperatively to consolidate their knowledge, skills and conceptual understanding through the application to an open project.

Key outcomes from this work are improved attendance, engagement and understanding. Students commented that working with real life data, particularly as a group, had improved their understanding and enjoyment of statistics.

The Transposition Project Julie Crowley and Catherine Palmer

Within the Department of Mathematics at Cork Institute of Technology and at a wider level across the institute, the topic of transposition or rearranging equations has repeatedly been flagged as one of the most problematic. Despite the importance of this topic, students' understanding is below the standards required. Lack of understanding of this topic impacts students' understanding of key concepts across many disciplines. Recognition of the issues surrounding this topic led to the Transposition Project, a project funded by the Teaching and Learning Unit at Cork Institute of Technology and run by ten members of staff from the Department of Mathematics. The project consists of three stages:

- Understand why the topic is not well understood
- Create a teaching tool to improve students' understanding of the topic
- Quantify the impact of the teaching tool

In this talk we will give an overview of the project and present findings from a number of methods employed to explore the problems associated with this topic.

Using attainment and attendance data to identify students in need of support

Calvin Smith, Karen Ayres, Joy Singarayer and Louise Strange

This session describes work done using student data to identify individuals who may be experiencing barriers to learning in the School of Mathematical, Physical and Computational Sciences at the University of Reading. This work is of interest to staff who have a dual role in providing both academic and pastoral support, as well as those more broadly interested in student welfare and programme design.

Students can experience barriers to engagement with their studies during their time at university and it is rarely possible for an observer to determine what these are and the impact they are having on the individual (both personally and in terms of their academic development) without intervention.

In 2017/18 a metric was proposed to monitor student engagement, as a proxy for a broader range of academic engagement issues and cause for concern/wellbeing; this was implemented across the whole School tracking approximately 1000 students.

This session will describe the choice of metric and an analysis of the consequences of this approach, both in terms of individuals identified and programme level data about crisis points in the assessment timetable. Strategies for re-engaging students will be discussed. Tensions with anonymous marking requirements and particular Virtual Learning Environments will also be commented on.

Creating an online mathematics and statistics community of learners

Rachel Hilliam and Gaynor Arrowsmith

There is a need to not only support students at all stages of their student journey, but create a space where they can provide peer support and engage with the mathematics and statistics community. In a society that is driven by social media, it is possible to create online spaces which complement and enhance existing communities available in traditional face to face courses or provide such an environment for students who learn at a distance. The School of Mathematics and Statistics has recently consolidated existing resources to produce a new online website resulting in an active and vibrant community of learners. The site not only contains resources for students to access at appropriate points in their student journey through mathematics and statistics modules and qualifications, but has a number of dedicated and well used online forums, in particular a forum providing course choice information. Discussions in the forum have ultimately led to improvements in the structure of the mathematics and statistics qualifications, content of new modules, assessment strategies, and ways of supporting students. It is a true community of learners where everyone - students, academics and educational advisors - all contribute, learn from each other and shape the student experience.

Stimulating engagement and group work through students' use of whiteboards

Alex Shukie, Wodu Majin, Mike Robinson and Claire Cornock

Within our mathematics courses, tutors have encountered some issues with example classes – i.e. classes where 20-50 students are working on exercises – particularly: student distraction and lack of engagement; and minimal time for individual student-tutor interaction.

To tackle this, some tutors in a variety of modules experimented with the use of whiteboards in class, primarily in two ways: the use of small individual whiteboards, and the use of large whiteboards at which a small group of students work together whilst the tutor moves between different groups.

The evaluation of this comprised anonymous questionnaires of students, student focus groups, classroom observation, and interviews with tutors.

In this presentation we report on these 'board tutorials', with particular reference to 5 themes: the impact on student engagement with the material, the quantity and quality of the interaction between students, the willingness of students to experiment and make mistakes, the interaction between staff and students and the overall staff experience, and the practicalities of using these approaches.

The session should be useful for any tutors who wish to consider alternative approaches to example classes.

Evaluating impact of formative assessment in engineering mathematics

Jonathan Cole and Karen Fraser

In keeping with our University's education strategy, which desires a balance between assessment of learning and assessment for learning, along with a greater focus on continuous assessment and less reliance on examinations, the core mathematics module for first-year engineering students (170 students) has recently been redesigned. The aim is to build student confidence by encouraging them to take greater responsibility for their learning through the use of peer review, self assessment and reflection on the quality of their work and learning.

Data gathered to evidence impact of the changes to the module has come through mid-module evaluation, focus groups, post-module feedback forms and exam results. The mid- and post-module questionnaires contained some questions that invited open-ended responses and others that had a list of responses from which students could select. Focus groups involved a semi-structured approach and participants were selected using purposeful sampling. The qualitative data was analysed thematically. Exam questions that had been used before the new module design were reused and hypothesis tests for the difference in mean marks were conducted while controlling for students' prior mathematical qualification. The session will describe the changes to the module and consider their effectiveness using some of this data.

Those involved with teaching and assessing a large class of mixed mathematical abilities should find this useful. The data is very interesting and the significant challenges associated with the practical implementation of peer review and reflection will be confronted.

Enhancing mathematics support using gaming technology, higher education current perspectives and future considerations

Chrystalla Ferrier

Mathematics support communities have developed, compiled and share a selection of local and external electronically available resources. In addition, hard copy materials and face-to-face guidance complete the support repertoire. Is there another type of resource that may enhance currently offered provision?

A systematic review into the use of serious games to support mathematics requirements in higher education has been undertaken. Research from the last ten years has been categorised and analysed in order to determine current uses of gaming technology, the types of programmes available, levels of use and means of incorporation into mathematics teaching and support. Additionally the use of gaming technology for assessment, formative and/or summative. The review examines student uptake, the nature of use by students and student outcomes following incorporation of gaming technology to the existing repertoire of resources.

People should attend to discuss as a group the findings of the review and the set of proposals arising for the inclusion of serious games into current mathematics support programmes.

Embedding Play in Higher Education

Andrew Wilson

Wisdom begins in wonder or so Socrates teaches — however embedding **wonder** in the fast-paced environment of HE can be challenging. This session will discuss the benefits and challenges of cultivating playfulness in small-group settings. Time spent in class maximises the focus on learning and, by in-game reflection on the dynamics of the playful interactions, is both a spring-board for improvised directed discussions of learning outcomes, and a formative assessment tool to personalise the class to the needs of the individual and group. In addition to showing extremely high levels of satisfaction, the creation of safe, playful and failure-friendly learning spaces gently shifts time in class towards a student-focused and student-centred experience at a pace defined by the group.

This presentation will expose innovative use of games in the promotion of active cooperative learning in the mathematics classroom. The author will discuss the planning and preparation involved in creating and leading a session built around the effective use of playfulness. Through sharing student and tutor feedback and observations, the impact of this methodology will be considered. Participants will leave this session with the tools to take forward the lessons learnt and embed playfulness in their teaching through the use of games.

Speedy Stats: The use of short SPSS sessions to aid student learning and understanding

Carole Ann Louise Davenport

Feedback from students at all levels of university education has shown that core statistics teaching can be very intensive, often requiring students to learn a number of different tests within a single session. The introduction of the Academic Achievement Team at LJMU has allowed the development of a series of short 30 minute sessions, each focusing on a single statistical test using example data sets. Each session covers a brief background to the test, the assumptions to be met, how to carry out the test and examples on how to present the results for a report. There was no requirement to attend all sessions within the series, with many students picking the tests they most wanted to focus on. Feedback was collected throughout the sessions using Meetoo, with a follow up Online Survey questionnaire to monitor the effectiveness of the sessions.

This presentation will explore the feedback given by the students in receiving short, test specific training in SPSS, as well as indicating those that had gone on to receive further support from the Academic Achievement Team within the current academic year. This presentation will be useful for those considering implementing 'speedy' sessions within the support environment, as well as those wishing to embed more into the curriculum.

Workshop: The Quest for the Holy Grail – researching the impact of tutorials on attainment

Alison Loddick

Learning Development at the University of Northampton supports students in academic skills including mathematics and statistics. Recently, along with the international Learning Development community, the team wishes to understand the impact it has upon those who utilise it.

This understanding is incredibly difficult to ascertain but it is imperative to inform our future working. The research aimed to understand the effectiveness and impact of Learning Development upon the students who use the team compared to those who don't by analysing student records and attainment data.

This workshop will share the initial findings from the research examining the impact of mathematics and statistics tutorials - showing on average a 5-6 per cent increase on attainment where students attended a tutorial.

Even with this approach, there are still known limitations with the research such as the impact of student engagement and confounding factors such as parallel subject teaching. Speaking with colleagues at other universities, understanding the impact of tutorials is something we are all grappling with.

This workshop will involve active participation: discussing and exploring different research approaches to share and develop our own practice.

Wednesday 5 September – Parallel Session III

14:50-16:10

Agile Maths

Thomas Davenport, Darren Campbell and Amy Patten

What the session is about

Teaching maths to large groups with a range of prior attainment and ability presents a challenge. Agile started as a software development methodology and has grown encompass project management. Using the concept of short, regular student presentations with peer marking large cohorts gain deeper learning and greater confidence in their maths ability.

The potential outcomes

Students are given permission to discuss concepts and make mistakes in a non-embarrassing context. This encourages more able students to help less able ones which improves the ability of both. The regular presentations mean students can monitor their weekly progress and module leaders have tracking data to monitor engagement of the cohort.

Why people should attend

Managing large modules is a challenging task. Agile Maths gives module owners the ability to deliver the module content and track student engagement week by week. This makes it possible to give timely intervention to the module if a particular topic is not understood and to individuals who fail to make due progress or do not engage.

Using peer-assessment to help students understand marking criteria

Chris Brignell, Tom Wicks and Carmen Tomas

At the University of Nottingham they piloted the use of peer-assessment in order to help students gain greater understanding of the marking criteria and the thought processes staff use when evaluating work. The pilot involved a large first-year mathematics class who completed a formative piece of coursework prior to a problem class. At the problem class students were trained in the use of marking criteria before anonymously marking peer work. The pilot was evaluated using questionnaires (97 responses) at the beginning and end of the class. The questionnaires elicited students' understanding of criteria and perception of their own abilities to solve mathematical problems (self-efficacy).

The survey results showed significant changes on all key aspects. Student's self-perceived confidence in assessing their own work and knowing how to write good solutions to mathematical problems, after the session, had increased. In addition, students' understanding of the assessment criteria was expanded. After the session, explanation of the method and notation (consistent and correct) were much more present in students' descriptions. Furthermore, 67 per cent of students stated they had specific ideas on how to improve their solutions to problems in the future. The pilot gives strong evidence for the use of peer-assessment within mathematics.

MLS and the need and means to be in n places at once – A brief share of ideas

Richard Walsh and Aoife Guerin

This session will briefly discuss current resource allocation at the Mathematics Learning Centre (MLC) at the University of Limerick and avenues that are being pursued to combat the shortage of tutors that the MLC is experiencing. The online support currently being developed with the use of an app entitled 'Explain Everything' will be described (including the benefits and shortcomings of the software). The presenters will open the floor to discussions about various softwares used for developing educational materials in order to facilitate the sharing of best practice and the most efficient and effective use of time and resources. People should attend if they are initiating the use of online methods of Mathematics Learning Support (MLS) in their institutions in order to see one viable way of developing effective materials (with some pitfalls mentioned) and to get involved in discussions around the area.

Piloting a problem-solving module for undergraduate mathematics students

David McConnell

It is widely recognised that problem-solving and mathematical thinking are among the most important skills that students can acquire over the course of a mathematics degree. While students can develop these skills when undertaking 'traditional' undergraduate mathematics modules, many do not, and prepare for exams by practising routine procedural work and rote-memorisation, leaving a significant gap between the mathematics that students 'know about' and the mathematics that they can 'use.'

With these considerations in mind, Cardiff University introduced a new 'Problem Solving' module for second-year mathematics undergraduates, aimed at bridging this gap and enhancing students' mathematical thinking skills. In this talk, we will discuss the pedagogic and practical considerations involved in the design and delivery of such a module, and in particular, the question of how to construct open-ended problems and assessment activities that promote mathematical thinking, and reward genuinely original and independent mathematical work. We will also outline how some of these ideas could potentially be incorporated into written coursework in more 'traditional' mathematics modules.

This talk should be of interest to anybody involved in designing or teaching a similar module, or who is considering piloting alternative forms of written assessment in mathematics modules.

Enhancing teaching, learning and support for Undergraduate Nurses

Karen Symons

The session will be presented in the form of a Case Study to show how analysis and reflection on a range of evidence and data – from both within the institution and outside of the institution (partner NHS Trust)- has provided the impetus to enhance teaching, learning and support for undergraduate Nurses at De Montfort University.

The evidence considered includes informal feedback from students, NHS Trust Preceptorship data and an analysis of student exam responses.

There will be an opportunity to look in detail at the range of methods used by 3rd year Nursing students to answer a drug calculation question and to discuss the implications of these findings for teaching and support. The age old ‘use of a formula’ versus ‘non-formula’ debate!

Please come along and participate.

Success in Employers' Numeracy Tests

Shazia Ahmed, Ruth Douglas, Cunyi Wang, Ann Duff and Nigel Hutchins

Final year students applying for graduate jobs in industry are often required to sit numeracy tests as part of the recruitment process. Students in the College of Arts can be disadvantaged in this area as, often, the last time they will have come across any Mathematics will have been at National 5, GCSE or equivalent level (at the age of 15 or 16).

This project is a collaboration between the Mathematics & Statistics support within the Learning Enhancement and Academic Development Service (LEADS) and the Careers Service to create a repository of resources designed to help students refresh their basic mathematical skills and give them the confidence to tackle Employers’ Numeracy tests successfully.

In this talk we will discuss the content of the Moodle course which includes:

- A video featuring representatives in industry, giving students an insight into the application process and the place of numeracy testing within it;
- Resources and tailored learning materials to enable students to improve their confidence and ability in relevant mathematical and statistical skills;
- Khan Academy style videos giving a step-by-step demonstration of a variety of questions;
- Sample tests to give students an idea of what to expect in a real assessment, including both timed and untimed quizzes.

We will also reflect on the findings based on focus groups run with the target audience, and further plans for supporting our students with the recruitment process.

Teaching Statistics to large cohorts of students through active partnership

Matina Rassias

In this session, by reflecting on personal experience and the information conveyed by student data it is aimed to address some of the notable challenges and the undeniable benefits of engaging students as partners in Statistics education.

Acknowledging that it is the educators' responsibility to have a significant impact in shaping the forward thinking not only of the specialist but also of the non-specialist students in the discipline, educators are often invited to alter their teaching method in order to adjust to the student needs. Active partnership with students can effectively inform the educators' practice and enhance the students learning experience especially in large cohorts of students who study Statistics at an introductory level.

In this session ways that assist towards engaging with students as partners will be presented. Furthermore, it will be discussed on whether educational technologies can improve the experience of both educators and students and assist further towards effective and efficient communication in Statistics modules.

Addressing the BME attainment gap – exploring differential attainment by assessment type in mathematics, chemistry and life sciences

James Denholm-Price, Nigel Page, Neil Williams and Luis Dourado

Assessment practices must consider a significantly more diverse student body nowadays and measures taken to improve assessment should promote inclusivity. Poor legitimacy in assessment harms student confidence when assessments are not inclusive, authentic or linked to developing employability.

Modes or types of assessment have received relatively limited literature scrutiny with respect to the BME attainment gap debate, although there is well-established evidence of differences related to student gender. This project focused on the outcomes of a broad range of assessments with a sample from 25 undergraduate maths, life science and chemistry modules combined with demographic information from nearly 1000 students to examine student performance on different forms of assessment (encompassing formal exams, coursework, "in-class tests" and oral presentations). The sample data showed statistically-significant differences in the attainment of certain groups of students in some assessment modalities, but not all.

This talk will present some of the results of this analysis and their possible interpretation that is relevant to strategies for addressing the BME attainment gap.

The talk aims to give attendees an appreciation of the fact that students perform differently on different types of assessment across different subjects, irrespective of the relative perceived "difficulty" of the subject.

Applications and props: the impact on engagement and understanding

Claire Cornock and Alex Corner

A number of changes have been made to the first year module 'Number and Structure', including the introduction of more applications and the use of physical props when teaching the pure topics. More applied mathematical problems were incorporated because they are "well suited to assist students in acquiring, learning and keeping mathematical concepts, notions, methods and results, by providing motivation for and relevance of mathematical studies" (Blum & Niss, 1991). New additions to the module have included the utilities problem, data storage, cryptography, circuits, the mattress problem and chemistry.

Physical props that have been introduced are tori for the utilities problem, mini mattresses and molecule models. If used in the right way, physical objects can be used to represent abstract ideas in physical form to "help students deeply understand the math they are learning and needing to apply to our everyday life" (Furner & Worrell, 2007).

Evaluation has been carried out to gain the students' opinions on the changes and the impact on engagement and their understanding of the topics. During the session, attendees will hear about the changes and have chance to have a go at one of the exercises. Results from the evaluation will be presented in the session.

References:

- Blum, W. & Niss M. (1991). Applied Mathematical Problem Solving, Modelling, Applications, and Links to other Subjects - State, Trends and Issues in Mathematics Instruction, Educational Studies in Mathematics. Springer, 22(1)
- Furner, J. M., & Worrell, N. L. (2017). The Importance of Using Manipulatives in Teaching Math Today. Transformations, 3(1), 2.

Workshop: A system of tutor training which facilitates formal accreditation

Michael Grove, Ciarán Mac An Bhaird and Ciarán O'Sullivan

This workshop will seek to interrogate a proposed model of structured training for staff working in MLS which is potentially amenable to accreditation.

The impact that tutors in mathematics learning support (MLS) have on the student learning experience is significant. A successful teacher in these critical and challenging educational settings requires a unique set of skills, and appropriate training is crucial. Whilst such training is increasingly commonplace in the UK and Ireland, there is very little or no formal recognition or accreditation for it.

Delegates will be presented with an innovative model of structured MLS staff training. The associated challenge of how to guarantee formal recognition of the learning achieved using the model will be interrogated. Delegates will be asked for feedback on paths to achieving this recognition, this input will be central to selecting the best approach to achieve a model which will fully deliver MLS staff training which can be formally accredited. Feedback will also allow us to understand how the model might be funded, sustained and supported in a constantly evolving HE landscape.

Following this consultation, we hope to pilot and evaluate a model that not only works for those in MLS, but also that offers genuine transferability across disciplines within HE.

Recognising the Impact of Local, National and International Networks for Mathematics and Statistics Support

David Bowers, Shazia Ahmed and Eabhnat Ni Fhloinn

For the past thirteen years, **sigma** has been synonymous with the provision of cross-university mathematics and statistics support. Starting out as a HEFCE-funded CETL (Centre of Excellence in Teaching and Learning) based at Loughborough and Coventry, **sigma** has developed into a recognised professional network of mathematics and statistics support practitioners across the HE sector in England & Wales and beyond.

The Scottish Maths Support Network (SMSN) and the Irish Maths Learning Support Network (IMLSN) were subsequently formed with the aim of creating communities of practice for those with an interest in the provision of mathematics and statistics support in Scottish and Irish HEIs respectively. Through networking, collaborative professional development activities and the CETL-MSOR conferences, strong links have been created and maintained between the three networks.

This presentation will outline the activities and achievements of the networks in recent years, and the impact this has had on the provision of maths and statistics support. Attendees will learn how they and their institutions can become more involved, and will be encouraged to reflect on the possibilities that this offers.

Wednesday 5 September – Lightning Sessions

16:35-17:15

Using class responses systems to promote engagement and feedback in Maths for Chemists lectures

Frances Docherty

Third year students in the School of Chemistry at the University of Glasgow are required to undertake Maths for Chemists lectures to ensure they have adequate mathematical skills for the physical chemistry component of their degree. This cohort of around one hundred students has a wide range of backgrounds and abilities and includes pure chemists, medicinal chemists and those studying for joint honours degrees in chemical physics and chemistry and maths.

On-line voting was introduced to the lectures in a traditional way to allow students to attempt worked examples in the lectures. In addition, the voting system was used to ask students about their maths background and experience in specific topics. This allowed teaching to be tailored to areas where most students were weakest. The exercise also uncovered that the highest level of maths students had ranged from GCSE to 2nd Year University maths. This was surprising and gave the opportunity to create a support system for those with the most basic maths.

Students gave a very positive evaluation of the use of on-line voting in lectures and recommended it be used in subsequent years.

sigma Accessibility SIG: Manager and Tutor Resources

Emma Cliffe, Ciarán Mac An Bhaird, Eabhnat Ní Fhloinn and Clare Trott

In this presentation, we will update delegates on the sigma Accessibility SIG which has been working to develop a range of resources to assist with accessibility issues which are encountered in Maths Learning Support (MLS) and similar environments.

The topics for which resources are being developed include: Dyslexia, Dyscalculia, Maths Anxiety, Mature Students, Hearing Impairment, Dyspraxia, Visual Impairment, Physical Spaces for MLS, Collaborating with Other Student Services, Assistive Technology and Mathematics, Without Pen and Paper, Vocational Entry, English as Second Language, and Autistic Spectrum Conditions.

The resources take the form of A4 sheets, two per accessibility issue, one for the MLS Manager\Director\Co-ordinator and the second for MLS tutors.

The handouts for Managers contains a brief introduction, a list of recommended provisions, advice on working with other university services and recommended reading. The handout for tutors contains an introduction, a description of possible impacts on mathematics, strategies which can help and further information.

We will make delegates aware of where they can access these resources, and invite expressions of interest to be included in trials of these resources over the 2018-19 academic year.

First impressions of mathematical education in Benin and possible scopes for training mathematics teachers

Davide Penazzi

In the first two weeks of June, I visited the Atacora region in Benin with a small group of Mathematics and Physics students from the University of Central Lancashire. Our aim was to present a hands-on method of teaching mathematics, based on techniques from experiential and outdoor learning, to increase mathematical resilience in pupils. This gave us the chance to observe how education is carried in primary schools in Benin, analyse the current levels of mathematics resilience of students, and start identifying possible areas which need an intervention. We believe these preliminary observations and results show the importance of a training program for teachers of mathematics in the country. I will describe what we found and suggest a possible sustainable route for training Beninese and British mathematics teachers.

The Ambassador Scheme: My Experience

Sarah-Rose Muldoon

Sarah has just completed an undergraduate in Mathematics and Statistics at the University of Glasgow. For her fourth year Mathematics project, Sarah took part in the Ambassador Scheme, receiving the Weiglhofer prize for her written report. Through the scheme, Sarah was able to gain vital work experience in a local high school, allowing her to develop her skills and confidence within the classroom. She is currently completing her PGDE in secondary Mathematics at the University of Glasgow and today she will be sharing her experience of the Ambassador Scheme and how it led her into a career in teaching.

MSOR Connections special edition

Robert Wilson

The lightning talk will provide an overview of MSOR Connections and how delegates can publish work presented at the conference to a special edition of the journal.

Thursday 6 September – Parallel Session IV

10:40-11:45

Effective maths support and assistance for students

Inna Namestnikova

One of the reasons of the maths illiteracy is an increasing problem, is the diversity of students' background in mathematics, from students who have studied the more traditional A-level programmes to students with BTEC or international qualifications and mature students who have been out of education for long periods. In recent years Brunel has also dropped the entrance requirements in maths for some courses and as a result there may be students with a full A-level maths qualification (or equivalent) in the same classroom as students with no maths knowledge beyond GCSE, if that.

This talk will explore the ideas behind the running and be improving maths and numeracy support at Brunel University, give an overview of this form of student assistance and provide feedback from staff and students on the operation over the past few years. It is important to consider the costs and benefits, and to try to evaluate the effects of such provision on students' confidence, the failure rate and retention as well as its possible future development given the changing face of the student population and the views of the various stakeholders in HE.

The issues of measuring the impact of the maths support service as well as other challenges that have arisen recently at Brunel and possible ways to overcome them will also be discussed.

This talk will be of interest to anyone who is considering how to engage and effectively support students from a wide variety of different backgrounds and with different levels of ability during their studies at university.

Collaborative Delivery of Education Modules and School Experience Internships

David Bedford

In this session David will detail how the Mathematics Department at Keele is working with local Initial Teacher Training providers, schools and colleges to promote teaching as a career for undergraduates as well as supporting pupils. This work includes the introduction of two modules into the undergraduate programme, one at level 5 and one at level 6, which focus on how mathematics is learned and how mathematics is taught. These modules consist of weekly workshops together with a placement component. Independent of these modules Keele also offer a 4-6 week summer internship programme where students work full time in a school in June/July. David will outline how the modules and internships operate and will offer ideas as to how similar schemes could be set up in other institutions.

Assessing the impact of pre-submission feedback

Calvin Smith, Peter Chamberlain, Karen Ayres and Tristan Pryer

This session reports on the impact of offering students feedback on their assessed coursework before its deadline. Pre-submission feedback was offered to two distinct cohorts, one of specialist mathematicians and one of non-specialists. This work should interest staff who have an interest in the pedagogy of assessment for learning, and those interested in engaging the non-specialist with mathematics. One of the strategies described involves Maple TA so this session may also appeal to colleagues interested in e-learning and e-assessment.

Typically lecturing staff are eager to provide feedback to students on non-credit bearing work at all times during the life-cycle of the problem under consideration (e.g. prior to an attempt, during an attempt and after an attempt). However, there is sometimes a culture of purdah regarding similar conversations regarding assessed work. The provision of pre-submission feedback breaks this culture of silence with the goal of creating additional points of learning at a time when feedback can be effective to the student.

This session describes a number of mechanisms for providing pre-submission feedback to students and analyses the impact. Reflections on how this was achieved, using paper-based assignments and Maple TA, for a cohort of approximately 200 students will also be discussed.

The Engineering Peer Tutors in their own words

Kate Durkacz and Zhamilya Alabergenova

The Engineering Peer Tutor scheme at Edinburgh Napier University was originally developed in September 2012 in response to the challenges of increased student numbers and insufficient mathematics lecturers, which led to larger class sizes. Third and fourth year engineering students were asked to work alongside the lecturer in mathematics tutorials for first and second year

engineering mathematics modules. The peer tutors have taken the maths modules themselves, in previous years of study, so they are familiar with the subject matter, and they are given electronic access to the module materials. It is made clear to them that their own studies must come first, and that they are under no obligation to attend every tutorial. The scheme is currently in its 6th year of operation, and has proved to be advantageous for tutors, tutees and the lecturer. The peer tutors' support in tutorials has been invaluable, and has enabled the tutees to get the help that they need when they need it, and has also encouraged interaction between year groups. In this session, the peer tutor team will give details of the operation of the scheme and explain the benefits to the lecturer, the tutees and the peer tutors.

Undergraduate Mathematics with QTS course, perspectives of students

Ruth Fairclough and Diane Cochrane

This summer the University of Wolverhampton has its first graduates on the BSc(hons) Mathematics with Secondary Education. This undergraduate course also awards successful students with Qualified Teacher Status (QTS) enabling them to take up a teaching position in a UK state school without having to undertake a PGCE. This course is delivered jointly by the Mathematics Department and the Mathematics Secondary Education team across 2 different campuses.

This presentation centres around videos of interviews with students who have just finished their course and those who are part way through this course, where they reflect upon their undergraduate course, including:

- Their increased confidence over the three years of the programme, as result of a sharpening focus on teaching as the course progresses
- Exposure to a number of educational settings and teaching styles
- Learning a subject and learning how to teach it concurrently, with time to reflect and develop
- The connection between the two subjects
- The academic and pastoral support in both subjects
- Relationships with both the BSc Mathematics student cohort on the subject specialist route, and PGCE students
- The support of their school mentors and subject department

Comparison of student engagement in traditional and active learning environments

Lucy Lepore, Jonathan Gillard and Robert Wilson

The use of the "traditional" university lecture is still common place across Higher Education, particularly in the learning and teaching of Mathematics. While there is an increase in "innovative" approaches such as flipped learning, problem based learning etc. the debate on the effectiveness of the different approaches in a mathematical setting still continues.

This session will present outcomes of an initial study in relation to the above debate. In particular, it will report on levels of student engagement recorded in a traditional lecture in comparison with an active learning session among second year mathematics undergraduates at Cardiff University, School of Mathematics. The presentation will include:

- An overview of the approach adopted (based on the "mind-wandering probes" study undertaken by Varao-Sousa and Kingstone (2015));
- An analysis of the trends present in the data collected from the study;
- Reflections on potential developments and future work in this area.

Engaging non-mathematicians in mathematics learning through collaborative teaching

Jinhua Mathias and Christopher Saville

A mathematics module is essential for many science and social sciences courses; however, not every student engages successfully with the subject. This is often true for students who did not choose to study A-level mathematics. They are not intrinsically motivated to study maths and often show anxiety about undertaking the mathematics module. This introduces several challenges to the teaching. If they are not addressed, the consequences would be poor student engagement, low achievement and difficulties in progressing to further years of their degree study.

This session presents the success of collaborative teaching between two departments at Durham University. Two staff with different expertise worked together teaching a first year undergraduate module, Mathematical Methods for Geosciences, aimed at students who had not studied A-level mathematics. One is experienced in teaching mathematics and the other is an expert in Earth Sciences. The benefits of this collaborative approach were; that the delivery of the course had a 'baked-in' quality control system; ideas for content delivery were assessed from multiple educational perspectives; and student motivation was increased, both due to having mathematical content that was easier to follow and to seeing the relevance of the mathematical content to the rest of their degree course.

A Statistical Study of “Attainment Gaps” (and their Possible Causes) in Undergraduate Students’ Performance and Progression in Mathematical Degree Courses at a Post-1992 UK University
Gordon Hunter, Mastaneh Davis and Stenford Runvinga

Previous research (e.g. ECU (2008)) has indicated an “attainment gap” in academic performance and progression between certain groups of students in Higher Education in the UK. Even when factors such as socio-economic background and pre-University attainment levels have been controlled, Black, Asian and other Minority Ethnic (BAME) students tend to achieve lower grades than their White peers. In some disciplines (notably some science subjects), there is also a marked gap between genders.

A previous project at Kingston (2015) indicated that the performance of STEM students at one level of their HE studies correlated significantly and positively with their performance at later levels. However, the regression coefficients (notably the slope) relating their grades at different levels varied considerably between subject disciplines, and subject-specific simple regression only explained a modest proportion of inter-person variation. However, that study did not take any account of students’ individual attributes, e.g. age, gender, ethnicity, socio-economic background.

In this paper, although focusing on the progression and performance of Mathematics degree students at Kingston, we extend the previous project by taking such additional factors into account, to investigate how students from different backgrounds and of different genders and ethnicities perform at different levels of their degree studies. In the first year of their higher education studies, female students of mathematics actually performed slightly better on average than their male peers, and BAME students slightly better than white students, although neither of those differences was statistically significant. Noting that BAME students are more likely to continue living at home during their studies, and thus possibly have long commutes to University, we hypothesised that this could negatively affect their attendance at classes, and hence possibly have a detrimental effect on their academic performance. A student’s average first year module mark proved to be highly significantly correlated with their attendance rate ($R = 0.486$, $df = 84$, $p < 0.001$), although there was substantial variation between students with similar attendance rates.

The picture was somewhat different for students in the second and third years of their degrees. Students’ mean marks in their second and third years were significantly and positively correlated with their mean marks in earlier years. Unfortunately, however, no complete or representative information on their attendance rates was available. Nevertheless, use of multivariate (multiple linear regression and logistic regression) and multi-level regression models have yielded “all else being equal” results, indicating that BAME students typically achieve marks around 3% lower on average than those of their white peers, and older students tend to perform less well than younger ones. Similarly, there are lower proportions of BAME and older students achieving “good” (First and Upper Second Class Honours) grades in their final degree.

We are also investigating the influence of students’ socio-economic backgrounds and entry qualifications on their performance at University, and the influence of all these factors on student progression and attainment of “good” (First or Upper Second Class Honours) final degrees.

These results could be of considerable value for monitoring and addressing the BAME and gender attainment gaps at Kingston University and elsewhere, and to identifying and rectifying the origins of the problem.

Cross Faculty Online Numeracy Testing – determining the baseline

Liam Naughton and Abigail Parkes

In September 2017/18 an Online Numeracy Test was developed and delivered to over 900 students in the Faculty of Science & Engineering at the University of Wolverhampton. The test aims to encourage students to identify any numeracy issues which are likely to have a detrimental effect on their studies and to encourage them to address these issues as soon as possible. This test is part of a wider initiative at UoW to develop appropriate supports for students entering HE. This short presentation will report on the test outcomes as well as on a preliminary investigation of some of the variables which might be used to predict student outcomes in the future.

Workshop: Statistics SIG: Identifying and addressing issues within statistics support

Alun Owen and Ellen Marshall

This session is being organised by the sigma Network Statistics Special Interest Group (SIG) which aims to share best practice and resources within the statistics support and teaching community.

Statistics support is now provided at many HE institutions and although some support relates to the understanding of course content, it is often project based analyses that students require most help with. There are a variety of challenges that staff offering statistics support encounter and this discussion-based workshop will share ideas for addressing some of the most common issues.

- Key issues identified in the past include:
- Training of mathematics and statistics support staff
- How to provide support rather than a consultancy service
- Dealing with an increasing demand around project submission dates
- Providing adequate support with limited resources
- Effective advertising of support

Those involved with statistics support will be canvassed to contribute ideas in advance of this workshop, about the challenges they face, any methods they use for providing effective statistics support and key topics they would like to see discussed during the workshop. A summary of the information provided will be presented during the workshop and used as a base for further discussion.

Thursday 6 September – Parallel Session V

11:45-12:45

Video vs. written assignments: evaluation of student choices

Claire Cornock and Alex Crombie

In 2016/17 a video assignment was introduced into a first year core module, in which all students were required to submit their answers in a short video as one of their coursework tasks. In 2017/18, students were offered the choice of submitting assignment questions either via a video or on paper.

Allowing students to decide on their own method of assessment permits students to exercise choice in how they wish their work to be assessed. This element of choice has been shown to engender greater ownership in outputs which in turn can be linked to better attainment (Patall, Cooper, & Robinson, 2008, Chan, et al, 2014, Tierney, et al, 2014,). The benefits of students choosing to complete a video assignment are then two-fold, and so examining the decision process of students may be able to help us make this choice more appealing.

Evaluation was carried out in the form of focus groups with the aiming of finding out why the students had chosen to do the assignments the way they did.

In the session, details of the assignments will be provided along with the findings from the focus groups. A comparison will be made between allowing the students choice and specifying how they should present their work.

References:

Chan, M., Graham-Day, P., Ressa, K., Peters, V., & Konrad, M. (2014). Beyond Involvement. *Intervention in School and Clinic*, 50(2), 105-113.

Patall, E. A., Cooper, H., & Robinson, J. C. (2008). The effects of choice on intrinsic motivation and related outcomes: a meta-analysis of research findings. *Psychological bulletin*, 134(2), 270.

Tierney, William G, Sablan, Jenna R, Conley, David T, & French, Elizabeth M. (2014). Student Ownership of Learning as a Key Component of College Readiness. *American Behavioral Scientist*, 58(8), 1018-1034.

Extracting the treasure from buried data

Don Shearman

Western Sydney University is a multicampus university situated in the western suburbs of Sydney, Australia. The Mathematics Education Support Hub (MESH) has been providing a drop-in consultation service in several of the university campus libraries for the past five years as one of its modes of support. This service provides mathematics, statistics and basic numeracy support for all undergraduate students of the university regardless of discipline or subject. For each consultation a record has been generated containing data on the student's year level, discipline or subject which has generated the question, approximate duration of the consultation, and a description of the student's query.

By using current text mining techniques it is possible to identify key words, ideas and topics which arise from these consultations and control this information for such things as year of study and general discipline area (mathematics, statistics or other). A better understanding of the information generated by this analysis will allow MESH to be better prepared for future drop-in consultations and to identify or build resources to assist students with the most commonly asked problem areas.

This presentation will discuss both the text mining techniques used and the results obtained from the study.

Baseline

Thomas Davenport

What the session is about

It is important to measure the knowledge and competence of students as they start a programme of learning. Originally this was done at Aston by means of paper screening tests in the first session of the module. As the number of students grew the workload became difficult to manage in the short time available at the beginning of the module. The software, Baseline, was started as an automated method of carrying out screening tests. Originally the tests were carried out simultaneously in computer labs. Later versions allow multiple attempts over a period.

Over the past four years Baseline has grown to become the main delivery tool for maths in Aston's Foundation Year providing content, videos, tutorials, progress and tracking data.

The potential outcomes

Some of the benefits afforded by software like Baseline are:

1. For the Students
The software provides an interactive environment that provides immediate feedback, allows working at the student's own speed and shows progress made as the module progresses.
2. For Staff
Reports provide a regular overview of the whole cohort showing student engagement and identifying those in need of intervention and those at risk of failure/dropping out.

Why people should attend

Teaching is difficult with low staff/student ratios. This paper describes one instance of using a learning environment to assist the delivery of the content and assessment as well as tracking engagement and learning.

The Provision of Mathematics and Statistics Support in Scottish HEIs: A Comparative Study
Morgiane Richard, Kate Durkacz, Shazia Ahmed, Peter Davidson, Calum Macdonald and Alan Walker

The Scottish Mathematics Support Network (SMSN) was formed in July 2008 with the aim of creating a support network for people working in Scottish universities who were involved with, or wished to be involved with, providing mathematical and/or statistical support for their students. Through networking and professional development, the SMSN has developed and maintained strong links with individual practitioners, and more broadly with like-minded groups such as the sigma Network and the Irish Mathematics Learning Support Network. With the provision of mathematics and statistics support becoming more prevalent in UK Higher Education institutions, it seemed timely to assess the current state of this provision in Scotland, and to compare with the rest of the British Isles. At the 2016 SMSN AGM, it was unanimously agreed that such a study should be carried out with the SMSN committee taking responsibility for conducting the research. In this session, we will describe the questionnaire we devised and sent to Scottish HEIs and present the study results. We will discuss how the situation in Scotland compares with the rest of Britain and the Island of Ireland. Finally, we will discuss recommendations we can make for Maths support in Scotland.

Quality assurance for a mathematics support service
Emma Cliffe, Cheryl Voake-Jones and Rob Wilson

During the 2017/18 academic year the Mathematics Resources Centre (MASH) at the University of Bath decided to instigate a quality assurance review process designed and piloted by the team. Relevant University quality assurance statements and associated processes were considered and adapted to produce a draft quality assurance statement and pilot process. This included:

- agreement as to purpose, scope, principles and required evidence base
- appointment of an external critical friend
- collation of the evidence base including data, feedback and accounts of the service provided, change over time, challenges, responses and future plans
- drafting of a pilot review template
- review by the external critical friend who visited the university, spoke with a range of stakeholders and had access to our virtual learning environments
- reflection on the outcomes of the process and formation of an action list
- production of a quality assurance monitoring report forming a coherent summary of the review and actions to be taken.

In this talk two members of the MASH team and the external critical friend will give information about what they did, why they did it and what they learnt from piloting this process.

Making the grade - supporting mathematics students in understanding the use of grade-based marking criteria for assessments

Ewan Russell

Grade-based marking criteria are used widely in humanities subjects, and also in some areas of the sciences. In many mathematics assessments, individual marks are usually clearly allocated for specific elements of working in calculations, computations or theoretical arguments.

With graduate employability as a key focus for institutions, many universities have introduced mathematics modules which aim to develop employability skills. The assessed work in these modules often takes the form of reports, posters or presentations. These components lend themselves to an alternative form of assessment. Adjusting to these alternative forms of assessment can be challenging for mathematics students.

A final year module focusing on the development of professional skills has been running at Keele University for several years now. This session will discuss the use of grade-based marking criteria in this module. Exercises used to familiarise students with the criteria will be explained and the success of these exercises in developing an appreciation for the use of the criteria in assessments will be evaluated.

This session will document how the grade-based criteria were used in tandem with task-specific feedback to provide meaningful feed forward actions for students in their work.

Designing and implementing an intervention module to improve high-achieving, second-level students' problem solving abilities

Aidan Fitzsimons and Eabhnat Ní Fhloinn

Catering for our more-able students within the regular classroom is a difficult task due to different students having different needs or ability levels. Through rigorous research, the author developed a mathematics module rooted in constructivist theory and employing the concept of Problem-Based Learning (PBL). Student cohorts were participants in the Centre of Talented Youth, Ireland, and recognised as high-achieving through PSAT scores or teacher assessments.

Students (aged 14-17) were given an open-ended problem to solve three times over a fourteen week programme (in weeks 1, 8 and 13) and their attempts were graded using a detailed problem-solving rubric. Over the course of the programme, students engaged in the solving of open-ended problems in groups with the author acting as a facilitator in the classroom.

56 students completed the test all 3 weeks, and their results were analysed using a paired t-test, evaluating any change in scores from week one to thirteen, but also week one to eight and eight to thirteen. In students' results evaluated thus far, the scores showed that there was significant evidence to suggest students' problem solving abilities had improved. Changes in students' mindsets over the 3 weeks were also monitored, with strong improvement towards growth mindsets.

Using data to evaluate and improve the effectiveness of the provision

Kinga Zaczek and Katie Shaw

The talk describes an attempt to use data to improve and demonstrate the effectiveness of the Maths, Stats and Numeracy provision at Royal Holloway, University of London. Attainment data in relation to student characteristics and entry grades is used to inform the distribution of teaching resource. Existing attendance data is analysed to assess whether students at risk of low attainment access the Maths, Stats and Numeracy support available to them. Finally, consideration is given to which metrics most effectively demonstrate the impact of the Maths, Stats and Numeracy provision in relation to the university's strategic priorities.

Using data to monitor engagement and inform the differentiation of maths support interventions

Ioannis Lignos

Student engagement has become a major challenge for HE institutions, given its well-documented relation to student success. A basic aspect of engagement is attendance. Low attendance in course programme activities signals an expectation for similar behaviours towards academic support sessions. Although there may be clusters of students which disprove such a correlation, it is a common expectation that students generally disengaged with their programmes would demonstrate a similar behaviour towards all learning activities.

It could be said that failure in maths or science-related assessments is unavoidable for students who have gaps in their maths skills and demonstrate low engagement with both scheduled and support learning activities. Therefore, improving participation in math support sessions could be a first step towards positive learning behaviours.

The session will discuss an attempt for consistent use of collected data during the academic year in order to form a set of interventions which suits the expected student behaviour best and monitor whether target groups of students utilise what is on offer. Specifically, the focus is on the maths support offered to Level 3 and 4 Engineering students at the University of East London during the 2017-8 academic year.

Workshop: Comparative Judgement for Teachers' Understanding of Students' Understanding

Jodie Hunter and Ian Jones

We will introduce a comparative judgement method for assessing mathematics with a focus on teachers' and trainee teachers' professional development. A case study involving primary teachers will be briefly presented, although the main workshop will consider all levels of mathematics teaching.

Comparative judgement-based assessment involves no rubric and no marking. Instead assessors decide, holistically, which of two pieces of work presented side by side on a computer screen is 'better'. Many such binary decisions are then statistically modelled to produce a score for each student. The approach is particularly suited to hard-to-mark assessments such as open-ended questions and problem solving tasks. A programme of research has demonstrated that the approach yields reliable and valid assessment outcomes across a wide range of mathematical topics from primary to undergraduate students.

The workshop will focus on the professional development benefits to teachers and trainee teachers of judging pairs of students' mathematical work. Participants will be given the opportunity to try judging for themselves, and encouraged to discuss and share any arising insights about students' understanding. Three online judging tasks will be available at primary, secondary and tertiary levels to ensure there is something relevant for everyone who attends.

Participants will need access to a device such as a laptop, tablet or smart phone. As delegates will have the opportunity to pair up and work with others, those with no devices are welcome to come along and join in.

Thursday 6 September – Parallel Session VI

13:45-14:45

Quantifying the impact of mathematics support on the performance of undergraduate engineering and computing students

Calum Macdonald

The School of Engineering and Built Environment at Glasgow Caledonian University has provided mathematics support for all students in the school since 2012/13. The main forms of support available include a mathematics summer school at pre-entry to university, diagnostic testing during induction and ongoing term-time support.

This talk extends the work of a previous study and compares the performance of two groups of undergraduate students; those who engaged with mathematics support and those who chose not to engage. Data collected between 2013/14 and 2017/18 for students enrolled on modules with a substantial mathematical content were analysed.

Across the mathematics support community it is highly desirable to identify parameters that can be used to quantify the impact of mathematics support. In this study first diet module marks were used to obtain a measure of the effectiveness of engagement with the support mechanisms. The study showed that there was a substantial and significant difference between the marks achieved by students that engaged with support and those that did not. Students who engaged on average showed a 7% increase in the module mark compared with those who did not engage. The talk describes the processes involved in the study and presents relevant results.

Support for students in their transition to a first year Engineering degree

Stephanie Thomas and Clare Trott

This study aims to better understand and support students during their initial transition into university engineering mathematics as part of an engineering degree. To this end, first year students from three Engineering degree programmes were surveyed: Electrical, Chemical and Materials Engineering students. The research design comprised several stages. Data collected in Stage 1 consisted of both a mathematics diagnostic test and a questionnaire related to students' academic background and study habits. In Stage 2 students completed a maths anxiety questionnaire and took a dyslexia screening test. Finally, Stage 3 involved the development of an online, interactive resource designed to support a holistic approach to the revision of the topic of integration. The resource is in the form of a concept map, colourcoded and dynamic in nature. It is aimed primarily at revision and practice and at students in the first year of university study. The resource has been made available to Engineering students who have been asked to provide feedback via a short questionnaire. Further applications of the resource to cover differentiation, matrices and complex numbers are considered at present as is a more generic template that could be suitable for a variety of purposes.

Identifying Students Maths Anxiety Levels and Helping them Re-engage with Maths Learning

Chetna Patel

There are enough research studies that identify the negative correlation between maths anxiety and poor performance on maths tests. At the Maths Learning Centre (MLC) we attract student who have avoided maths or sadly have tried and not done well enough to continue. Therefore, the MLC has engaged proactively in the field to help student develop their skill to learn maths. Maths Anxiety is known to be more than a simple reluctance to engage or dislike of the subject, it causes trauma suffered by people with recognised phobias such as Post Traumatic Stress Disorder (PTSD). This presentation shows how Maths Anxiety is being identified using a survey. Consideration is given to the usefulness of the identification and a demonstration of some methods being trialled to build maths resilience.

The impact of this study will lead to developing resources and approaches to tackle the maths anxiety problem and this in turn will have a responding effect on students' personal resilience and attainment. For staff this can feed into Course Design, Student feedback and Personal Tutoring.

Facilitating the Creation and Editing of On-Line Resources for the Teaching and Learning of Calculus within the QTI Framework

Gordon Hunter

Development of competence in mathematics is an essential aspect of most higher education programmes of study in science and technology, including specialist courses in mathematics and many other disciplines, including engineering and most natural sciences. Students' knowledge of and expertise in mathematics (or lack thereof), at least at an elementary level, can have a major impact on other aspects of their studies and their subsequent career prospects. However, mathematics is a subject which many students find difficult, they often do not realise its relevance and importance to their other courses, they may not devote as much time or effort to it as they ideally should, and face to face tutorial support is often limited. Although there have been previous attempts to develop on-line tutorial exercises, with automated marking and feedback, to assist students with their mathematical studies, most of these have either been restricted to multiple choice or numerical answer questions, or have only addressed the most elementary of topics – notably simple algebra, functions & graphs and trigonometry.

In a previous paper (Davis & Hunter 2016), we described our efforts to remedy this situation through the production of a set of on-line tutorial resources, called *CalculEng*, which included a variety of exercises on single variable differential and integral calculus, with applications, which could be delivered on-line or using a Virtual Learning Environment such as *Blackboard* or *Moodle*. These exercises, in the form of structured questions developed using the QTI framework, allow algebraic input from the student, which is checked for consistency with the "correct" solution, and with the outcomes of anticipated "common errors", using the *MAXIMA* computer algebra engine. The students' responses were automatically marked, with the aid of the Computer Algebra System, and intelligent, relevant feedback - based on the mistakes made by the student - provided. However, as we noted at that time, the creation and editing of those resources was not a trivial task for tutors, since it required "hard coding" of both the correct and "common mistake" answers in MathML/XML using the QTI framework. Most tutors would tend to find this rather tedious and very time-consuming, which limited the prospects for the range of materials being widely adopted or extended.

Since that previous paper, we have developed a Java desktop question editor application, which allows tutors to type-in questions and both the correct and "common mistake" answers (using ASCII Math notation for equations and formulae) in a straightforward way, and which will automatically generate the required QTI MathML/XML code to render the question and allow the student's responses to interact with *MAXIMA*. The application allows the production of multi-part structured questions, where the answers to later parts of a question depend on the answers to earlier parts. For example, a structured question on differentiation could ask the student to differentiate a specified function, and then find the points where the derivative was zero in order to locate the stationary points of the function. This application will greatly simplify the task of creating and editing additional resources, facilitating making them useful to a wider range of students and for a more comprehensive set of topics.

In addition to providing details on the new editor application, we discuss the design and implementation of resources we have produced, their relevance to various degree curricula, and their evaluation when used on a number of first year mathematical modules both for specialist mathematics students and those studying calculus within other undergraduate science, engineering, economics or business degrees.

“I am a Management student; do I really need to use ANOVAs?” An exploration of discipline-specific Statistical enquires within Mathematics and Statistics Support Centres

Monica-Cristiana Hess

Past studies (Smith & Gadsden, 2006; Curley & Meehan, 2016) reported Statistics and Mathematics-related enquiries encountered in various Mathematics and Statistics Support Centres. However, to the researcher’s knowledge, there is not a study to date that has investigated the nature of Statistics-related enquiries in association with different disciplines. Therefore, the main aim of the current session is to present some findings related to these associations, highlighting similarities and differences across different disciplines.

These findings could potentially lead to the development of a discipline-specific Statistics-related enquiries/frequently asked questions database. This database may offer additional statistical support for both the Statistician and the Student.

Attending this session could open conversations with regards to similarities and differences in terms of Statistics-related enquiries encountered across different disciplines within various Mathematics and Statistics Support Centres.

References

Smith, K. & Gadsden, R. (2006). Sigma SAS rescuing projects. Proceedings of the CETL-MSOR 2006 Annual Conference (pp.149-154). The Maths, Stats & OR Network: University of Birmingham.
Curley, N. & Meehan, M. (2016, September). Most commonly occurring Mathematical difficulties – eight weeks in the life of a Maths Support Centre. Paper presented at the CETL-MSOR 2016 Annual Conference, Loughborough University, UK.

Embedding the practice of teaching mathematics in an undergraduate mathematics degree programme

Robert Wilson and Mathew Pugh

We present on the experiences gained from delivering two third year undergraduate mathematics modules at Cardiff University, School of Mathematics, which seek to encourage students to consider secondary school mathematics teaching as a profession and prepare them for subsequent teacher training programmes. The modules (one delivered through the medium of Welsh) include a compulsory placement in local secondary schools, and are assessed via essays and a viva. We will discuss how the modules have evolved over the 5 years that they have been running, not least in terms of the nature and volume of assessment utilised, and reflect on:

- the positive impact of introducing the modules to the undergraduate programmes;
- the challenges such modules present to mathematics students and lecturers alike;
- the potential for expanding provision in this area.

The session will appeal to practitioners from the full range of mathematical related disciplines, particularly programme leads considering potential curriculum developments with the School/F.E. sector.

Maths Hangouts - Breaking Down the GCSE Maths Barrier using Team Based Learning

Rebecca Butler and Liam Naughton

Students need GCSE Mathematics at grade C/4 to progress into Higher Education and many professions. This grade C target was missed by 39 % of 16 year old mathematics examination entrants in 2016.¹ Most of these students (80 %) head to Further Education (FE) Colleges where least progress in Mathematics is made when compared to other types of institution.² In 2016 only 29.5 % of post 16 year olds were able to reach the grade C standard at re-sit.¹ Additionally in deprived areas [like Wolverhampton and the Black Country] results drop on average by 0.8 of a grade and further declines as the number of attempts increases.³ Clearly a new approach is required.

The School of Pharmacy at the University of Wolverhampton are experts in Team-Based-Learning (TBL), a structured peer learning approach. In conjunction with the Aspire to HE initiative, which seeks to allow all school and college leaders to make an informed and ambitious decision about higher education and their future, a course utilising TBL was developed to support students re-sitting GCSE Mathematics. This presentation will describe the approach used, the student feedback and evaluation of the program and the outcomes for the students who took part.

1. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/548277/Detail_analysis_of_summer_2016_GCSE_results.pdf

2. <https://www.tes.com/news/further-education/breaking-news/college-students-are-not-progressing-english-and-maths-dfe-data>

3. <https://www.tes.com/news/further-education/breaking-news/poorest-students-hit-hardest-gcse-resits>

Learning Undergraduate Mathematics and Computer Programming: How can one inform the other?

Chunhua Yang and Siri Chongchitnan

It is well known that many undergraduate mathematics courses can be supported and enhanced by using computer programming to solve challenging numerical problems that are difficult to do by hand. However, the reverse link, of how the learning of computer programming can be enhanced by learning mathematics, is much less understood.

In this session, it will be presented that mathematics students perceive possible links between learning university mathematics and learning a programming language. The results are based on analysing qualitative data collected from intensive interviews with second-year mathematics students who had learnt introductory computer programming in year one. The preliminary data analysis suggests that there are some mathematics courses that are perceived by students to share some learning demands with computer programming.

The session will be of interest to those who teach mathematics courses with computational elements, as well as those who are keen users of ICT in their classes.

The contribution of interdisciplinary learning to employability development in maths and engineering

Alex Crombie and Peter Rowlett

In an effort to improve students' employability development, second year mathematics and aerospace engineering modules were brought together to complete a short interdisciplinary project designed to require input from both disciplines. The teaching intervention required engagement with a simulated tender process, which constituted the assessed output. Students undertaking the project were measured before and after the intervention on scales related to employability to examine what impact this process had.

With the expansion of the higher education sector, employability is becoming an increasingly important aspect of higher education to all stakeholders. The responsibility of tertiary education providers must extend beyond the graduation of students and support their mobility in the labour market. In order to do this, an increasing focus on how to deliver content which is not only technically appropriate, but provides sufficient employability development is important. Interdisciplinary teaching has the potential to develop students in ways that are strongly aligned to improved employability - self-efficacy, communication, reduced egocentrism, et cetera.

This talk discusses the design and delivery of an interdisciplinary teaching intervention and how the various features of this process impact students' employability development.

Workshop: STACK: Improve your online mathematics assessment and feedback

Ian Jones

The workshop will introduce the STACK question format in Moodle for the assessment of mathematics.

STACK allows students to enter answers using standard mathematical notation which are then automatically marked using a computer algebra system (MAXIMA). This approach offers a substantial improvement on multiple-choice or simple text-matching systems. Moreover, questions can be randomised (so one student might get "expand $(x+2)(x-5)$ " another "expand $(x+3)(x-4)$ " etc) and personalised feedback can be provided based on the particular random variant the student saw and, uniquely, their attempted answer.

In the workshop, participants will be provided with an overview of what STACK can do, including example test questions, and the basics of borrowing, adapting and writing questions. The second half of the workshop will involve participants working through the tutorials at <https://stack.maths.ed.ac.uk/demo> with help from the presenter. If you already have access to Moodle and STACK at your institution you are more than welcome to have a go at the tutorials beforehand, and to bring some example questions you would like to implement.

Participants are required to bring a laptop with them.

List of Delegates

Shazia Ahmed, University of Glasgow
Zhamilya Alabergenova, Edinburgh Napier University
David Bedford, Keele University
David Bowers, University of Essex
Noel-Ann Bradshaw, Argos
Liam Brierley, Coventry University
Chris Brignell, University of Nottingham
Gavin Brooks, University of Reading
Scott Cameron, Abertay University
Emma Cliffe, University of Bath
Jonathan Cole, Queen's University Belfast
Alex Corner, Sheffield Hallam University
Claire Cornock, Sheffield Hallam University
Alex Crombie, Sheffield Hallam University
Anthony Cronin, University College Dublin
Julie Crowley, Cork Institute of Technology
Thomas Davenport, Aston University
Peter Davidson, University of Strathclyde
John Davies, University of Glasgow
James Denholm-Price, Kingston University
Frances Docherty, University of Glasgow
Pamela Docherty, University of Edinburgh
Ruth Douglas, University of Glasgow
Kate Durkacz, Edinburgh Napier University
Ruth Fairclough, University of Wolverhampton
Chrystalla Ferrier, University of Westminster
Aidan Fitzsimons, Dublin City University
Nick Goddard, University of Chester
Christopher Graham, Newcastle University
Michael Grove, University of Birmingham
Aoife Guerin, University of Limerick
Monica-Cristiana Hess, University of Bath
Rachel Hilliam, The Open University
Mark Hodds, Coventry University
Janet Horrocks, Abertay University
Henri Huijberts, Queen Mary, University of London
Gordon Hunter, Kingston University
Jodie Hunter, Massey University
Ian Jones, Loughborough University
Matthew Jones, Middlesex University

Joe Kyle, University of Birmingham
Wendy Lawrenson, University of Aberdeen
Duncan Lawson, Newman University
Ioannis Lignos, University of East London
John Little, Robert Gordon University
Yinuo Liu, University of Glasgow
Alison Loddick, University of Northampton
Ciarán Mac an Bhaird, Maynooth University
Calum Macdonald, Glasgow Caledonian University
Wodu Majin, Sheffield Hallam University
Tony Mann, University of Greenwich
Basile Marquier, University of Sheffield
Ellen Marshall, Sheffield Hallam University
Jean Mathias, Durham University
David McConnell, Cardiff University
Morag McFadyen, Robert Gordon University
Ben McGovern, The University of Sheffield
Alison Megeney, Middlesex University
Mohamed Mehbali, London South Bank University
Sarah-Rose Muldoon, University of Glasgow
Inna Namestnikova, Brunel University
Liam Naughton, University of Wolverhampton
Eabhnat Ni Fhloinn, Dublin City University
Ciaran O'Sullivan, IT Tallgt
Alun Owen, Coventry University
Catherine Palmer, Cork Institute of Technology
Abigail Parkes, University of Wolverhampton
Clare Parks, Quality Assurance Agency
Beth Paschke, University of Glasgow
Chetna Patel, De Montfort University
Davide Penazzi, University of Central Lancashire
Kirsten Pfeiffer, NUI
David Pritchard, University of Strathclyde
Mathew Pugh, Cardiff University
David Quinn, University of Edinburgh
Matina Rassias, University College London
Morgiane Richard, University of Aberdeen
Mike Robinson, Sheffield Hallam University

Peter Rowlett, Sheffield Hallam University
Ewan Russell, Keele University
Anne Savage, Abertay University
Christopher Saville, Durham University
Jia Shao, Coventry University
Laurence Shaw, Nottingham Trent University
Don Shearman, Western Sydney University
Alexandra Shukie, Sheffield Hallam University
Calvin Smith, University of Reading
Ed Southwood, University of Bath
Craig Stark, Abertay University
Peter Sweby, University of Reading
Karen Symons, De Montfort University
Jim Tabor, Coventry University
Stephanie Thomas, Loughborough University
Clare Trott, Loughborough University
George Vazanellis, University of Glasgow
Alan Walker, University of West of Scotland
Richard Walsh, University of Limerick
Samuel Walton, Birmingham City University
Graham Weston, University of Leeds
Andrew Wilson, University of Glasgow
Robert Wilson, Cardiff University
Sarah Woodall, Sheffield Hallam University
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Notes

