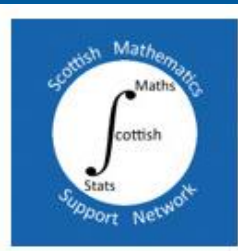


# CELT-MSOR 2022



Abertay  
University

Abertay University, Dundee, UK

1<sup>st</sup> – 2<sup>nd</sup> September 2022

**Book of Abstracts**

# Keynote Speakers

## **A problem shared is a problem halved: moving forward with mathematics and mathematics**

Ciarán Mac an Bhaird, Maynooth University  
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In this talk we will discuss the importance of shared experiences in the teaching, learning and development of mathematics. Many students, particularly those struggling with mathematics, are not efficient in how they study the subject, inadvertently raising further barriers which can inhibit their progress. This issue has been exacerbated by the move online during COVID-19. We consider the significant positive influences that mathematics support, both online and in-person, has had on getting students to work together, increasing their appreciation of the value of discussing solution attempts, helping to tackle the fear of asking for help and realising the importance of 'getting things wrong' in the learning process. In addition to interactions with their peers, students can also participate in discussions between mathematics support tutors on how to approach problems. Students are often unaware of the experiments and underlying processes which were involved in the development of much of the mathematical theory that they study. Indeed, many major mathematical breakthroughs were as a direct result of an initial 'bending of the rules' and collaborations. We will look at some of these historical examples and make the case for increased incorporation of the history and development of mathematics into all forms of mathematical teaching.

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## **Data Science: transformation or transition?**

Rachel Hilliam, The Open University  
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In 2020 the Alliance of Data Science Professionals was created to shape professional standards within data science. It was argued that such standards were needed to ensure an ethical and well-governed approach within data science, so the public, organisations and governments can have confidence in how their data are used. The Alliance includes The British Computer Society (BCS), The Operational Research (OR) Society, Institute of Mathematics & its Applications (IMA), The National Physical Laboratory (NPL), Royal Statistical Society (RSS) and The Alan Turing Institute (ATI). The work quickly gained support from Government and is referenced in the National Data Strategy.

However, are these standards necessary and how do they differ from those for professional titles such as Chartered Mathematician, Chartered Statistician or Chartered IT Professional? In this talk we will consider the rise of Data Science both as a profession and a degree qualification and revisit the question of whether data science is a new professionalism or whether it is just statistics with a new title.

The talk will outline why these standards in Data Science are necessary to address current issues, such as data breaches, data misuse in modelling and bias in artificial intelligence. And how they can give people confidence that their data is being used ethically, stored safely, and analysed robustly. We will outline the progress which the Alliance has made in collaboration with volunteers and stakeholders to develop a certification process and create a searchable public register of certified data science professionals. The Alliance is also committed to supporting quality enhancement of data science education in the UK and internationally. Alongside The Alan Turing Institute, the Alliance is working to stimulate the development of open-source material addressing the most significant curricular gaps in data science and to provide training to support data science educators to adopt evidence-led best practices in their delivery. The talk will conclude by considering the impact this work will have on the curricula within HEIs and the implications for those working in mathematics and statistics support centres.

# Presentation Abstracts

## An Updated Show of Hands

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It is a tried and tested technique to gauge the overall understanding of a class: a multiple-choice quiz with a show of hands for who thinks the answer is a, b or c. Although quick and easy, how much does it really measure the students' understanding? On top of that, how useful is it as an informal formative assessment? Few students usually dominate the class and lesser confident students may not put up their hand, or may follow what their classmates are doing, and hence both the learner and educator may never know the individuals' true answer. Cold calling techniques can be used with some success, provided that the student have built confidence in giving answers in front of their colleagues.

Here we discuss "an updated show of hands", whereby students scan a QR code to take them to a realtime quiz they can answer on their smartphone. All students answer the same question at the same time, and after a set time, the correct answer is revealed and the class results for that question are then displayed to everyone as an anonymous percentage. Whilst this updated method has the obvious advantage of anonymity and the obvious disadvantage of potential technical problems, in this presentation we provide an in-depth discussion on the pedagogy and practicalities of the updated show of hands – the realtime smartphone quiz.

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## Embedding Fundamental Data Skills for Students in Non-cognate Subject Areas

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Modes of delivery in Mathematical Sciences - the best of the old and the new.

As part of an Office for Students funded project, staff at the University of Wolverhampton secured funding to trial the delivery of a self paced online data skills course to students in subject areas where this kind of material might not usually be included. In this presentation we will report on the design, delivery and preliminary findings from the pilot delivery of this course to students.

We will also report on some of the findings from a parallel aspect of this project which uses structured interviews with staff and students to gather data on the perception of the pedagogical approaches best suited to embed data skills in non-cognate subject areas.

This important work is contributing to government strategic policy around the National Data Strategy.

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## How to train more excellent mathematicians?

**First Author:** Chris Brignell

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The Bond Review noted that “skilled mathematicians of a high calibre are needed and they are in short supply” and the Council for Mathematical Sciences has called for double the number of Master’s and PhD students in order to meet employer demand for skilled mathematicians as the STEM sector of the economy grows. So how are we going to meet this need?

According to UCAS, the number of students studying mathematical sciences degrees has not increased over the past 10 years. Female students, students from state schools and FE colleges, some ethnicities and students from low socio-economic backgrounds are all under-represented in the mathematics undergraduate community. Many of the reasons behind this unequal access to HE are not specific to mathematics, but the unequal access to Further Mathematics A-Level and the typically high entry requirements for mathematics courses exacerbate the problem. The government-funded Advanced Maths Support Programme and Mathematics Schools combined with university-led outreach, tutoring and mentoring programmes aim to address this problem but are they successful?

Once at university, students from disadvantaged backgrounds have lower retention and success rates than their peers. Does school mathematics adequately prepare students for university mathematics? Do interventions such as peer-mentoring, maths support centres and a greater diversity of assessment formats help students from less traditional backgrounds make the transition? At postgraduate level, there is even less diversity. Other allied subjects, such as data science, run conversion courses supported by scholarships and industrial placements to draw graduates of other disciplines back into the subject. Would such an approach work for mathematics?

In this session I will report findings from semi-structured interviews with professionals working in HE mathematics departments and charities supporting students into HE. The interviews, combined with a literature review, show that there are several inter-related problems, each with multiple potential solutions.

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## Using the concept of 'Statistical literacy' as a guiding heuristic to create a learning experience

**First Author:** Adrian Bromage

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In 2021-2022, Coventry University's sigma centre was awarded funding for a bid led by Dr. Alun Owen to develop a workbook entitled "Developing Resources to Enhance Research Culture" and associated videos. My role was to write the first of three units for the workbook, entitled "Introduction to quantitative research methods" as a primer for the subsequent sections.

Sigma operates for all staff & students across Coventry University. Many courses at Coventry have a data analysis component, and this can surprise students of the humanities, who may feel under-confident or uninterested in mathematics and statistics. That summarises the key challenge facing many colleagues, helping students become confident and able to apply appropriate statistical techniques.

My contribution to the workbook drew heavily on my prior experiences as a research fellow on 'Transform Statistics' (2019-21), a project to develop brief video resources. The team also published a literature review on current thinking in statistics education (Bromage, Pierce, Reader & Compton, 2021).

This body of literature broadly advocates the development of learners' 'statistical literacy', moving away from focussing on mathematical calculations to focus on statistical concepts. The wide availability of software such as SPSS, Jamovi and R facilitates this.

My presentation will explore how I selected relevant recommendations and guidelines from that body of literature, and how I operationalised them within the context of my contribution to the workbook.

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## **Student engagement and statistical anxiety**

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At the OU we have students on different qualification routes studying a second year statistics module. The module has around 800 students on it and the majority of the students are not studying for a Mathematics or Statistics degree- many are Data scientists, Economists or studying for our Open degree.

Students are allocated to tutors on the basis of the qualification that they are studying and tutorials, which are open to all students, are arranged by core topics, by qualification group, and on specific skills. Additionally students have some sessions just with their tutors and tutor group. We hoped that this approach might increase tutorial participation by building on the common ground of qualification route amongst students.

The talk will outline how we measure some elements of engagement by looking at tutorial attendance and viewings of recordings by qualification group. Similarly, we look at engagement in terms of assignment submission and collection by qualification. The talk will go on to outline how a drive to increase engagement led us to consider statistical anxiety and both how we might recognise, measure and seek to reduce it.

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## **Raising Awareness around Dyscalculia in a Technological University**

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The "Raising Awareness Around Dyscalculia" project has been running in Munster Technological University since 2020. The project is a collaboration between the Disability Support Service, the Academic Learning Centre, the Mathematics Department and a student partner. The objectives of this project are to raise awareness about dyscalculia in our University community, identify best practice approaches to support MTU students with dyscalculia and create a plan to implement what we have learned with our students. Over the two years of the project so far, we have organised various workshops and feedback gathering sessions. We have used the outcomes of these to inform the direction of the project and to feed into the creation of resources for students and lecturers.

This project has created an opportunity and a space for the team to work closer together and to access external expertise in this field to develop best practice in supporting our students with dyscalculia. It has also created focus and time for reflection on how to follow through on what we have learned. Following the principles of Universal Design for Learning (UDL) we hope that the outcomes of this project improve the learning experience of all students dealing with Mathematics, Statistics and general numeracy in their studies. Working with our student partner and eliciting inputs from other students have been invaluable throughout this project. In this talk we will present what we have learned so far and discuss our reflections on how the project has progressed. We will also elaborate on and our plans for the future of the project.

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## **What does ‘partnership’ mean within this conference community?**

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Partnership has many meanings depending on context. Healy, Flint and Harrington (2014) give a definition of partnership widely accepted in the context of higher education, which informed a number of collaborations we undertook during the pandemic, Casey et al. (2022), and yet we found limited examples of such defined partnership activity in mathematics.

We wondered how the term partnership is used in this conference community. What other meanings and contexts do we have for “partnership”? Using the MSOR Connections journal as a proxy for the conference community we sought to figure this out. We used NVivo to search for ‘partner\*’ within the journal issued between 2016 and 2021.

In this talk we would like to discuss our findings about how the words “partner” or ‘partnership’ are used within the community.

Healey, M., Flint, A., & Harrington, K. (2014). Engagement through Partnership: Students as Partners in Learning and Teaching in Higher Education. York: HEA.

Casey, D., Fairclough, I., Perisic, V., Carey, W., & Smith, A. (2022). Facing Challenges in Remote Mathematics Education and Support by building a Community of Practice around Student-Staff Partnership. MSOR Connections, 20(1), pp.102-110.

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## **A Modern Twist on Traditional Mathematics Lectures**

**First Author:** Kristian Evans

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Providing meaningful recordings for traditional 'chalk and talk' lectures can be challenging - standard audio-visual equipment can usually provide good audio recordings, but technical details written on boards can be cut off or not legible. Many academics have therefore chosen to use different techniques of teaching, for example, using slides or tablets, to try to avoid these issues. Over the last academic year, a group of lecturers from the Mathematics Department at Swansea University have trialled the use of tracking cameras with very positive results. In our experience, this technology provides very good quality recordings of technical materials written on boards. In this talk I aim to provide an overview of our experiences using this technology.

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## **Improving student engagement through employability themed group work**

**First Author:** Simon Fairfax

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During 2021-22, I introduced a group project into my second-year financial mathematics module (for students not on financial mathematics programmes), with approximately 150 students, written from the perspective of a fictional employer. Half of the students on this module were from our overseas partnership University, XJTLU based in China, and the other half were predominately UK students. As part of the project design, I held discussions with the Careers and Employability team for enhancement from a careers point of view. I also received input from experts from industry to ensure it is an authentic piece of assessment. The assessment design aimed to bring together these like-minded mathematics under-graduates from completely different cultures. Of course, there was a bit of fine tuning to bring it in line with the module specification and the development of processes to ensure a collaborative & supportive environment.

In this talk, I will present ways to embed employability into large modules. I will discuss how I created an environment for students which allows them to explore their career prospects, facilitates reflective practice, encourages peer learning, and takes steps to promote multi-cultural integration within the mathematics student community. Finally, as part of the evaluation of this group project, I will discuss the impact it had student engagement and their confidence.

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## **Can the use of digital badges enhance maths support?**

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The University of Westminster School of Life Sciences offers maths support to students, within modules and as extracurricular sessions. We are currently working on a new project which will provide all students with permanent access to a dedicated site on our virtual learning environment for maths support. The organisation and structure of this site in addition to providing generic core mathematics skills for our courses will also provide specific items relevant to each of our degree pathways. The site will include existing resources we have available, links to external sources and new to our provision, the option of digital badge

recognition for the completion of some of the available activities. It is envisaged that a well-constructed set of activities leading to digital badges will encourage use of the site and improve engagement for those requiring maths support.

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## **Barriers to engagement: The student perspective of Mathematics and Statistics Support**

**First Author:** Holly Gilbert

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It has been regularly reported that engagement with mathematics and statistics support (MSS) had rapidly declined at the beginning of the pandemic when all higher education activities moved online. It has also been reported that, following that initial drastic drop, student numbers have gradually increased, although in many cases usage of MSS has not returned to pre-pandemic levels. Beginning with a pilot study at Coventry University, before investigating further afield, this mixed methods study investigates current student opinion of MSS, both in-person and online. All levels of engagement have been explored, from both online and in-person use, through using just one mode of MSS, to never having used any support, across all levels at universities both in and outside of the UK. A preliminary questionnaire gathered initial student characteristics and their use of MSS, gaining a baseline of general student opinion, and data from follow-up focus groups and interviews further explain ideas generated from questionnaire responses. With a focus on barriers to engagement, this study seeks to explore whether there is significant difference in student opinion of MSS provision based on the form they have used and also to identify recommendations for improving student engagement with both forms of MSS.

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## **Student engagement with mathematics and statistics support: some student perspectives**

**First Author:** Farhana Gokhool

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The rising requirement for quantitative skills in numerous academic disciplines has been highlighted for many years, alongside the numerical shortcomings of countless incoming undergraduates. One of the measures taken to combat this skill deficit has been the establishment of free, optional mathematics and statistics support across universities worldwide. However, despite the convenience and success of these centres, many students in need of support still fail to access them.

The discussed research aims to discover student explanations for engagement (or non-engagement) through the use of semi-structured interviews and questionnaires. The data findings will be shared, alongside proposed changes to the delivery of MSS to increase student engagement with the services. Some focus will be placed on student suggestions on how to encourage mathematically anxious to access the support, as well as the current methods used that students accept are already particularly successful.

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## **A case-study using the open-source Chirun tool to build accessible, flexible learning materials for a mathematical programming module**

**First Author:** Chris Graham

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This talk will consider the development and delivery of a module in mathematical programming, which utilises the Chirun software to prepare learning material. Chirun is an open-source tool, developed at Newcastle University and used at other institutions around the UK. It produces flexible and accessible course notes, in a variety of formats, from LaTeX or Markdown source and is aimed primarily at notes in the mathematical sciences.

Originally developed to accommodate a web-based alternative to traditional formats for mathematical lecture notes, the output allows students to personalise their learning material with, for example, changes to font size, line-spacing or background colour, and offers the flexibility of multiple output formats, including themes which allow content to be customised to different applications. For example, Chirun powers the content on the mathematics and statistics support website at Newcastle University, whilst allowing a page or section of the same content to be embedded directly into module pages in our virtual learning environment, wherever it may be useful.

This flexibility has additional benefits in the teaching of mathematical programming, where the addition of programming software and languages into the learning process adds complexity to the accessibility of course material. Chirun allows the same source material to generate web-based handouts, a Jupyter notebook version of the same content, as well as a printable PDF. The web-based format enriches content, allowing, for example, code to be run directly in the page, without the need for programming software, and the embedding of web-based programming exercises, which allow students to receive feedback on their progress directly inside practical handouts. The talk will discuss the impact of the learning material on the running of practical sessions during and post-pandemic and the positive engagement from students with the course material.

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## **Using online STACK assessment to teach complex analysis: a prototype course design?**

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We describe a new course design, informed by our experience of the pandemic, that we think could be used in other high-level mathematics courses.

The course's main resource was a set of interactive STACK workbooks containing the course notes, automatically-marked comprehension and practice questions for self-assessment, and short videos of examples, calculations and high-level motivation. This freed up synchronous class time to address conceptual understanding using interactive polling. We will give an overview of the design and talk about how it worked in practice.

This project was joint work with Giampaolo D'Alessandro (University of Southampton), Ivona Gjeroska, Maddy Baron, and Jie Xin Ng (student interns).

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## **Supporting teaching enhancements within a large mathematics department**

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The Mathematics Centre for Enhancement in Education (MathsCEE) at The University of Liverpool comprises academics on the Teaching and Scholarship career pathway, and was founded to enhance mathematics education both within and beyond the department, through enhancement projects and scholarly activities. These included flipped classrooms, active learning workshops, and team teaching.

These practices provided the foundations for the department's remote delivery, and the team were instrumental in ensuring continuity and quality of provision during the pandemic. The team are currently supporting the department to make the most of lessons learnt as we navigate the 'new normal'. This talk will combine concrete examples and reflections from the 'before', 'during' and 'after' phases of this journey.

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## **The use of Tablet PCs in mathematics learning and teaching**

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At the Department of Mathematical Sciences at the University of Liverpool, an increasing number of lecturers use Tablet PCs for mathematics delivery. A Tablet PC is a computer equipped with a touch screen, which enables us to write notes electronically using a digital pen, while at the same time providing all functions of a PC. Tablet PCs have been used in education for many years to enhance teaching practice in diverse disciplines, including mathematics. The use of Tablet PCs for teaching mathematics has been particularly important during the pandemic, facilitating high-quality learning and teaching in remote settings. Among other benefits of remote uses, Tablet PCs enable to create asynchronous videos (e.g. pencasts) and support synchronous one-to-one or one-to-many interactions.

In this talk, I will discuss various ways of using a Tablet PC to enhance teaching practice and to contribute to better student experience. I will talk about wide-ranging benefits of using Tablet PC for teaching mathematics, and I will also present results of a 2021 study that investigated student perceptions of mathematics learning and teaching conducted using Tablet PCs, in both face-to-face and online contexts. This study also provides comparative results of a variety of approaches for mathematics delivery, based on students' responses. Students responding to comparative questions about delivery styles experienced traditional delivery (board & chalk) and delivery using a Tablet PC.

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## **What do our student staff know about supporting peers with accessibility requirements?**

**First Author:** Ruth Hand

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Many of the student facing tutors in maths support centres are themselves students and young people. How well do they understand the access requirements of the students they support and does their lack of experience affect their ability to confidently support these students?

A survey of Mathematics Support Centre staff (Cliffe et al, 2019) reported varying levels of awareness, both in terms of understanding the range of learning difficulties experienced by student and knowledge of how best to support them. Cliffe et al identified a need for high quality training resources and recommended training activities for tutors working in mathematics support. Subsequently, the sigma Accessibility SIG produced advice sheets to address this need. The advice sheets come in pairs, one for tutors and one for managers of mathematics support centres. The team at Maynooth University initially trialled the dyslexia resources (Heraty et al, 2021).

A small group of peer tutors, working in the maths support centre at the University of Bath, trialled all four currently available advice sheets, which offer information and practical advice on supporting students with dyslexia, dyspraxia, dyscalculia and mature students. The tutors filled in a survey about their understanding of and their confidence in supporting these students before and after they received the resources.

A survey of teachers in England and Wales (Knight, 2018) demonstrated that school teachers have only a basic understanding of dyslexia centred mainly on behavioural issues and Knight argues that high quality teacher training increases knowledge and confidence in working with dyslexic students. Taking Knight's method as a model the peer tutors' responses were coded in an analogous way. In this session, a comparison of the tutors' responses and those of Knight's teachers will be presented.

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## **Where shall we start? Using knowledge of pre-university teaching to support transition to university.**

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Many courses have entry requirements of a particular grade at GCSE or A-Level maths. However, are our expectations of students' prior knowledge realistic, even when we know their grades? It is not unexpected when students with the highest grades will not be entirely familiar with everything on the syllabus. If there is a gap between a student's level of knowledge at the beginning of the course and the level of knowledge we expect the student to have, can they succeed?

This session will describe what we can reasonably expect students with different grades at GCSE or A-Level to know, informed by experience of teaching in the 11-18 age bracket. We will look at topics covered on GCSE and A-Level courses and the differences in approach between school and university teaching.

We will go on to discuss the approach taken towards these problems by the MASH service at the University of Sheffield. At the beginning of the year, we provide diagnostic tests to many courses, before students get too far into their new courses. We will discuss how these tests have been constructed and which topics are

chosen for inclusion. Students are then directed to a curated suite of online resources, depending on which questions they answered correctly on the diagnostic tests.

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## **Making Sessions More Interactive: A Case Study on the use of Interactive Polls within Synchronous Online Statistics Workshops**

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The Sars-Cov-2 pandemic has had an impact on the HE sector, with teaching shifting to online methods at very short notice. One frequent comment from lecturers when teaching online is that it is not possible to gauge students' engagement and understanding as the visual cues in most cases are absent, thus new learning and teaching strategies have had to be implemented.

Drawing from different pedagogical concepts and theories such as Gagne's and Briggs' (1974) categories of learning outcomes (i.e. verbal information, cognitive strategies, etc.), Bloom's (1956) taxonomy of educational objectives (i.e. knowledge, application, etc.), and Kolb's (1984) experiential learning cycle (i.e. abstract conceptualisation, concrete experience, etc.), coupled with the principles of good (online) teaching (i.e. student-faculty interaction, feedback, etc.) and the importance of active/interactive learning and teaching as a way of increasing student engagement (Buck, 2016; Kahu, 2013), the aim of this presentation is to show how the aforementioned elements have been implemented within a synchronous online environment, using a series of Graduate School Research Methods and Statistics workshops at Brunel University London as a case study. We highlight especially the use of interactive polls/self-tests, implemented on Blackboard Learn, as a medium of making these sessions more interactive, thus improving student engagement.

Indeed, students' feedback praised the use of polls/self-tests: "the polls were such a good idea"; "thorough explanation and practical self-tests". More detailed students' feedback, alongside additional characteristics of these sessions (i.e. format, topics covered, polls participation rates etc.) will be described throughout this presentation.

This presentation may thus be of interest to practitioners who have had similar experiences or who are considering collaborating on a more long-term basis not only at undergraduate and master levels but also with their respective Graduate Schools/Doctoral Colleges or who are contemplating using polls on a more consistent basis within their sessions.

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## **The impact of in-person and online maths and stats support facilities as social learning spaces on engagement**

**First Author:** Mark Hodds

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**CoAuthors:**

Prior to the pandemic, Maths and Stats Support Centres (MSSCs) were not only used as places to improve understanding, but as social spaces to learn. Many students would take the opportunity to work in an environment conducive to social learning whilst being in the right place to obtain support if needed.

Although the idea of MSSCs as social learning spaces is not new (e.g., Patel and Little, 2006), there has yet to be any quantifiable evidence of the impact on engagement. This presentation reports on the work of a final year undergraduate project looking at the impact on engagement with in-person Maths and Stats Support (MSS) at one University based on a variety of factors, such as visiting with friends, maths anxiety, and course. It also reports on work to set up an equivalent online social learning space ready for the new academic year using “Discord”. Discord is usually used in gaming but it has been reported that students used it to connect with each other during the pandemic, instead of using the channels provided by their universities, to discuss work. It has been successfully utilised in places such as Norway and Germany to provide MSS both during and since the pandemic.

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## **Do Mark Standardisation Algorithms Necessarily Disadvantage Students ?**

**First Author:** Gordon Hunter

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In the Spring of 2020, in the midst of the first wave of the Covid-19 pandemic, the UK Government announced that the national secondary school examination results – in particular, those for GCSE and A levels – would primarily be determined by a “standardisation algorithm” based on each school’s own ranking of candidates for each subject, and the same school’s typical performance over previous recent years. Although only general details of the “standardisation algorithm” were revealed, it sounded very similar to the “histogram matching” approach used to compare images taken under different lighting conditions. The announcement that grades would be determined by a computer algorithm led to many complaints from parents and candidates alike, resulting in the Government abandoning that plan and instead rate students based on teacher’s predicted grades alone.

However, do such “standardisation” algorithms necessarily disadvantage students ? In this paper, we present a case study where students’ marks from the 2021-22 academic year – the first returning to traditional written exams after the peak of the Covid-19 crisis – are compared with those during Covid (when coursework-type assignments were used in place of exams) and pre-Covid (2017-18, 2018-19 and 2019-20), and the effect of applying a “histogram matching” type algorithm is also investigated.

The results suggest that such algorithms may not be so bad for students after all.

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## **Online distance learning in Data Analytics – benefits, challenges, and suggestions**

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In 2017 the School of Mathematics and Statistics within the University of Glasgow developed part-time, online distance learning (ODL) programmes (PGDip/PGCert/MSc) in Data Analytics. The success of the programmes led to a collaboration with the Office for National Statistics in the development of an ODL MSc in Data Analytics for Government programme, which includes the option of taking individual modules as continuing professional development (CPD). The programmes have been highly successful and have considerable innovation in the course content, assessment, the course management and delivery, and in student support.

The programmes' targeted audience comes from all over the world, is already in employment and has professional experience from a variety of sectors. Furthermore, the programme is accessible to students coming from a broad range of backgrounds, educational experiences, and levels of knowledge in programming, mathematics and statistics. Our students also tend to be older and more likely to have caring responsibilities, when compared to traditional on-campus undergraduate and postgraduate programmes. These characteristics, along with large time-zone differences, present unique challenges when designing and delivering a programme of this nature and developing a teaching style to meet the needs of such a varied audience is continually of high importance.

As well as giving a brief overview of the programme, this talk will discuss some of the learning technologies we have adopted and our approach to overcoming the challenges listed above. We will also discuss our perspective on student and staff expectations and changes we have implemented to try to align these.

This talk will allow us to share our lived experience of delivering an ODL programme over 5 years, providing valuable insight to others who are considering launching, or have recently launched, ODL programmes in Mathematical Sciences.

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## **Students as Partners – working with students to widen engagement with skills support**

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The requirement for universities to develop Access and Participation Plans (APP) if they want to charge the top level of fees has increased attention on the skills support services that are offered. It has also opened opportunities to access university APP funding for projects that address widening participation goals.

The Academic Skills team at the University of Chester offers maths and statistics support as part of its remit. The team have used APP funding to employ Student Engagement Assistants through the institution's Unijob scheme. Following a pilot project in 2020, a student perceptions project ran online in 2021. In 2022 two projects were run concurrently, one on widening engagement and one on digital resources.

Alongside funded projects, the team has also offered placements to level 5 students undertaking Chester's industry acclaimed Work Based Learning module.

Using students as partners has given new insights into what motivates students to access skills support and has enabled the team to adapt its digital resources and extra curricula offer accordingly. It has also resulted in a change of name!

An unexpected benefit of developing different projects has been increased collaboration with colleagues in other university departments such as student wellbeing, careers, and outreach. Often it has been the students themselves who have facilitated new contacts and enabled relationships to develop.

This presentation will describe the work done so far, how the findings have been put into practice, ideas for further developments, and the methods that are being used to evaluate the impact of the projects in increasing student success.

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## **From Individual Support to Small-Group Problem-Solving: Encouraging Speech Online.**

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A sequence of studies 2008-16 suggests that few students speak in OU STEM online tutorials. However, students do speak in online individual support sessions (ISS), and hence small-group sessions informed by ISS have been designed and run.

Data was gathered from tutors of pure mathematics modules who provide ISS for some students. A survey asked what tutors thought encouraged speech in online ISS, and how to do this in group sessions. Three tutors compiled descriptive Logs of ISS, documenting the speech and interaction. These provided rich data, which was analysed thematically.

The themes which emerged about when students were willing to talk in ISS will be briefly outlined. These ideas were built into the design for online small-group problem-solving sessions. Sources on language tutorials and on small-group sessions during the pandemic contributed additional ideas.

The design begins with a quiz to establish needs and preferences, then an icebreaker involving identifying errors in a solution. It continues with four problem-solving styles, two each in plenary and breakout, which will be outlined.

Two sessions were run for nine students on the third year module Complex Analysis. They ran in Adobe Connect in conjunction with OneNote. The students had a session overview and the problems in advance. Participants were surveyed about effectiveness and suggested improvements. Sessions were documented by observers and researcher.

Transcripts of plenary parts were broken into segments, and interaction coded according to several categories. Conclusions were drawn about the success of the Icebreaker and changes which could bring improvement. Student and observer feedback on the same issues was brought into the discussion. The same is being done with the other plenary part. The nature of the interaction in the breakout parts will also be analysed. The design will be modified and further sessions run and evaluated.

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## **Widening participation lead by mathematics students**

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This talk will present the project developed internally by the Middlesex University Maths Team on widening participation for our mathematics students and for the students at the partner FE college. The project was originally conceived as part of the wider, national initiative which lent its name to the current policy (<https://levellingupschememaths.co.uk/>) but was eventually scaled to a pilot project funded internally by the university. The pilot project involved our mathematics and data science students tutoring A level students from a local/partnership FE college.

An interesting fact of our project was that our own students come from a very diverse background: 58% of Middlesex Students are from the most deprived areas (2019-20 Index of Multiple Deprivation quintiles 1-2; n.b. this is a property of the geographical area the students come from, not of the students themselves), and 40.2% of Middlesex Students were eligible for Free School Meals at Key Stage 4 (OFS2019-19 data; n.b. this

is a classic measure of deprivation, and is a property of the students themselves). This is the 7th highest in the HE sector, and the 2nd highest across non-private universities.

The talk will explore the benefits of the project to three groups of participants, based on the feedback from all participants (by focus groups and reflections):

- FE college students
- Our university students
- Teaching/research staff from both institutions.

It will argue that the successful widening participation in mathematics is a multi-agent and complex operation and explore the development of multi-faceted relationships network between teachers and students that is rooted in developing a common framework of values and views of mathematics. The talk will further explore development of this framework and begin to explore the features of interactions that offer insight into the mechanisms of communication, setting and agreeing values we individually and as a group found to be most important for the study of mathematics, and practicalities of introducing new students to mathematics at HE level.

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## **What leads to student engagement? initial finding from a case study from both the student and lecturer perspective**

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Student engagement and disengagement have been linked to student achievement, retention, and satisfaction (Klem and Connel, 2004; Shernoff and Schmidt, 2007; Appleton, Christenson and Furlong, 2008, Finn, 2016; Khademi Ashkzari, Piryaei and Kamelifar, 2018). Despite extensive research, scholars have been unable to agree on a definition of student engagement and disengagement. This research as part of a PhD explores students' and lecturers' lived experiences to explain why students become academically engaged or disengaged. The most widely acknowledged research defining student engagement focuses on what student engagement entails, such as students attending lectures or investing time in challenging activities. Less research has been conducted to understand why students choose to engage in their studies. The outcomes of this research are expected to aid universities in better understanding the student experience, so that appropriate support can be provided to improve the student experience and encourage them to participate in their studies.

This presentation will share some of the literature review backing up the need for this research as well as the findings from a small number of student and lecturer interviews comparing the experiences of both.

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## **The student perspective of Engineering maths teaching and embedded maths support**

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The engineering mathematics team and the maths support team at the University of Northampton have worked closely together to improve mathematics teaching over the last four years. We felt it was important to evaluate the module teaching and the weekly embedded mathematics support from the students' perspective.

Previous maths education of the engineering students varies from mature students with limited recent mathematics education, those with a C grade at GCSE, and those with A level. Weekly embedded mathematics support was introduced in 2018/19 to support students needing more help. During this time, student results show that those attending support sessions regularly improved their grades. However, the numbers using the service are limited, and we need to understand the barriers to usage. In addition, module lecture attendance has been erratic with significantly varying levels. Research shows that attendance impacts attainment (Nordmann et al., 2019; Doggrell, 2021). Our research focuses on understanding both issues.

A survey was sent to first and second-year maths students and one third-year engineering module with a high level of maths content (additional maths lectures support sessions). The survey aimed to evaluate the current offering and understand any barriers the students had to learning.

This presentation shares the survey findings that included open questions to help understand the student experience. In addition, the research examines the hypotheses that we as lecturers had felt were important to attendance, including travel time to university, paid work, and past mathematics education.

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## **Clinical Trials with the Q-Step Model: Lessons Learned from the Ground**

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In this session, I will provide an insight into the political and student-based challenges faced when seeking to address statistical learning deficits in undergraduate Medicine. I shall begin by providing a brief recap on the findings of my own research on the statistical learning needs of undergraduate medical students for clinical practice, as informed by medical graduate responses to a comprehensive survey. Based on my own teaching experiences at Edinburgh Medical School, I shall also explain why I do not believe that the Q-Step model used within the social sciences in seeking to address quantitative skills deficits would be welcomed in Medicine. This will include a focus on the learning culture in early years of the Medical Curriculum, while appealing to the diversity of student learning backgrounds and aptitudes and the impact of General Medical Council regulatory procedures on programme design and management. I will in turn offer some personal reflections on potential programme development routes to pursue as an alternative to the Q-Step model for addressing evidence-informed medical student learning needs in statistics. There will then be an opportunity for delegates to share their own views and experiences on seeking to overcome barriers to programme development in the teaching of statistics to non-specialists, including health professionals, and to comment on the potential usefulness of the ideas proposed in this session for addressing their own teaching needs, including through future cross-institutional collaboration.

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## Assessment as a barrier to inclusion

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The author will present a personal perspective on how assessment in mathematics can be a barrier to inclusion. He will discuss particularly how traditional examinations disadvantage non-traditional students, and argue that fairer methods of assessment can also help address the awarding gap.

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## Evaluating strategies used to reduce statistics anxiety

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Many students feel anxious and lack confidence when it comes to statistics which can impact on their learning, performance and progression. The presenters of this talk have developed research-based resources including a short video, and an interactive workshop, with the aim of reducing anxiety about statistics and enabling students to learn effectively.

As the workshop developed, student feedback and survey data suggested that students already have some understanding of statistics anxiety and its impact on learning which are initial strategies used within the workshop.

Further research was then carried out to ascertain whether students are already using the main strategies often suggested within this type of anxiety intervention, regardless of whether they have attended a workshop or watched the video. In particular, the strategies are evaluated with regard to their association with changes in statistics anxiety and student performance.

This talk will be useful for those wishing to reduce anxiety and build confidence around maths or statistics with their students. By understanding which strategies are most effective for reducing anxiety and increasing performance, and which are already used by students, future interventions can be tailored accordingly.

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## Statistics Support and anxiety explored

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Many Higher Education institutions have some form of maths and statistics support providing teaching to students which is in addition to their timetabled teaching. As well as gaining clarity in their understanding of statistics, there is anecdotal evidence that students feel less anxious and more confident after attending maths and stats support but there is little quantitative research in this area.

This talk presents results from surveys carried out before and after students' first visits to statistics support and the end of year stats support feedback survey along with some data from surveys of the general student population to help investigate:

Are anxious students engaging with statistics support and how do their statistics anxiety levels compare to their peers?

What are the immediate and longer term effects of statistics support with regard to reducing statistics anxiety and building confidence with statistics?

What are the benefits of statistics support from the student perspective?

This talk uses research to try to evaluate the effectiveness of statistics support at addressing anxiety and confidence with statistics and will therefore be of interest to those working in maths or stats support or teaching statistics in higher education.

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## **Best of old and new - Foundation students' experience and perception of flipped and blended learning compared with traditional teaching**

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Flexible learning such as flipped and blended learning provides flexibility and individualization and often has a positive influence on students' cognitive, affective, and soft skills (Birgili et al, 2021). High education Institutions recognise that flexible learning can empower the students, therefore the question about flexible learning is often not "if" but "how" (Loon, 2022).

This paper presents two years of study implementing flexible learning within Foundation mathematics modules at a university. A blended learning approach was applied when teaching the mathematic modules in the 2020/2021 academic year, and a survey on students' experiences and perceptions regarding blended learning was conducted at the end of the year. The results show that the students were satisfied with blended learning and would like to continue to use the blended learning strategy. The following year, flipped and traditional learning were compared when teaching statistics to two groups of students, the same survey was conducted at the mid-year and end of the year. The results showed that the students liked the flexibility of flipped learning and believed that studying asynchronously encouraged them to develop study skills and improved engagement, which broadly agrees with other studies (Price and Walker, 2021). However, it was surprising to find that they believed they would learn better with traditional teaching than with flipped learning, this was also apparent when comparing student performance in statistics between the two groups taught using flipped and traditional learning respectively. Further analysis of the survey showed mathematics competency and difficulty of the content have a significant effect on their preference of learning approach.

The study concludes that careful considerations must be made to make flexible learning effective. These include the student mathematics competency, the module contents and difficulty level, quality of recourse and motivation of students. Otherwise, it may reduce student academic performance.

Reference:

Birgili, B., Seggie, F.N. and Oğuz, E., 2021. The trends and outcomes of flipped learning research between 2012 and 2018: A descriptive content analysis. *Journal of Computers in Education*, pp.1-30.

Loon, M Flexible learning: a literature review 2016-2021. <https://www.advance-he.ac.uk/knowledge-hub/flexible-learning-literature-review-2016-2021>

Price, C. and Walker, M., 2021. Improving the accessibility of foundation statistics for undergraduate business and management students using a flipped classroom. *Studies in Higher Education*, 46(2), pp. 245-257.

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## Digital accessibility for online distance learning course materials

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Within the mathematical sciences, many course notes are compiled using LaTeX or Markdown, which often produce output as a PDF. The PDF format is popular because of its universal properties, with most software, devices and operating systems supporting this format. However, such notes do not cater well for those with physical and cognitive disabilities, with large document size, text spacing and background colour often causing issues for such learners. PDF style documents also do not permit the addition of interactive elements, such as short quizzes, to enhance student learning.

In this talk, we will demonstrate a HTML based solution, which takes a holistic approach to building in accessible features from the start. This approach has involved taking into consideration features which are thoughtful, and concentrate on simplicity first and foremost, with multiple options for users. These features are designed to be useful for everyone and can therefore be widely used.

The HTML notes are self-contained, with a simple and distraction-free design, and include an accessibility pane providing foreground and background colour options, and text size and spacing control. The HTML file is also responsive and can adapt to a variety of screen sizes. Solutions are also provided as a drop-down option next to questions to avoid excessive scrolling. Within our HTML file, we have proposed our own pre-compiled, accessible version of LaTeX-as-SVG using MathJax, allowing for the use of screen readers for mathematical equations.

We will also discuss future extensions in development looking at interactivity within the notes and inclusion of animations for complex data visualisations.

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## Mathematics Anxiety in Undergraduate Business Studies Students

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Mathemaphobia was a term used in early studies (Gough, 1954) by a teacher who referred to her students' striking emotional reactions in the face of mathematical tasks and challenges. However, in the 1970s, a more widely accepted definition of the phenomenon was provided, describing mathematics anxiety as "[...] a feeling of tension and anxiety that interferes with the manipulation of numbers and the solving of the mathematical problems in a wide variety of ordinary life and academic situations" (Richardson & Suinn, 1972,

p. 551). Mathematical Anxiety is a phenomenon which has been shown to have far-reaching impacts on an individual and on society (Furner & Marinas, 2016), most significantly as a potential inhibitor for career and education opportunities. Prior studies in mathematics anxiety have primarily examined experiences in second-level education (For example Mohamed and Tarmizi 2010). A prior study within the Irish tertiary education sector focused on the experiences of mature students (Ryan and Fitzmaurice 2017), where mathematics anxiety was found to have a significant impact on education and career pathways. The purpose of this research is to examine the prevalence, characteristics, and impact of mathematics anxiety in undergraduate business studies students. Our study's focus on undergraduate business studies students explores priors such as students' self-efficacy, proficiency, and experiences around mathematics using both a modified version of the Mathematics Anxiety Scale (MAS-UK) and life history interviews. This is an important group for which to examine mathematics anxiety given the strong impetus for the adoption of Artificial Intelligence (AI), data analytics and machine learning in Irish enterprises, prompting reform of business studies curricula. This addresses a significant gap in the literature and can help inform policy development, particularly in education's role in the strategic development of a digital economy.

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## **Authentic by design: developing mathematicians for the talent economy**

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MSOR programmes are highly valued as intellectually demanding, and require students to formulate, abstract, and solve problems rigorously. A current challenge is to reconcile the most abstract maths with sector trends towards practice-based learning and teaching, and authentic assessment. Some institutions are responding by reviewing the balance of pure and applied mathematics.

The Middlesex University mathematics team have redesigned our degrees so that authenticity can be achieved across all areas of maths, including the purest. This is accomplished by learning and assessing using a wide range of technologically enhanced methods to support the development of the broad skill set required for the talent economy. Skills like creativity, originality, critical thinking, problem-solving, communication, collaboration, and to learn and develop independently are highly sort after. As technology is increasingly integrated into everyday life we must recognise and prioritise digital skills within programmes to ensure graduates are employment ready.

In this talk we will discuss our approach by highlighting some key features of the new programmes.

\*Modules such as Problem Solving Methods and Communication concentrate on developing higher order maths skills such as problem solving, communication, data assimilation etc. collaboratively.

\*We assess entirely through coursework assignments to explore students' understanding of these complex topics using novel problems that would be intractable in time-limited assessment such as exams.

\*Technology is integrated throughout allowing students flexibility in how they solve and present solutions to problems.

\*The programmes develop graduates that are future focussed and employment ready.

\*Collaborative problem-solving spaces create flexible, virtual learning communities.

Equitable access to technology allows for inclusive assessment: students can choose their preferred submission format without disadvantaging others.

The aim of the talk is to describe an approach that moves away from standard practices to the creation of a learning environment drawing on the best of the old and the new.

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## **Initial Findings from a Systematic Scoping Literature Review of the Impact and Evaluation of Mathematics and Statistics Support in Higher Education**

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This talk details the authors' ongoing systematic scoping literature review of the evaluation of Mathematics and Statistics Support (MSS). We use a broad definition of MSS including not just mathematics support centres but other supports such as bridging courses or video resources to be as inclusive as possible of the various ways MSS is provided worldwide. This study builds upon two previous MSS literature reviews (Matthews et al., 2013; Lawson et al., 2020) which included, among other topics, the evaluation of MSS. These studies collated the majority of evaluation research from the UK, Australia, and Ireland with some German literature included in the latter study. The systematic methodology of this review allows a synthesis of all MSS evaluation studies published in English since 2000 with a greater international focus.

The nature of systematic scoping reviews (Tricco et al., 2018) will be explained, showing how publications were systematically identified, screened, evaluated for bias and quality, and synthesised to create a comprehensive picture of MSS evaluation studies and dissemination of MSS research worldwide. Initial results of the review pertaining to the benefits and consequences this review process brings to MSS research will be discussed.

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## **A Win-Win-Win Story: Drop-in Mathematics Support for Secondary School Students**

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Since 2009, the Mathematics Support Centre (MSC) at Maynooth University (MU) has provided a free drop-in service for secondary school students one evening each week. Like the drop-in service for our undergraduate students, no appointment is necessary. Some students attend on their own, while many use the room as a space to study collaboratively with their peers. They typically attend to work on homework or other curriculum related material. The tutors usually comprise of qualified secondary school teachers along with volunteer student teachers. Tutors will help if students need assistance, but do not provide homework solutions.

In this talk we will share our experience of providing this service at MU, describing how the service operates each year, with focus on a thematic analysis of ten years of survey responses from the students and volunteer tutors. For example, students identified the positive atmosphere of the MSC and the helpfulness of tutors.

They also reported that attending the service improved their confidence in their mathematical abilities. Trainee teachers reported that this experience has positively influenced their teaching practice and provided extra insights into the common issues that students experience.

MU authorities are also very positive about this service, as it raises the profile of the university, provides outreach to the community and has a very low cost.

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## **Data & AI Driven Approaches for Predicting Student Progression**

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Student engagement, what is it and how do we measure it?

Engagement, retention & progression are key concerns for all HE providers. In this talk we will outline how some simple data and AI driven approaches can be used to predict student progression based on their scores in an on-entry mathematics diagnostic tool. All new students in the faculty of science and engineering at the University of Wolverhampton are compulsorily enrolled in a mathematics induction course. This is a self paced online course supported by drop-in sessions as necessary. The aim of the course is to encourage students to overcome any issues with mathematical preparedness before these issues start to cause problems within their course of study. But the course also presents a rich pallet of data which can be used to help direct the limited supports available to the students who will benefit most in order to increase engagement and enhance student outcomes. In this talk we will outline the current status of the work, the findings from year one and the plans for future development.

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## **Enhancing outreach**

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The Ri Mathematics Masterclasses programme is a UK-wide outreach scheme established in 1981 to enable school students to “explore mathematics outside the confines of the classroom”. In this talk we reflect on our experiences of running Ri Masterclass programmes in south-west Wales (organised by the Further Mathematics Support Programme Wales and Swansea University) and consider two initiatives that we have run to enhance our provision. The first initiative is a series of girls only masterclasses which began in 2017 with support from the LMS Girls in Mathematics initiative. These masterclasses were for year 10 girls (ages 14-15) from the south-west Wales region and focussed on topics from current areas of research and application in mathematics with the aim of encouraging more girls to study mathematics at higher levels. The second is a series of online masterclasses which began in 2021 to enable our Masterclass programme to run during the pandemic. These online masterclasses were open to students from years 9 and 10 (ages 13-15) from across Wales. We discuss how these initiatives were established and run and reflect on both our experiences and those of the students involved.

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## **Exploring Undergraduates' Views related to Mathematics Service Teachers' Knowledge**

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In today's increasingly interdisciplinary educational landscape, it is common for universities globally to teach compulsory courses in mathematics for all undergraduates – regardless of their chosen subject specialism. This means there is a vast range of mathematical experience and ability that needs to be catered for by their tutors and lecturers – usually members of a mathematics department and known as “service teachers”, since they are teaching mathematics courses for many other university faculties/departments. It is not yet clear from the literature what knowledge or expertise these teachers need to do such a diverse, demanding and growing job effectively in today's higher education institutions. This research reports on an online survey of 90 undergraduates' perceptions of their mathematics teaching in highly diverse contexts, from business to STEM subjects, in two universities situated in the Global South and North. Within its limitations due to sample size and disparity and its chiefly quantitative methodology, it seeks to promote discourse on this important issue, complement literature on university mathematics support and add insight to studies identifying priority areas for professional development and further research. It thus taps into students' perceptions of both their own needs and their teachers' knowledge. The survey results support evidence promoting learner-centred education, by uncovering a potentially unmet need for personalised instruction – tailoring the teaching to the individual needs of students, based on a deeper knowledge of both them and their degree subjects. It is further suggested that the blended approach catalysed by the COVID-19 pandemic lends as-yet untapped efficacy to the assessment required to identify those needs and thus maximise students' mathematical potential – while minimising the number who might otherwise fall through the cracks.

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## **Statistics Support: The past, the present and the future**

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Over the last 15 years, statistics support has evolved as an effective and well-established field of student support in Higher Education. However, the range of breadth of undergraduate and postgraduate degree courses that include some elements of data analysis in the curriculum is expanding. Disciplines that in the past made little use of quantitative methods are becoming increasingly reliant on them. Furthermore, Industry 4.0 and the availability of huge amounts of data and the move to a more connected autonomous society and economy is changing the skills needed by industry. Undergraduate degrees in Data Science and postgraduate ‘conversion’ degrees in Data Science and related subjects are very quickly becoming popular with applicants. However, there is at the same time a dearth of suitable skilled staff to teach these topics, which means these changes that are happening now and in the future, will present challenges to those engaged in statistics support. In this talk, look to the future of statistics support over the next 15 years, and examine what these challenges might be so we can begin the conversation to make sure we are ready for them.

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## **Widening Access to HE using in house mathematics equivalence assessments**

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Widening access to, and success in, Higher Education is a key part of the mission of the University of Wolverhampton. In this talk we will outline the outcomes of a recent project to offer mathematics equivalence routes into HE via a suite of bespoke tools for students in courses in science, engineering, healthcare & education. The equivalence provision is also being evaluated as part of the University Access & Participation Plan. Preliminary findings in this respect are nothing short of remarkable. As part of Phase 1 of the evaluation, the data tells us that 561 students are either currently enrolled or at live applicant status to courses at this University having utilised a mathematics equivalency route. BAME students are almost twice as likely as white students to have used the equivalence provision to meet the terms of their offer. Female students make up 88% of those utilising equivalence routes in order to enrol at the University. Adult learners (over 25s) make up 64% of those accessing HE via an equivalence route. In terms of socio-economic disadvantage, 56% of students utilizing a mathematics equivalence route come from areas classified as within the lowest Index of Multiple Deprivation in England (IMD1).

This work is directly facilitating the progression of students from low socio-economic areas to HE. The mode of delivery and the assessment strategies employed are clearly encouraging students from ethnic minorities and under-represented groups to reach attainment levels which they have not previously achieved. This work is embedding the inclusivity framework at the heart of the University curriculum, and it is supporting students with protected characteristics to achieve their potential.

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## **Study groups and student engagement**

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The talk aims to present the lesson learnt from an intervention introduced as a response to the Covid-19 pandemic and its adaptation on this new post Covid hybrid world.

Facing a challenge to teach mathematical analysis to a large cohort of students during the Covid-19 pandemic in the first semester of the academic year 20/21, when possibilities for in-person teaching were extremely reduced, a small study group concept was employed to create infrastructure for enabling students to support each other and to explore the ways how to learn together supported by technologies, as described in [1].

Pedagogical research shows, peer supported learning has a huge potential to improve and sustain student engagement with their learning and supporting their development as reflective learners.

In their reflective journals, students were elaborating on their positive experiences.

The provision was not only beneficial for their learning and academic development, but also it supported their wellbeing and, by establishing meaningful connections with their peers, gave them a sense of belonging.

To continue this concept of small study groups beyond the COVID-19 pandemic felt as a 'must'. With some changes, the exercise was repeated this 21/22 academic year.

Again, the concept has proved to be quite successful. However, it felt different, there were different challenges which we are aiming to explore, discuss and understand in order to shape the next iteration.

[1] Diedre Casey, Isabella Fairclough, Vesna Perisic, William Carey, Ann Smith: Facing Challenges in Remote Mathematics Education and Support by building a Community of Practice around Student-Staff Partnership, MSOR Connects, Vol 20, No 1 (2022) CETL-MSOR Conference Special Issue 1: Responding to the COVID-19 pandemic

DOI: <https://doi.org/10.21100/msor.v20i1>

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## Accessibility for LaTeX teaching materials

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The accessibility regulations from 2018 imply that higher education institutions must upload course material on their Virtual Learning Environments (VLE) in an accessible format. This is technically difficult for STEM disciplines, as documents are traditionally written in LaTeX which generates PDF that do not meet all the accessibility criteria. An alternative is to upload documents in HTML format.

In this presentation, we will describe the results on two subsequent projects at the University of Aberdeen, working on solutions to make STEM course material accessible. Firstly, we obtained an internal Learning & Teaching grant and investigated four existing software for converting LaTeX documents into HTML documents. Our results showed that two software, LaTeXML and Chirun (previously coursebuilder) produced more satisfactory outputs. Then, we secured funding from the Council of Professors and Heads of Computing (CHPC) to recruit a pool of educator volunteers and collect their feedback on a range of methods to:

convert LaTeX documents to HTML format using LaTeXML for notes, and Chirun for notes and slides, and use a selection of alternative markup languages to write HTML outputs: Pandoc Markdown and Rmarkdown for notes and slides, and Bookdown for notes.

We designed a questionnaire to quantify the amount of effort taken to prepare new teaching material and update existing teaching material in LaTeX, and the trade-offs between effort and accessibility coverage obtained. We wish to design advice and guidance for staff to use these tools to make their course material accessible, as well as inform further development of these tools.

We are also recruiting a pool of student volunteers to collect feedback on the user experience of the HTML outputs thus produced.

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## **What can online platforms tell us about student engagement and understanding?**

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Over the last year most of our embedded sessions with Nursing students have continued to be delivered online via Zoom. In this session I will discuss what can be learned about students' engagement and understanding from the reports available in Zoom and on the SafeMedicate platform, which is used for the students' high-stakes drug calculations tests.

I will present an analysis of how student engagement might be measured by looking at attendance at embedded sessions, contributions to Chat and attempts at formative SafeMedicate tests. A key question is whether such measures of engagement are linked to summative test results and, if so, what we can do to try to increase engagement.

I will also discuss how responses in the Chat, Zoom Poll answers and attempts at individual SafeMedicate questions can reveal some common mistakes and misconceptions among Nursing students and how these might be addressed.

The presentation will also highlight some of the difficulties involved in analysing the data available and the limitations of its conclusions.

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## **Adapting successful online activities for in-person classes - a new challenge**

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Over the past few years, discussion across the sector has rightly been concentrated on how to provide a valuable and engaging online experience for students. The shift back to in-person classes has left many practitioners considering whether there are any lessons from the necessary shift to online teaching that can be applied to in-person teaching. This session will cover experiences stemming from a welcome but unanticipated dilemma - the live online classes for the module in question were extremely popular with students in 2020/21. How should the lecturer approach the return to in-person sessions? The session will focus on the design and development of in-person classes for a core Year 1 algebra module. The module had been delivered in a traditional format pre-pandemic (three lectures and one tutorial session per week). Activities and resources were created for the necessary remote sessions in the 2020/21 academic year. Activities for live online classes were designed as consolidation "games" which sought to encourage peer learning and discussion. The positive response to these activities encouraged the lecturer to pursue a flipped classroom model for the 2021/22 academic year. This session will discuss the various considerations when planning the transition to in-person classes for the 2021/22 academic year. In addition to reflections from the lecturer on the experience, this session will also present preliminary findings from a formal study aiming to determine whether the activities have any positive effects on student confidence. Specifically, the study will investigate student confidence in areas such as working with peers, preparing for a class using online resources, and communicating mathematics in a written format. This session will be of interest to anyone who is wanting to try something different with in-person classes based on experiences over the past couple of years.

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## Factors which align with high failure rates in mathematics

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At Western Sydney University, Australia, we have high failure rates in a variety of mathematics and statistics subjects. Data has been collected, including lecture attendance (for online lectures), tutorial attendance, secondary mathematics background, degree studied, education level of parents, assessment marks for the semester, learning management system engagement and use of support. Initial results on how these factors relate to failure in one of these subjects will be presented.

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## Students` profiles of (non-)engagement with mathematics learning support in Germany

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Students` engagement with mathematics learning support can be crucial for their study success. It has been analysed in the past in relation to their study programmes (mathematics or others with some form of relation to mathematics), their mathematical ability and competence (e.g. students at risk) as well as their individual progress in the degree programmes (beginners vs. experienced students). Lawson, Grove and Croft (2019) summarized these findings and other studies, which analysed reasons for students` non-engagement, in their well-known review. In Germany, the first studies on engagement across different mathematics learning support centres were carried out within the WiGeMath project from 2015 to 2020 (Hochmuth et al., 2018; Schürmann & Schaper, in press).

In the oral presentation, we present current research findings based on students` survey data from the WiGeMath project of seven German universities (N=874) from 2017 and 2019. We describe different forms of engagement categorized by the intense of usage (non, occasionally, intensively, former) to define these user groups in more detail. Frequencies of given reason of non-users were analysed to prove if these were "shallow reasons" (Lawson & Croft, 2015) by comparing it with ratings on individual needs for mathematic support. To describe the different user groups in more detail, we used the method of latent profile analysis with the packages of tidyLPA (Rosenberg, 2021) and mclust (Scrucca et al., 2016) in R. In sum, four different classes of students namely students at risk, non-engagement, anxious-engagement and joyful-engagement were identified. Each user group can be described based on this classification and profiles of the psychological constructs math anxiety and joy, self-regulation, self-efficacy and self-concept, study interest and engagement as well as their tendency to drop out or switch their study programme.

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# Multi-perspective analysis of needs for the development of digital blended learning for mathematics and mathematics related degree programmes in Germany

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Many formats of digital teaching elements for successful learning of mathematics, such as explanatory videos, digital tasks, digital scripts or quizzes exist. However, there are challenges in developing digital elements which address students' needs and in embedding the elements in coherent educational concepts across universities. Within the German LLV-HD project it is the aim to develop digital teaching and learning network for blended learning formats. Focus is set on the development of additional mathematic learning material in an agile process across two partner universities for the degree programmes in mathematics, mathematics teaching, engineering and economics. For this purpose, common elements for courses are identified across the universities and enriched with digital elements for blended learning formats. Therefore, students and lectures from two German universities and four degree programmes participated in interviews and surveys to identify common needs of students for mathematic support, typical problems and requirements for additional learning material. Based on these results, the project develops digital elements to address these demands.

Within the oral presentation, the LLV HD project will be described and a focus will be set on the results of the needs analysis and the following development process of the digital blended learning material. The different formats of digital elements will be presented as well as typical development workflows. Finally, we will discuss actual challenges like different mathematical concepts, conventions and notations that differ across subjects, universities and lecturers as well as teachers' and students' efforts to use additional teaching and learning.

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## Incentivisation and its effect on engagement and student performance

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It is a commonly held belief that many university students are "assessment-driven" (e.g. Holmes, 2018); that is, students engage more with activities that are assessed compared with those that are not. "Incentivised engagement" includes the practice of providing incentives (such as marks or otherwise) for students to engage in particular activities. However, there is very little evidence about the impact of incentivisation, and the results that exist are mixed. Perusall (<https://perusall.com/>) is a social annotation platform designed to increase student engagement with pre-class reading. It measures student interaction with the text and annotations and calculates scores, which may or may not contribute to a subject's assessment. In a second-year undergraduate Statistics for Engineering module, students were invited to carry out the weekly reading activity via the Perusall platform. During the first half of the semester, students' engagement via Perusall did not count towards student marks, whereas during the second half of the semester, it did. As such, it was possible to subsequently measure the effect of introducing incentivisation of Perusall engagement. In this talk, we present the estimated effect of incentivised engagement via use of the Perusall platform, both in

terms of student engagement and performance. Our results show that incentivisation increased the engagement of students who were previously less engaged with the pre-class reading. For those students who were previously less engaged and had lower performance in summative assessments, there was also an increase in student performance following incentivisation. However, incentivisation had no impact on student performance in summative assessments for students who were already performing well before incentivisation.

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## **Student Video Curation**

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In the academic year 2020-21 Middlesex University maths students accessed all learning sessions remotely. Each of these interactive sessions was live-streamed, recorded and uploaded to our Virtual Learning Environment, providing hundreds of hours of recorded, unedited maths lecture for students to review.

In this project (partially funded by an IMA Education Grant) we invited undergraduates to reflect on their remote learning experiences and curate these video lectures. Students were asked to identify the most engaging, most useful and most interesting segments, and explain their choices to help us develop our approach to producing engaging videos.

A total of 33 video clips were identified by students across levels 4 to 6 on our specialist BSc Mathematics and BSc Mathematics with Computing programmes. Students categorised their choices, explicitly flagging some segments as “very engaging”, and provided free-text comments to explain their choices. In this presentation we will discuss our findings, illustrate with examples clips, identify themes in the student choices, and conclude with tips to produce engaging video content.

We will also discuss applications of video curation as a social pedagogic tool for the current generation of university “Zoomer” students (otherwise known as “Generation Z”). Ipsos Mori report these students have ubiquitous access to digital communication technology, but lower income families are less likely to use this technology for learning and are less likely to develop certain key skills as a result [Ipsos Thinks, 2018]. We will argue that sharing how students’ interact with digital learning resources can help address this significant digital divide in education.

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## **It's so unfair! - Can we help students to feel less resentful of group projects and presentations?**

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Graduate outcomes are playing an increasingly prominent role in higher education and the embedding of soft employability skills into our curricula has become essential. This often means more group work and more presentations. However, these methods of working and assessment often prove unpopular with students. Public speaking, worries about peers working to schedule, and concerns about whether their final grade reflects their individual efforts are all major causes of stress for students.

In this talk, we examine three methods used by colleagues at Nottingham Trent University, with the intention of alleviating some of the anxieties and stresses associated with group presentations:

- 1) Declaration of work forms - In which groups attribute a percentage of the overall workload to each member of the group. The allocation of workload is reflected in the grading.
- 2) Allocation of group roles – In which each member of the group is given responsibility for a specific aspect of the project. Grading is equally weighted according to the quality of the overall submission and the quality of the aspect of the work that the individual is responsible for.
- 3) Video presentations – Using pre-recorded videos rather than traditional live “speak in front of the class” style presentations.

All three methods come with positives and negatives. We will analyse survey data from students who have taken part in modules using these techniques, with a particular focus on their perceptions of how these methods affect fairness, stress, and anxiety. We will also consider anecdotal evidence from colleagues regarding how these methods seem to affect student happiness, engagement, and skills development.

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## Assessment in tertiary mathematics post COVID-19

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Assessment in tertiary mathematics subjects has become one of the most significant challenges of learning and teaching during the pandemic.

What will the new normal look like for mathematics examinations and who will decide what that is?

In Australia there has been a move to online assessment and the removal of final assessment at many universities during the COVID-19 pandemic. As we come out of the pandemic and enter a new normal, several universities are making a push to continue with this form of final assessment or lack thereof. This is being viewed with considerable concern by mathematics departments (and others) at the universities concerned.

In order to measure the extent of this trend and the opinions of academics in Australia and beyond the First Year in Mathematics group has released a survey to gather data on how assessment, particularly final examinations, has changed in universities and whether these changes are in the best interests of assessing students' abilities.

In this talk we will present the results of this survey.

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## Optimising the blend of in-person and online mathematics support from the student perspective

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As education moves towards a new normal following the COVID-19 pandemic we, as educators, seek to find the optimum blend of online and in-person mathematics and statistics support to best help our students. In two papers published in 2021 we thematically analysed interviews with students and tutors about their experience of online mathematics and statistics support at two universities, one in Ireland and one in Australia. Using the results of this analysis we designed a set of surveys for current students of both institutions to develop the themes found and attempt to find an optimum blend of services.

Surveys were directed to three groups of students from each institution, those who had experience with pre-COVID-19 in-person support and online support provided during the pandemic; those who had only experienced online support; and those who had experienced in-person support pre-COVID-19 but had opted not to use online support during the pandemic.

In this talk we will discuss the results of the survey including students' attitude towards mathematics and statistics support and their preferences for modes of support for the future.

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## Student Engagement with Maths and Stats Support

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Most HE institutions have dedicated maths and stats support services which primarily offer individual support, provide students with additional teaching and alternative explanations which may be easier for the student to understand in a non-threatening, supportive environment.

Previous research suggests that whilst maths and stats support can improve confidence, attainment and retention, many students who could benefit from the additional support do not engage with the service.

At Sheffield Hallam a number of support sessions for maths and stats are offered to all students across the university. This presentation uses student demographic data on the users of maths and stats support, as well as survey responses from users and non-users to assess:

Who is/is not utilising the service

How students are made aware of the service

The reasons for students not using the service

How engagement has changed during and after the pandemic

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## **Beyond alt text: Creating explorable objects in place of images in digital resources.**

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The digital resources used to support students at university are required to be accessible. This includes any images they may contain. If a picture tells 1,000 words then writing alt text for the 1,000+ images on mathcentre, the post-16 maths resource sharing website, is going to take quite a while. However there is an alternative - convert these images to explorable accessible digital objects. A screen reader can do the heavy lifting for the words, and all students will benefit from an interactive resource.

A team from the University of Bath and Coventry University have been working together to explore the conversion of images to digital objects. This session will cover what the teams have learned, based on the objectives of the project.

The session will aim to:

- Offer guidance on how to use the digital tools Desmos and Geogebra to create digital objects in place of images, and share insight on which is best to convert different types of images.
- Expose the size of the conversion task for the resources on the mathcentre website.
- Set out a framework to allow the maths support community to collaborate on the mathcentre image conversion task.

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## **100s of questions offered to 1000s of students – I like them NUMBAS.**

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We would like to share our repository of over 450 “ready to use” NUMBAS questions with you.

- Inexhaustible supply of randomised questions
  - Tried and tested - thousands of uses by students at the University of Bath
  - Detailed, adaptive feedback
  - Ten topic areas from the A-level maths syllabus covered
  - Easy to add to moodle – just drag and drop
-

## **Lecturers don't know everything: students watching the thought processes of lecturers on unfamiliar ground**

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In a project in 2017/18 a picture was gained on students' perceptions of making a mistake within BSc Mathematics at Sheffield Hallam University. Following this, a teaching intervention took place in January 2020 to tackle some of the views held by students regarding mistake-making. By presenting lecturers with unseen problems in front of classes, students witnessed the lecturers going wrong and getting stuck on questions. Questionnaires before and after the intervention showed a change in students' perceptions, particularly regarding their expectations of lecturers. This was explored further in focus groups, where students discussed the benefits and also highlighted the potential damage such an intervention could have. We will present some of the key findings of the evaluation of this teaching intervention.

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## **Test, refresh, practise: how study skills can increase your maths confidence**

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Following the disruption in A-level courses during the COVID-19 pandemic, the Mathematics and Statistics Help centre at the University of Sheffield saw a rise in the number of students asking for 1:1 support in structuring their mathematics study, both throughout their courses and in the revision period. Though this was not a new topic of discussion, the increase in anxiety in the students and frequency of appointments prompted the creation of a workshop on building Study Skills for Maths.

In most courses, it is clear how general Study Skills advice can be embedded, and the nature of effective mathematics practice means this is not always appropriate or necessary. Through the Study Skill for Maths workshops, students have a space to think about their maths needs, schedules and goals for their studies. By centering their revision of a "Cycle of Practice", the aim of the Study Skills for Maths workshop is to leave students equipped with the tools needed to effectively embed their maths skills ready to take on their goals. Here, we will discuss our process for building the workshop, including the consideration of students from non-STEM disciplines, so that we could ensure students left the workshop confident in tackling the work lying ahead.

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## **CRaP in Assessments**

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Recently, some institutions have moved from formal closed-book examinations, to open-book, do-at-home, short time-frame assessments. With these enforced changes, the mathematical sciences assessment setter is tasked with creating assessments which are resistant to CRaP: Collusion, Rackets, and Plagiarism.

In this presentation, I'll provide some recent examples of issues encountered in the assessment of science and engineering modules in my role as module coordinator, moderator, and member of my institution's academic malpractice panel.

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## **Digital mathematics support for prehonours students with a view towards hybrid**

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MathsBase is the University of Edinburgh's mathematics drop-in support for pre honours students who are enrolled on one of the School of Mathematics courses. In September 2020 this was transformed to a synchronous online drop-in support. The online support is structured around a common MS Team, emulating the fixed in person venue which had been used in-previous years. In the summer of 2021 the School of Mathematics began a project to analyse the rich quantitative data available from the Teams software and qualitative data obtained from surveying users and tutors of the support, with the aim to inform how hybrid mathematics support might be offered in future.

In this talk we will present our findings after analysing two years of data. These findings include the pattern of use of the digital support, certain barriers in the delivery of digital mathematics support, students' changing attitudes towards the service and towards potential hybrid models. Although most of the students surveyed expressed a preference for in-person support, there was a clear minority who had a preference for online often citing the improved accessibility and the possibility of instant access. A future hybrid offering will allow us to support more students. It is clear, however, that hybrid support will need monitoring and iteration to keep up with students' attitudes as they continue to study in changing circumstances.

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## **Translating HELM workbooks into interactive online workbooks using STACK**

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Since the onset of the COVID-19 pandemic, the University of Edinburgh and Loughborough University collaborated to develop interactive online workbooks for the mathematics education of STEM students. These materials have been in use and evolved over the two years in which we have seen a significant amount of online teaching and students have engaged significantly better with the interactive online workbooks than in the other elements of the courses over this time.

Our approach to the online workbooks was to use the STACK online assessment system and combine our experience gained with running the fully online course “Fundamentals of Algebra and Calculus” (FAC) with materials from the HELM (Helping Engineers Learn Mathematics) project workbooks. Each interactive workbook is a Moodle quiz with textbook-style written content, worked examples, simple tasks and practice questions. Almost all questions are randomised so each student will have a collection of questions which use different values. New features of STACK, to be made available in 2022 have allowed for a greater range of questions.

This talk is an update on the HELM into STACK project. It focuses on specific upgrades that happened over the last year, such as including more interactive elements into questions, and new STACK features.

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## Lightning Talks

### Spinning a yarn about... Maths Week Scotland

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Three years ago, the School of Chemistry’s RSC-funded outreach project aimed to celebrate International Year of the Periodic Table (IYPT2019) by engaging the knitting community at the University of Glasgow and further afield. This project culminated in a knitted periodic table which was unveiled at a public lecture in December 2019.

Inspired by the success of this project, we decided to engage our network of knitters and the wider community in a mathematical knitting project for Maths Week Scotland. The plan was to knit a mathematically themed banner for use at Maths Week Scotland and other outreach events that would initiate mathematical interest and conversations in a fun and accessible way.

In this talk, I will outline the highs, lows and conclusion of running an outreach project during a pandemic.

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### Transition to Glasgow: Logic, Reasoning and Problem Solving

**First Author:** Ruth Douglas

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The Student Learning Development team at Glasgow University launched a new initiative for incoming undergraduates in August 2021 - an optional, online, two-week course called 'T2G: Transition to Glasgow'. Students completed core content around effective learning and study skills as well as selecting two subject-specific electives. In this lightning talk, I will talk both about T2G and the elective I developed and delivered on Logic, Reasoning and Problem Solving. The elective was taught over Zoom and used a flipped approach to encourage engagement and collaboration. T2G has since been nominated for a Herald Higher Education Award under the category of 'Enhancing Student Learning'.

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## **Correct for the wrong reason: Why we should know more about Mathematical Common Student Errors in e-Assessment questions.**

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Students may arrive at an incorrect answer when answering a mathematical question due to several reasons, such as random errors, calculation errors or misreading the question. Such errors are sometimes referred to as Common Student Errors (CSEs).

Several e-Assessment systems have been developed and used by universities to conduct formative and summative assessments. Dewis is a fully algorithmic open-source e-Assessment system, which was primarily developed at the University of the West of England (UWE Bristol).

The CSE project at UWE Bristol began with an aim of developing a technique to detect CSEs and provide tailored feedback in Dewis e-Assessment questions. In this talk, we briefly present one important finding of this project that is related to the parameter selections of e-Assessment questions which have at least one CSE. We will highlight why it is important to know more about mathematical CSEs in this digital era than ever before.

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