



The Open
University



ESTEEM
THE OU CENTRE FOR
STEM PEDAGOGY

ESTEEM TEN YEARS OF SCHOLARSHIP AND INNOVATION

Marking the tenth anniversary
of the OU Centre for STEM Pedagogy

ACKNOWLEDGEMENTS

This publication showcases 19 eSTEeM projects. Our thanks and appreciation go to those project leaders for allowing us to include their work, and for providing reflections on their scholarship experiences and feedback on the draft sections.

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I would like to thank Liz Berry, Sarah Davies and Karen Kear for working with me as co-authors.

Trevor Collins.

Dr Trevor Collins
eSTEeM Deputy Director
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FOREWORD

Ten years ago, as an externally funded initiative in STEM pedagogy was coming to an end, it was realised that we had tapped into a rich seam of enthusiasm for coordinated, reflective practice. There was no doubt that we needed this seed to grow. A key part of the concept was that it encouraged us to apply a scholarly analysis to our own teaching – for the immediate benefit of all involved whether teachers or learners.

Another important part of the foundation was the name: what a gift that when so much was getting a prefix of 'e' or 'i', from e-learning to iSpot, that we should find a name that has gravitas, includes S, T, E and M in sequence and starts with 'e': eSTEEem – it's not an acronym as such but the lower-case letters can be taken as highlighting 'engagement' and 'excellence'.

When we formed the STEM Faculty in 2015 from two faculties (Science plus Maths, Computing and Technology) it was extremely helpful to highlight five years of excellent co-operation across the Open University's STEM landscape that eSTEEem had then achieved. Now, five years further on, it is a pleasure to see that spirit of co-operation spawning equivalent practitioner-based centres for pedagogy in our three other faculties.



Prof Nicholas Braithwaite
Executive Dean, STEM



INTRODUCTION

In this publication, we look back over ten years of eSTeEM projects and highlight examples demonstrating how scholarship has made a difference to teaching and learning across the STEM Faculty. Scholarship refers to a set of practices and activities leading to evidence-informed innovation that enhances teaching and learning.



ORIGINS

Following the OU's successful hosting of four Centres for Excellence in Teaching and Learning (CETLs) from 2005 to 2010, eSTeEM was initially a joint initiative by the (then) Science and MCT (Maths, Computing and Technology) Faculties. eSTeEM was established as the OU Centre for STEM Pedagogy to sustain the University's position at the forefront of distance education in STEM disciplines.

In 2018, a university-wide **Scholarship Plan** was approved by the OU Senate, which enabled the creation of Scholarship and Innovation Centres in each of the faculties and a university-

wide Scholarship Steering Group. These centres were based on the scholarship support model developed by eSTeEM; we now work alongside our sibling scholarship centres to coordinate scholarship and further the University's reputation for excellence in the Scholarship of Teaching and Learning (SoTL). eSTeEM has been commended in several of the University's periodic quality reviews for the role it plays in embedding scholarly practices and promoting the adoption of evidence-based teaching and learning strategies in STEM modules.

eSTeEM has built a significant body of work and experience amongst

colleagues through initiating and supporting scholarship projects. Originally, calls for project proposals were themed, but over the last five years, we have increasingly targeted our resources on scholarship to addresses strategic priorities of the STEM Faculty and the wider University. For example, the 17th call for projects, which was launched in July 2020, included a specific focus for projects to investigate the degree awarding gap affecting particular student groups (as detailed in the University's **Access and Participation Plan**).

WHO IS INVOLVED?

eSTeEM aims to support members of the STEM faculty to engage with, and participate in, SoTL. Our approach is inclusive, as a range of groups have vested interests, including: lecturers, staff tutors, curriculum managers, Associate Lecturers (also known as tutors or ALs) and students. OU Associate Lecturers are dedicated subject specialists, working at a distance, to run tutorials, mark and give feedback on student assessments, and provide academic support.

As the OU's teaching method of open supported learning involves multi-disciplinary teamwork to produce module resources and support students, eSTeEM's projects often involve collaboration with colleagues in other parts of the University, including the other faculties, IT, Professional Services, and Quality Enhancement.

ACTIVITIES AND METHODS OF OPERATION

Professional development through scholarship

eSTeEM provides a mechanism for professional development through practice-based scholarship within a peer-supported community. Our development activities include training in research design, evaluation and dissemination. We also support project teams to report their findings externally through presentations at STEM pedagogy conferences and publications in peer-reviewed journals.

Rolling project portfolio

We operate a rolling project portfolio; currently, there are over 80 projects in progress, over 100 completed and a further 17 that are due to commence imminently. Projects typically run for around 18 months. A call for projects in strategic priority areas is issued twice a year to STEM staff, with an annual call specifically for proposals led by Associate Lecturers. Proposals are reviewed by our Coordination Group, which includes the Scholarship Leads from each STEM School and representative colleagues with scholarship expertise. The project leaders from each funding round take part in an induction session and are offered a project mentor for the duration of their project. Project leaders are also encouraged to include their scholarship project as a case study when applying for professional recognition through the HEA Fellowship scheme.

Community events and national standing

Now in its ninth year, the eSTeEM Annual Conference takes place each spring, providing an opportunity for the community to come together and share their findings across the faculty. eSTeEM was the founder of the Horizons

in STEM Higher Education Conference, which is now coordinated by a network of UK universities which, between them, host an annual conference. This provides further opportunities for OU colleagues to network and disseminate their scholarship findings nationally. A STEM Education Research Group has been established through eSTeEM, which provides a peer-support network for colleagues on educational research and authoring journal papers.

Students as partners in scholarship

An integral part of our work within the Scholarship Steering Group has been to lead a Students as Partners workstream. We have been developing ways of engaging OU students in scholarship, not only as research participants, but as members of project teams and in a

consultative capacity for the Centre. For example, we have been piloting the use of a Student Register for expressions of interest from students seeking to work on scholarship projects. We also have a well-established Student Reference Panel that provides a basis for consultation and discussion on matters of STEM scholarship.



To view the full range of our projects and events please visit the [**eSTeEM website**](#).

PROJECT HIGHLIGHTS

eSTEeM is a diverse and thriving community of scholars built on a foundation of excellence in teaching and learning that drives innovation through critical inquiry and evidence-based practice. In its ten years, eSTEeM has launched around 200 projects, this publication highlights a selection of 19 of these under eight thematic areas (listed below).

These projects were selected to illustrate the range and depth of scholarship undertaken over the last decade. In 2018 we introduced a set of annual awards, which several of these projects received. The project leaders were asked to comment on their experiences and excerpts from these reflections are included in the project descriptions.

The eight thematic project areas are as follows.

- Applying an evidence-based approach to assessment
- Effective transitions and enabling early starts
- Equality, Diversity and Inclusion within distance learning
- The use of learning analytics and exploring unpredicted outcomes
- Understanding the power of learning communities
- Evidencing the value of technology for learning
- Tuition at a distance and the challenges of evidencing effective support
- Tutor development and academic practice





APPLYING AN EVIDENCE-BASED APPROACH TO ASSESSMENT

Assessment is a challenging topic for scholarship research because of the potential for confounding factors and difficulties in performing valid comparisons. However, it is an important field for the OU where aspects of assessment, from the mix of formative and summative approaches, to the way in which questions are asked, can carry implications for student success and retention. The three eSTeEM projects described here were chosen to illustrate the range of topics.

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no evidence has been seen to support a return to summative continuous assessment

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A comprehensive eSTeEM project, **‘Thresholded assessment: Does it work?’**, led by Sally Jordan, investigated the benefits and drawbacks of various models of assessment. The models studied included summative, purely formative and formative-thresholded assessment. In summative assessment the mark contributes to the student’s grade and in purely

formative assessment it does not. In the formative thresholded assessment model, students must reach a threshold mark for the formative elements of the assessment, but their final grade is calculated from the overall examinable component alone. The project analysed many undergraduate modules in a range of subjects. An overall conclusion was that there was no evidence to support a return to continuous summative assessment.

However, relying on examination alone was not recommended. Instead, to account for topics for which an examination is not an appropriate form of assessment, such as experimental work, two-component assessment was recommended as a sensible approach, together with formative-thresholded elements to help students prepare. Looking back now at the project, Sally says *“the most surprising aspect was that the strategy actually worked! Some of the comments from students who reported feeling able to learn from assessment rather than worrying about the grade and spending an unreasonable amount of time on the task, were particularly pleasing.”*

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students only visited the quiz when they had to

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The next two projects are both related to the use of practice questions within the formative-thresholded element of a module. **‘Assessment analytics of student engagement with, and performance on, S217 online quizzes’** concerned the module S217 ‘Physics: from classical to quantum.’ The S217 module team included a series of quizzes designed to help students pace themselves through the material and to reinforce learning at the relevant points in the study units and before assessment. Each TMA included a question that required submission of a screenshot from a relevant quiz together with a brief reflection on associated learning. The eSTeEM study was designed to determine if the students were using the quizzes as the module team intended.

The study had two components, firstly an analysis of online data concerning use of the quizzes (e.g. the number of students completing each quiz) and



secondly telephone interviews with 11 students to discuss their experience of using the quizzes. It was found that the quizzes were not being used as intended. The TMA question designed to encourage students to look at the quizzes had the desired effect, but students looked at the quiz in order to address that question, and after they had done the TMA question for which the quiz was intended to provide practice.

The project made use of a new analytics system that was introduced at the start of the project, in which data were updated much more frequently than before. This made rapid analysis possible. Regarding changes that were made to the next presentation of S217, Project Lead Andrew Norton reports that *“in the second presentation, some students did indeed access the quizzes earlier (as intended) but TMA scores, exam scores and pass rates were essentially unchanged. So, we succeeded in the objective of the project, and changed student behaviour as a result, but unfortunately this had no effect on student success.”*

Andrew has since taken forward his work on quizzes to generate online exam questions, he says: *“Using multi-variant iCMA style questions we have written a two-part deferred feedback*

exam for S284. ... The multiple question variants mean that there are more than 30 billion question combinations for the main (Part 2) exam”. He notes too that these developments are timely, *“I can see that, with the current move towards at-home, open-book exams more widely across the OU, this experience is likely to prove useful and find wider applicability.”*



more likely to engage



The final example, **‘Use of STACK to generate formative assessment for level 3 Pure mathematics’**, led by Hayley Ryder, concerned the module M303 ‘Further pure mathematics.’ The motivating factor here was that, as a relatively new module, M303 did not have a large set of previous exam questions (and solutions) available for students to use for practice. As it is time-consuming to produce and check such questions, a computer-algebra system, STACK (System for Teaching and Assessment using a Computer algebra Kernel) was used to generate longer, examination-like quiz questions. Students could compare their solutions with answers supplied by STACK.

The project aims were to determine if (i) student engagement with the new quizzes was higher than with the existing (shorter) quizzes, and (ii) students using the new quizzes felt better prepared for the exam. The approach was evaluated by an analysis of analytics data covering 660 students over four presentations, a questionnaire completed by 58 students and semi-structured interviews with 12 students. The findings supported the introduction of the longer, examination-like questions. More students attempted the new style of quizzes than any of the quizzes with shorter questions. Furthermore, the number of quiz attempts was significantly higher for students who had maintained or improved their M208 exam result in M303 than for those who had not.

Looking back at the project, Hayley comments *“Often initiatives are taken to help struggling students or to stretch the high achievers. I found it particularly satisfying that these quizzes, whilst aimed at all students, appeared to be impacting most strongly on the middle third (since it is often harder to target this group).”* Furthermore, students liked them: *“Exams are not usually seen as pleasurable, and these quizzes were intended to mimic a ‘mock’ exam, so I was also very happy to discover that the students had enjoyed doing them.”*

FURTHER INFORMATION

Thresholded assessment: Does it work? – Sally Jordan, John Bolton, Lynda Cook, Saroj Datta, Jon Golding, Janet Haresnape, Richard Jordan, Kerry Murphy, Karen New and Ruth Williams.

Assessment analytics of student engagement with, and performance on, S217 online quizzes – Andrew Norton and Alan Cayless.

Use of STACK to generate formative assessment for level 3 Pure mathematics – Hayley Ryder and Joe Kyle. **HIGHLY COMMENDED:** Innovative/original approach to teaching 2020

EFFECTIVE TRANSITIONS AND ENABLING EARLY STARTS

Transition Materials and Early Start programmes are intended to improve retention by providing students with the opportunity to start studying before a module begins. The distinction between the two types of programme is that material provided in the Transition Materials approach is specially prepared (although it may be based on current or past module materials), while Early Starts make available some of the module materials that will be encountered later. Study support from Associate Lecturers is usually offered in both approaches, but the level of support varies.

There are two main drivers behind a module being chosen for such a scheme: subjects such as Mathematics or Chemistry where students need to be confident in their basic knowledge before moving on to more advanced work; and specific modules where retention has been a problem (e.g. students registering early but then not engaging with the module a few months later, or differences in retention between students on different qualifications).

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The clinics received excellent student feedback on the website forum

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An example of a scheme covering Transition from Level 1 to Level 2 was associated with the module S215 'Chemistry: Essential Concepts.' The eSTeEM project, led by Nick Chatterton and Elaine Moore, provided '**Online Chemistry Support Clinics**', which, based on feedback received, were later renamed *Getting Ready for* Students worked through problems for which worked answers, online learning materials and support (including bookable one-to-one online sessions



with a tutor) were provided. Evaluation was specifically focused on retention. The team showed that retention was better than in previous years, but because a number of other retention measures were implemented at the same time as the scheme, it was not possible to attribute this improvement entirely to the scheme. It was found that those who engaged with the scheme were those who had done well at Level 1 and were not those most at-risk of dropping out. This finding fed into later work, including the Chemistry Early Start schemes, in which specific student groups were targeted.

For Nick, the scholarship involved in the project provided unforeseen personal benefits – he recalls *“This was my first experience of working directly with OU students and tutoring online. I had over ten years of face-to-face university lecturing experience prior to joining the OU, so the insights gained from the project were invaluable. It was interesting to see how differently the OU students engaged with the teaching materials and it demonstrated to me how essential it is to structure material effectively for distance learners.”*

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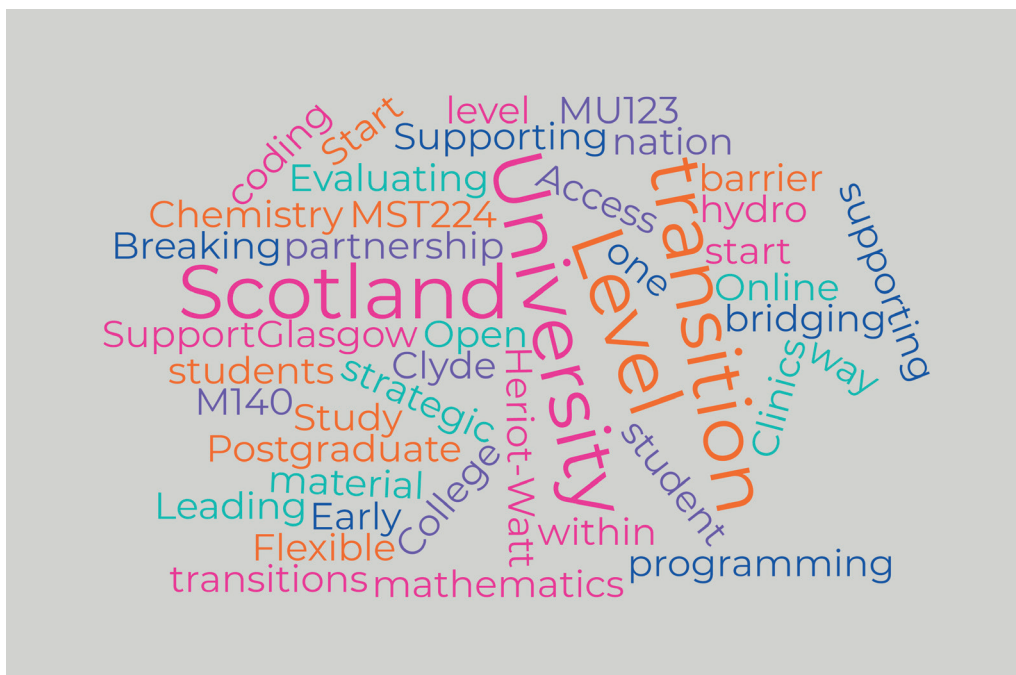
Around 30-40 more students passed M140 than we would have expected

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The '**Early Start**' programme that was designed for the module M140 'Introducing Statistics' built on the student tips for success, developed in the 'Succeeding Against the Odds' project (see page 14), where students had recommended getting ahead with their studies. For the presentation starting in October, it was noted that many students registered very early on M140, and of the students who registered in April and May there was a disproportionate dropout rate compared to those who registered in July and August. So, in this programme students were able to start their study up to three months in advance of the usual module start. To evaluate the programme, the project team used student questionnaires, tracked student participation and measured retention at several points during the module.

It was found that the Early Start programme led to an improvement that corresponded with retaining about 30 more students (out of 1,000). Since the end of the project the programme has continued and expanded. Project Lead Carol Calvert tells us: *“It is a formal part of the M140 offering; it is now run by ALs and around 60% of students take up the offer of a place on the flexible start programme.”* And it is popular – *“Student comments on the M140 flexible start have been amazingly positive with so many ‘thank you’ comments. ... It has eased the October start pressure for many students ... This year over 600 students took up the offer to take part.”*

In all, seven eSTeEM projects on Transition Materials and Early Starts have been completed, with several underway that build on the previous findings. There has been widespread implementation, with scholarship outcomes feeding into institutional guidance for colleagues setting up such programmes ([Document available on OU Intranet](#)).



FURTHER INFORMATION

Online Chemistry Support Clinics – Nick Chatterton, Elaine Moore, Catherine Halliwell and Louise MacBrayne.

A Flexible Start to M140 – Carol Calvert, Gaynor Arrowsmith, Colin Fulford, Mark Hobbs, Luay Salman and Tricia Terndrup. **WINNER:** Enhancing the student experience 2019

Background

There have been many initiatives over the past 30 years to increase the number of girls choosing to study engineering at university. Despite these initiatives the numbers of professional female engineers has remained low at around 9%.

Women account for ~ 10% of undergraduate engineering students at the OU. We have investigated their backgrounds, motivations and aspirations through a recent survey, which has revealed some interesting differences between male and female students.

Work experience

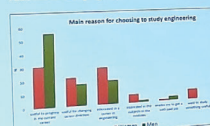
Women
71% work full-time, 10% part-time
19% work in engineering, 23% in STEM
44% have never worked in engineering but want to.

civil
sustainability
development medical aerospace energy
environmental
chemical

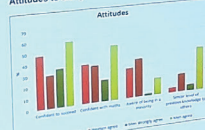
Can you guess which set of disciplines most interest women and which most interest men?
The relative sizes of the words represent the popularity of the discipline.

automotive
energy
civil
aeronautical
medical sustainability
environmental

Reasons for studying engineering



Attitudes to study



EQUALITY, DIVERSITY AND INCLUSION WITHIN DISTANCE LEARNING

The principles of equality, diversity and inclusion are closely aligned to the OU's mission of being 'open to people, places, methods and ideas' and values of being 'inclusive, innovative and responsive'. However, these are challenging to achieve and therefore have been the focus of many scholarship projects. Valuing diversity and enabling inclusion often involves positive action to overcome society's inequalities and enable equitable participation by all. A significant number of eSTeEM projects have been completed on gender and disability inclusion.

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most students reported positive attitudes towards their study of engineering

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The projects on gender have explored gender differences and actions to encourage and support more women in STEM. An illustrative example, led by Carol Morris and Sally Organ, was the project **'Engineering qualifications at the OU – what motivates women to study?'**. This project set out to investigate the differences in motivations and career aspirations of women and men studying engineering. Responses to a primarily quantitative questionnaire were gathered from 76 women and 61 men. This was followed-up with a qualitative interview study with 12 of the women and five of the men. The study found that women were more likely to be studying to change career direction and enter the engineering profession, whereas men were more likely to be studying to progress their current career. Notably, 46% of the women already had a degree compared to 16% of the men.

The men were more likely to have been encouraged to do engineering by others, and the women were more likely to report a family connection with engineering.

Looking back at the impact of the project, Carol and Sally comment: *“Extra support has been put in place for female students, for example, an annual conference to celebrate International Women in Engineering Day, networking through a dedicated Women in Engineering forum. We are currently working with employers to find potential mentoring opportunities for final year students, working with Careers and Employability to encourage student placements, and a Women's Engineering Society student group has been established.”*

The projects looking at disability have focused on accessibility and the use of assistive technology and reasonable adjustments. Here we include two examples that set out to improve the accessibility of maths materials for blind and visually impaired students.

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The basic principle ... is to map the various dimensions of the data ... to different aspects of sound

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The **'Sonification of Depictions of Numerical Data'** project, led by Karen Vines and Chris Hughes, enlisted a group of 12 participants (five sighted and seven blind or visually impaired) to review a set of six graphs and plots taken from four Level 1 modules in Maths and Statistics and Science. The

graphs and plots were presented first as sonifications (i.e. as sounds with varying pitch over time), then as figure descriptions, and finally as visual or tactile versions. Sonifications were found to be an effective way of communicating the general gist, figure descriptions were effective at communicating the detail, and tactile graphs enabled the students to interrogate the graphs and plots for themselves. The project concluded that a blended approach is best, as each alternate representation provides a different but complementary aspect of the original graph or plot.

Reflecting on the project now, Karen and Chris comment that *“it has extended our network of connections at a variety of levels: at school level, across the faculty and beyond. Even though both of us are in the same school, working on the project provided us with an opportunity to collaborate that probably would not have happened otherwise. Furthermore, the project team encompassed colleagues from a variety of schools within STEM, SeGA [the Securing Greater Accessibility team] and from outside the OU. Working on this project enabled us to build and foster these relationships, encouraging the development of future scholarship and collaborations.”*

'Evaluating the accessibility of an alternative format of module materials in Maths & Stats' a project led by Chris Hughes, explored the extent to which online mathematical notation (written in MathML and rendered using MathJax) could be interrogated, explored and studied using screen reader applications. The project contracted the Royal National Institute of Blind People (RNIB) to conduct an expert assessment in phase one, and user testing with eight participants in phase two. Thirty-one of the 36 issues identified in the expert assessment were resolved prior

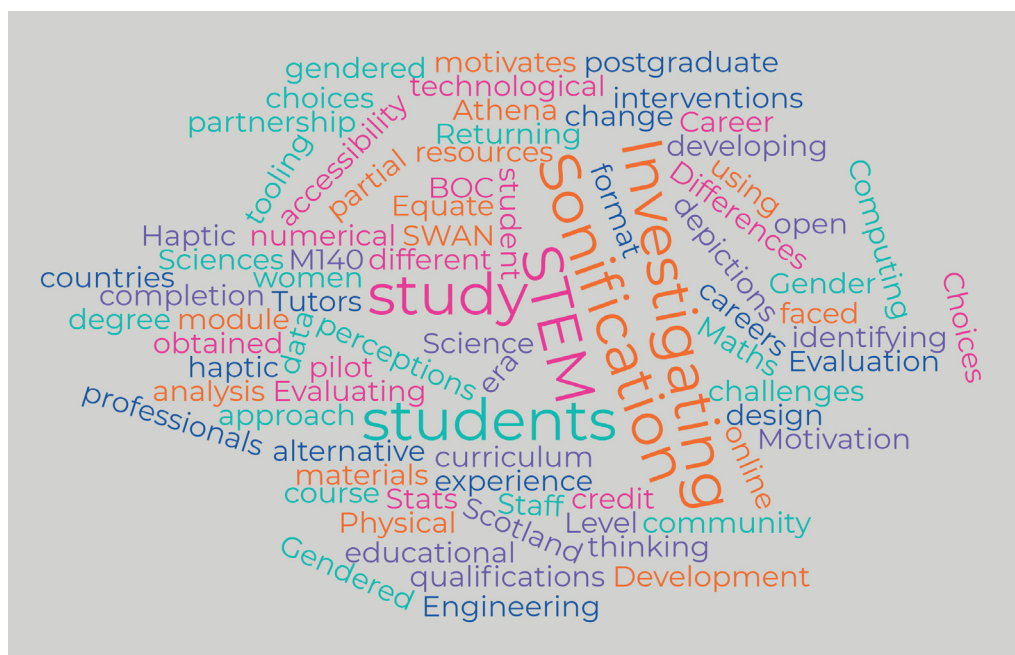
to the user testing phase. Observations and feedback from the participants in the user testing phase provided rich insights into the suitability of the generated notation and the usability of the combination of notation and screen reader application.

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it is not simply enough to produce an output that may be accessible via assistive technology

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Lessons learned through this project underlined the importance of tutorials for using assistive technology, the care required in authoring for use with screen reader software, and the level of training needed to operate the system effectively. Commenting on the project, Chris says “We were able to develop an output that could be engaged with meaningfully by users of assistive technology who wished to study materials containing mathematical content. ... Working with the RNIB and meeting the participants for the user testing was a fantastic opportunity. The output that we developed for this project has since been deployed to some of our visually impaired students in physics and statistics.”



These examples of scholarship focus on understanding different students' motivations, aims and experiences and using those insights to tailor support appropriately in each case. This is an expanding area for scholarship, as increasing attention is being drawn to the degree awarding gaps recorded for specific groups of students, including students with disabilities and students from Black, Asian and Minority Ethnic backgrounds.

FURTHER INFORMATION

Engineering qualifications at the OU – Carol Morris, Sally Organ, Moira Dunworth, Elaine Nicholls and Jo Olley. **POSTER PRIZE:** 2018

Sonification of depictions of numerical data – Karen Vines, Chris Hughes, Hilary Holmes, Victoria Pearson, Claire Kotecki, Laura Alexander, Chetz Colwell and Kaela Parks. **WINNER:** Innovative/original approach to teaching 2018

Evaluating the accessibility of an alternative format of module materials in Maths and Statistics – Chris Hughes, Chetz Colwell, John Clarke, Kaye Williams and Alison Bromley. **WINNER:** Enhancing the student experience 2020

THE USE OF LEARNING ANALYTICS AND EXPLORING UNPREDICTED OUTCOMES

Learning analytics has been an emergent field over the last decade that looks at the use of data about learners and their contexts, for the purposes of understanding and optimising learning and the environment in which it occurs. At the OU a range of learning analytics tools has been produced to track student engagement and to predict students' performance on assessments.

Applying the critical perspective of scholarship, eSTeEM has supported a series of projects looking at how learning analytics are used to target student support. Here, we highlight two contrasting examples: a project looking at Associate Lecturers' and module team members' experiences of using learning analytics, and a project exploring the behaviours of students who succeeded even though the predictions made by learning analytics suggested that they may not.

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a method to support tutors in their work

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The **'Piloting OU Analyse and the Student Probabilities Model on 12 STEM Modules'** project, led by Carlton Wood, Steve Walker and Tom Olney, looked at the use of learning analytics across the faculty to support student retention and progression. This involved a preliminary interview study with seven tutors prior to the introduction of 'data dashboards' (combining a set of learning analytics tools) and a main interview study with 38 tutors at the end of the presentation. The corresponding module teams also completed an initial survey questionnaire and interview at the beginning of the presentation, and a final interview at the end of the presentation. A thematic analysis of the interview transcripts identified a series of themes that were used as the basis for developing recommendations for policy and practice.

The evaluation was carefully designed to avoid conflating the use of the descriptive and predictive learning analytics tools. The tutors typically found the descriptive tools more useful than predictive tools for reasons of trust, transparency and accuracy. When they were positive about the Data Dashboard tools, they were using the descriptive tools to look at an individual student's VLE activity data and assignment marks, rather than the 'at-risk' indicators generated by the predictive tool.

In particular, the tutors identified a desire for data that might give them some insight into their students' behaviour at the beginning of the module. However, the predictive learning analytics model is not accurate before the submission of the first assignment. In most cases, after submission the tutor has established a relationship with the student, which they rely upon more than the algorithm. This explained the low take up rate of the predictive tools and a decrease in their use by tutors over the length of the module.

As a consequence of the project, the Data Dashboards used across the STEM modules include the VLE activity and assignment data by default, and the predictive tools are now available on an opt-in basis, after the first presentation of the module. Looking back at the project now, team member Tom Olney comments: *"One of the really satisfying things about our project is that the findings have been able to shape faculty strategy and policy towards the use of learning analytics. ... This project has resulted in two papers being produced – one is already published whilst another is imminent."*

In the **'Succeeding Against the Odds'** project, led by Carol Calvert, interviewed a group of ten students from a sample of 168, drawn from two module presentations for a Level 1 Maths module (MU123 'Discovering Mathematics') and Level 2 Physics modules (S207 'The Physical World' and its replacement S217 'Physics: From Classical to Quantum'). Initially, students were selected from a sample who had passed their module despite the predicted probability of them passing being less than 50%. In the second phase, students were selected if they had continued studying at a point when the predicted probability of them carrying on was less than 75%.





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the importance of getting organised

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The reflections of the project team highlighted that these successful students took a ‘can do’ approach to their studies and that two strong themes emerged from the interviews: the importance of being well organised (e.g. getting ahead of the study planner), and the value of being willing to try different study approaches. From the findings a set of tips for study success were developed and integrated into

the induction session for Maths and Statistics students, an integrated study planner was developed for students studying MST124 ‘Essential Mathematics 1’ and M140 ‘Introducing Statistics’ concurrently, and a further eSTEeM project was undertaken to explore the impact of enabling students to make an early start on M140 (see page 10).

Carol reflects that: *“The project started as a result of a casual comment over a cup of coffee in a regional centre. I was building models predicting success, based on hundreds of thousands of student records, and worrying about those who failed. A comment flipped my viewpoint – why did students predicted to fail pass? The experiences of ten students prompted two major initiatives that would never have come from the statistical modelling.”*

Both examples demonstrate how scholarship has been applied to reflect on our teaching and learning practices and constructively question our use of learning analytics. Furthermore, Tom notes *“... it provided me with an opportunity to lead a teaching and learning research project for the first time. I developed skills in qualitative research, such as creating interview instruments, interviewing, organising transcriptions, coding, using NVivo and writing an academic paper.”*

FURTHER INFORMATION

Piloting OU Analyse and the Student Probabilities Model on Twelve STEM

Modules – Carlton Wood, Steve Walker, Tom Olney, Maria Kantirou, Anactoria Clarke and Moira Dunworth.

Implementation of lessons learnt from students who succeed “despite the odds” – Carol Calvert, Dave Edwards, Linda Brown, Colin Fulford, Juliet Coleman and Rachel Hilliam.



UNDERSTANDING THE POWER OF LEARNING COMMUNITIES

Projects about learning communities are often across a curriculum area, rather than a single module, and sometimes go beyond the OU into the wider community. There have been projects about collaborative learning, social networking, citizen science and many other topics. The motivation for these projects is to help learners feel connected to each other, to broaden their horizons, and enable peer learning. This can overcome the isolation of distance learning, keeping learners on track and making study more enjoyable.

Projects typically use communication technologies to enable groups or communities of learners to communicate and collaborate with each other. For example, projects have investigated wikis, web conferencing, and online platforms for practical science. Several projects have focused on the OU's OpenStudio environment, where learners can share and discuss visual artefacts that they have created or found (e.g. photos, design sketches, modelling diagrams).

To investigate these settings, projects use a range of methods, typically gathering data from learners and ALs via surveys or interviews. Online observation methods are also used, to look at the interactions between learners, and the resources they share.

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Social engagement in OpenStudio at level 1 is linked to the gaining of confidence, skills development and student success

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The two example projects discussed below give a flavour of eSTeEM project work in this area.

The context for the **'Are we making progress?'** project was learners' use of OpenStudio in the OU's Design and Innovation qualification. The project collected quantitative and qualitative data about engagement with OpenStudio, and statistical data from OpenStudio usage by nearly 3,000 students, distributed over several presentations of modules at different levels. Data were gathered about the design work students created and uploaded to OpenStudio, the conversations around students' uploads, and students' perceptions of OpenStudio.

Project Lead Nicole Lotz summarises the findings: *"The research has shown that distance learners gain confidence by just looking at their peers' contributions, and over time students learn to engage more actively and critically by commenting on others' work. The style and focus of comments also changed with progression across the qualification, starting off with encouraging yet superficial likes, and moving to helpful critiques drawing on concepts from the module materials. We have learned that an induction of students and ALs to the benefits of studio-based learning needs to be integrated at every stage and not just at Level 1."*

The **'Online journal clubs'** project created a dedicated Online Journal Club (OJC) platform, accessible to students across the University. It included an online room for real-time events and an area to support the development of an OJC community. Journal Clubs are a well-established aspect of face-to-face academic life in conventional Universities. Typically, a single participant presents an academic paper to a group for subsequent discussion. However, given the wide range of experiences and academic backgrounds of OU students, the OJC project offered a variety of clubs, following different models. For example, where students were new to study, they might share an item of news relevant to their field of study, which they had heard about from mainstream media.



Fiona Moorman
Staff Tutor, STEM Faculty

Karen New
Staff Tutor, STEM Faculty

"

Project leaders Fiona Moorman and Karen New comment on the value of Online Journal Clubs for students:

"The experience of taking part in OJC helps OU students in so many ways! When students search for their 'news' story they are developing skills such as finding and evaluating information. Using PowerPoint to generate their online presentation builds their digital information literacy - and during the OJC event itself, they develop skills and confidence in online communication and collaboration. Listening to students sharing their presentations and talking to each other online is our favourite part of the OJC story."

Reading survey feedback from students who participated has also been so encouraging. Here are two lovely quotes from students who presented during an OJC event: **'I am finding my voice' and 'I didn't feel confident talking in a tutorial but now I do.'** Students who participated in OJC told us that the experience made them feel part of something bigger – an academic community."



Are we making progress? Progression through learners' interaction in OpenStudio across a qualification – Nicole Lotz, Derek Jones and Georgy Holden.

Online journal clubs in distance higher education: an opportunity to develop skills and community? – Karen New, Fiona Moorman, Kathryn Fox and Hazel Church. **WINNER:** Innovative/original approach to teaching 2020

EVIDENCING THE VALUE OF TECHNOLOGY FOR LEARNING



Although technology underlies much OU teaching, projects fall into this theme when the focus is on the development and evaluation of a technology used for learning. Many completed eSTeEM projects are included in this theme, with technologies ranging from Google Maps to Augmented Reality.

“

students can work towards the best result they can achieve

”

Just one example is the **'Automated Java specification marking'** eSTeEM project led by Anton Dil, associated with the Computing module M250 'Object-oriented Java Programming'. Java programs should adhere to various specifications, and although software was available to check some of these, there was a need for a tool to check adherence to the specification defining the structure of the program. The tool was developed, tested and evaluated within the project. Two versions were developed, the first for use by tutors alongside traditional marking notes, and the second for students to use on

the VLE. Evaluation included Associate Lecturer (AL) surveys and interviews about the tool and alternative marking methods.

Initially, the tool was seen primarily as an aid to markers, but once it was available, it was found to be useful in other ways. For example: for students to check their own code and receive automated feedback, for question setters to ensure that their model answers meet specifications, and for automated online marking.

Several issues arose in the evaluation, highlighting that the tutoring body is not a homogeneous one. ALs fell into two groups – those disposed towards using a variety of marking aid tools and those who preferred to avoid such tools. The project team was able to draw up a list of points that would need to be discussed with ALs before implementing software tools of this kind in the future, addressing concerns over automated marking and clarifying the role of the tool. Indeed, Anton has been able to carry on working on this aspect: *"I have continued to develop the software and solve problems identified in my original report, hopefully making it more attractive to tutors."*

Since completing the eSTeEM project, the student-facing version has been further developed. Anton notes: *"They can simply press a button, read the feedback generated for their code, and use it to help them correct their mistakes. Students have been very positive about this facility, which also provides feedback on the functionality of their code. The context is important – we provide a TMA-like question, and students are motivated to help each other solve problems and improve their chance of a good grade."*



TUITION AT A DISTANCE AND THE CHALLENGES OF EVIDENCING EFFECTIVE SUPPORT

Tuition at a distance is at the heart of the OU's work, so it is no surprise that it is a major area for scholarship research. Tuition requires a continuum of support, from learning support within modules to wider support of the learner, for example help with module choice.

Three projects have been selected to illustrate the breadth of activity in this area. Although superficially very different, the projects were all prompted by concerns that technological developments were having a negative impact on the student experience, and all were able to gather data that gave a much better understanding of the issues involved.

“

investigate the perception that students receive too many communications

”

The first project '**A quantitative and qualitative investigation into communications sent to students for selected level 1 MST and science modules**', led by Linda Robson, focused on email communication from the University, prompted by a perception

that too many such communications are received by the student, and that for some, this could be overwhelming. University emails received range from those from the OU Students Association, through those from services, such as computing and the library, to module-specific messages and automated acknowledgements from the assignment submission system. Excluded from this study were emails not sent via the University system, including messages from the student's module tutor.

Analysis was mainly on two consecutive presentations of three first year modules. The quantitative results showed that students do receive a large number of emails, and that the number varied both between modules (from an average of 55 emails on MU123 to 124 on S142) and within a module, reflecting the individual circumstances of students (32 to 145 for individual students on S142).

Interviews revealed that, although students do receive a lot of emails, for those interviewed this does not (as feared) lead to them becoming overwhelmed or confused. The researchers noted, however, that because the subjects were recruited using email, they may have been particularly comfortable with email. With this in mind, the team

recommended that, to help students prioritize and search messages, thoughtful use of the subject field should be made.

Overall, the findings of the study gave quantitative data and supporting qualitative information for a recommendation that "email should continue to be the primary mode of communication between students and the main hub of the University". There is potential for reducing the number of emails through a better understanding of the variations observed and an assessment of the effectiveness of the messages.

Reflecting on her experience, Linda comments: *"Being part of eSTEeM was fundamental to this project. The three of us had each responded to a call for interest in doing scholarship. eSTEeM brought us together for a brainstorming workshop to develop a suitable project idea – two hours of discussion later we had an outline project plan."*

The next two example projects focused on supporting the delivery of learning. Both were prompted by the same observation – when online tutorials replaced face-to-face tutorials, there was less student participation.

“

a lack of shared understanding of the role of tutorial provision

”

‘Achieving student centred facilitation in online synchronous tutorials’, led by Diane Butler, concerned Level 2 Life and Health Science modules. The original plan was to focus on the effect on student participation of recording online tutorials, but initial investigation showed that the prospect of recording was just one factor affecting participation, and the project was therefore broadened.

The analysis of 74 tutorial recordings from four modules, and a student survey, provided striking evidence to support the observations that had prompted the work. Online tutorials were indeed often didactic in approach and with little student interaction. When interactive tools were offered, students were more likely to use those with associated anonymity, such as polling and drawing on the whiteboard. Students in general found didactic tutorials useful but did not rate the opportunity to work with other students highly. Tutors, however, would like to provide such opportunities for interaction.

Although the majority of students said that they do not feel that they alter their behaviour in a tutorial if it is recorded, there was evidence that some students’ live attendance is affected by the action of recording the session and that students are reluctant to speak using the microphone.

Project recommendations were to increase the number of events, rather than expecting all needs to be met within the single session. So, there would be large-scale events to meet didactic, lecture-style needs, while small group tutorials would have a pre-defined focus, such as problem-solving or drop-in support.

The work has been followed up by further eSTEEeM projects – Diane says: *“I can’t tell you how nice it is to see our work quoted by others in more recent scholarship projects about tuition. It feels as if we moved on the collective thinking about STEM online tuition even if we didn’t sort out the complex issues – yet!”*

“

Anonymity emerged spontaneously ... as an important factor

”

In Maths, similar difficulties in encouraging student participation led to a related project **‘Active learning in synchronous online tuition: increasing student interaction’**, which focused on increasing students’ active participation in tutorials through three specific tools available in Adobe Connect (polling, on-screen activities on a shared whiteboard and text-chat). The project involved three modules (one at each of the three undergraduate levels), three different tutors and observations of 11 online tutorials.

For the group of students involved (who had chosen to attend the tutorials), there was a high degree of engagement with the activities. Project Lead Katrine Rogers comments: *“I was surprised at how overwhelmingly positive students were to interactive activities in online tutorials. Not only was the level of participation very high, but the vast majority of the students also found the activities both useful and enjoyable.”*

A key practical issue was that there were technical problems in nine out of the 11 observed tutorials. The project output included best practice tips for tutors, which are generalisable to other subjects, especially for the class of problem-solving tutorials defined by the project team.

Katrine summarises developments since the project: *“This work has fed into numerous staff development sessions for tutors, to encourage them to build interactive activities into their online tutorials and give them techniques on how to do so.”*

FURTHER INFORMATION

A quantitative and qualitative investigation into communications sent to students for selected level 1 MST and science modules – Linda Robson, Lynda Cook and Nicolette Habgood, Nigel Gibson, Christine Harris and Carole Arnold.

Investigating factors which affect active student participation during tutorials in online rooms – Diane Butler, Lynda Cook, Vikki Haley-Mirnar, Catherine Halliwell and Louise MacBrayne. **WINNER:** Enhancing the student experience 2019

Active learning in synchronous online tuition: increasing student interaction – Katrine Rogers, Claudi Thomas and Hilary Holmes. **HIGHLY COMMENDED:** Enhancing the student experience 2020



TUTOR DEVELOPMENT AND ACADEMIC PRACTICE

Tutors are a core part of the OU's teaching model of supported open learning. There is, understandably, a keen interest in developing distance tutoring skills and sharing good practice by tutors, who are, themselves, working at a distance from their peers.

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How do you develop a community of practice among distributed staff who hardly ever meet?

”

A strong theme running through the ten years of eSTeM projects in this area is the vital importance of community for tutors' academic practice and professional development. The two projects highlighted here looked at community support through peer observation: the first focusing on the thorny problem of how best to use synchronous online tuition, and the second on academic identity and community of practice.

The project **'Developing practice in online synchronous tuition by peer observation, feedback and reflection'** grew out of the observation that training for tutors in this area tended (at that time) to focus on technical aspects – how to use the technology – rather than on pedagogical aspects – how to develop teaching practice.

One of the challenges of online synchronous tuition is the relatively low levels of student interaction, leading to the question of how tutors can encourage interaction through their teaching practices. In consequence, this project designed a peer observation and feedback process to encourage tutors to consider how to increase student interactivity in online tutorials and to foster the tutor's own development through subsequent reflection and dialogue.

Project Lead Mark Jones explains: *“The project arose from a need to solve a practical issue – that of developing the teaching practice of tutors using synchronous online communication tools. In analysing the experiences of tutors, we ... could start to see how the online setting may reinforce or change some of the known characteristics of peer-observation that had been found in a face-to-face context.”*

From a cohort of 20 physical science ALs, 12 volunteered to take part in the peer observation programme. Structured conversations, covering tutors' reflections as observer and as observee, revealed six themes with implications for: peer observation in online settings, including levels of anxiety felt by tutors; how the presence of an observer can change the dynamic of the online learning environment; the effects of observer and observee knowing, or not knowing, each other beforehand; and to what extent the act of *observation* was more effective, for personal development, than *being observed*.

“

That the act of observing is a stronger trigger to reflection than the receipt of feedback is not surprising. What was unexpected is just how strong this effect was in this situation.

”

Despite the dispersed nature of ALs at the OU, frameworks for ongoing dialogue and community support exist in the form of self-help forums and team teaching. This project suggests that encouraging reflective practice using peer observation can be valuable within such naturally sustaining peer relationships.

Mark is proud of the wide impact this project has had: *“The project resulted in a paper in a peer-reviewed journal that was one of the first to explicitly look at peer-observation in the context of synchronous rather than asynchronous online teaching. ... The paper has been referenced over 30 times (Google Scholar) by academics from around the world.”*

Sally Crighton's project – **'Using peer observation within a Mathematics and Statistics community of practice in Scotland'** arose from tutor feedback from development events in the community. Some tutors, despite being reflective practitioners who based their teaching on sound pedagogical ideas,

reported feeling disinclined to engage with reflective writing and scholarship literature formally as required for professional recognition through **Applaud** – the OU’s supported route towards professional recognition with Advance HE. Some ALs also expressed a lack of confidence in front of peers.

This project sought to address both points. Sally comments that *“The main motivation for the proposal was to explore the idea of a paired-peer observation project with Andrew Potter, who was an AL at the time. This was an opportunity for Andrew to gain valuable experience beyond the core AL role, as part of my on-going work of fostering scholarly practice within this community and aligning appraisal and development needs of ALs.”*

An opt-in paired-peer observation scheme was developed to boost AL confidence. This approach built on a strong tradition of social learning and enthusiasm for sharing good practice within the community. To encourage participation and a positive atmosphere, the scheme was light touch and flexible. From a cohort of 40 ALs, 22 initially signed up for the paired-peer observation scheme and 16 ALs participated fully through to the evaluation stage.



strong evidence of ALs ‘picking up new ideas’ from each other.



Analysing AL feedback, the team found ALs gaining specific new ideas for practice and a clear focus on student-centredness. Evaluating the project, the team concluded that a three-part structure, with an event to introduce the scheme, the observation period and a final event to share ideas, was critical to success. They demonstrated that paired-peer observation can act not only to improve AL confidence, but also to produce practical examples of good practice.

Both projects highlighted here have demonstrated an impact, not only on ALs and the wider scholarship debate, but on the project teams themselves. Mark reflects: *“Although this project started as a lone effort, I soon came to realise that scholarship of teaching and learning needs to be informed by multiple perspectives. I invited a colleague with similar interests to join me ... Our collaboration has continued in further fruitful projects together with other colleagues.”*

From her viewpoint, Sally highlights the unexpected bonuses from being an eSTeEM project leader: *“The most surprising aspect is that my project turned out to be a significant step on my own transformational scholarly journey ... [including] participating in the International Visiting Scholar programme in Shanghai Open University (June 2018) ... further opportunities for practice research development with colleagues across the OU and continuing international collaboration within the Scholarship of Teaching and Learning community.”*

FURTHER INFORMATION

Developing practice in online synchronous tuition by peer observation, feedback and reflection – Mark Jones and Anne-Marie Gallen.

Using peer observation within a Mathematics and Statistics community of practice in Scotland – Sally Crighton and Andrew Potter.



REFLECTING ON OUR PAST AND PLANNING FOR THE FUTURE

eSTEEeM has put scholarship 'on the map' by raising the profile of evidence-informed innovation and enhancing teaching and learning. Over the last ten years of eSTEEeM, the Centre has become a core strand of the STEM Faculty's teaching and learning strategy, and scholarship is now a widely recognised and valued aspect of professional academic practice.

eSTEEeM has fostered colleagues' development of pedagogical research methods and legitimised scholarly inquiry. For many, the scholarship undertaken has had a personal impact and contributed to cases for promotion and professional accreditation through the HEA Fellowship scheme. The role that scholarship plays in the professionalisation of teaching and learning is recognised nationally and internationally, and the contributions of our scholars further enhances the reputation of the OU.

A signature of eSTEEeM scholarship has been practice-based scholarship, where research is undertaken by practitioners for teaching and learning, rather than by researchers of teaching and learning. Working with students to improve our understanding enables our scholarship

to inform policy and support the development of a grounded institutional strategy for distance learning in higher education. The balance and interplay of practitioner-led and strategy-led scholarship is a strength that enables the OU to address the diverse needs of students.

eSTEEeM has grown and matured as a Centre by broadening the community, and valuing the diverse roles involved in distance learning and the perspectives and insights they bring. Initially, targeting academic staff in the Science and MCT (Maths, Computing and Technology) faculties, eSTEEeM has expanded to include academics across the STEM faculty and professional services staff. Over recent years, we have benefited from the increasing involvement of Associate Lecturers as project leaders and in project teams, and from the engagement of students as project collaborators.

The journey continues as we plan for a future where scholarship is embedded in the strategic plans of the Faculty and six schools. eSTEEeM has helped establish a culture of scholarship across the Faculty and we are proud to be part of the scholarship landscape, but

we are not the only part. We hope to see a continued growth in school-based scholarship and the further development of special interest groups and discipline-based educational research centres. This would further enhance the OU's participation in higher education networks of the professional associations and learned societies relevant to STEM.

As more individuals integrate a scholarly approach to their practice and progress their careers, the OU benefits from enabling colleagues to engage in scholarship as their focus shifts between the module, discipline, school, faculty, institutional and sector levels. eSTEEeM has excelled at supporting module, discipline and faculty scholarship. The school Scholarship Leads are developing a culture of school level scholarship. A target for the future is to resource institutional and sector level scholarship through internal and external funding, enabling further engagement in national and international networks and events. This could lead to increased influence and involvement in higher education policy. This is not the ambition of eSTEEeM alone, but a realisable goal for the OU through scholarship and collaboration across the faculties and professional services.



DIRECTORS PAST AND PRESENT

The eSTEeM Manager, Diane Ford, is the lynchpin of the Centre. We asked Diane to offer some reflections on the directors and the initiatives they introduced.



Steve Swithenby (2010-2013)

Steve was the founding Director, establishing the vision for a STEM scholarship network that evolved into eSTEeM. He was also Co-Director of the OpenScience Laboratory, and championed projects focused on the design and delivery of distance learning and teaching in STEM education for an international audience, including the exploration of collaborative scholarship in open and distance learning. During his directorship, Steve initiated collaborations with colleagues in Nigeria (National Open University Nigeria), Ghana, China, to name but a few.



Keith Williams (2011-2014)

Keith was instrumental in introducing an induction event for new project leaders. The first cohort of eSTEeM project leaders were inducted on 3rd March 2011 at an event that generated an enormous buzz and excitement amongst colleagues. Highly passionate about the Quality Assurance of e-learning, Keith drew upon his extensive experience of international developments in distance learning during his time as eSTEeM Director. Initiated by Keith, the second eSTEeM Annual Conference in 2013 saw keynote contributions from Spanish colleagues at UNED (National University of Distance Education) and The Centre for Higher Virtual Education, which stimulated discussion and debate relating to the future of STEM scholarship within the rapidly evolving international higher education landscape.



Nicholas Braithwaite (2013-2016)

At the time, Nick was also Co-Director of the OpenScience Laboratory. With a huge passion for the effective use of learning technologies, in his time as Director, Nick expanded the fourth eSTEeM Annual Conference into a two day event in 2015, introducing the idea of a thematic workshop to bring together experts in a particular field to discuss and debate the issues within an open and distance learning context. Entitled 'STEM Futures: Technology Enhanced Learning in Practice' the second day of the 2015 conference focused specifically on the use of remote experimentation for STEM teaching and learning and welcomed an international group of colleagues from a number of prestigious distance teaching universities.



Clem Herman (2014-2019)

During her time as Director, Clem was also appointed Academic Lead for the university-wide Scholarship Plan, which was approved by the OU Senate in October 2018. The plan led to the creation of the Scholarship and Innovation Centres in each of the faculties. The Scholarship Plan supports a unified approach to scholarship that accelerates and increases the impact of the University's excellence in scholarship applied across all disciplines.



Diane Butler (2016-2020)

Diane led on the creation and development of the Scholarship Toolkit, which is hosted on the 'Enhancing Scholarship at the OU' intranet site. The toolkit provides a set of resources and materials for running a scholarship centre, and describes the approach, methods and resources used by eSTEeM over the last nine years to promote practitioner-led scholarship. Diane was instrumental in bringing about the first call for projects led by Associate Lecturers and established a framework for involving Students as Partners in scholarship projects.



Trevor Collins (2019-2022)

Trevor is continuing the work on engaging Students as Partners in scholarship. Moving this year's conference online was a learning opportunity for all of us. Trevor's experience and enthusiasm for using web technologies played a vital role in enabling that to be such a successful event. He has also been working with colleagues in the scholarship centres and the Office of the Pro Vice Chancellor (Students) to develop a collaboration framework to disseminate scholarship findings and help target strategic priorities.



SCHOLARS' REFLECTIONS

Finally, the project leaders have reflected on their experiences and the impact scholarship has had on the University and their practice.



... a small SoTL [Scholarship of Teaching and Learning] project can make a big difference! ... as a practitioner you know more about teaching and learning than you think.

Diane Butler

Two initial amazing things were how generous students were in wanting to share their experience and then how clear and consistent their advice to other students was.

Carol Calvert

Thank you eSTEEeM – let's celebrate your substantial contribution to building capabilities in the university by offering extraordinary development opportunities, and unfailing support, for all.

Sally Crighton

I find the support and structure that eSTEEeM give to be incredibly helpful and clear: submit a bid, discuss with eSTEEeM, run the project, report to eSTEEeM along the way, submit final report, present at eSTEEeM conference.

Chris Hughes

This experience has highlighted to me the importance of collegiate support in making progress with scholarship projects.

Mark Jones

Presenting this work at conferences helped us to develop new partnerships.

Nicole Lotz

We discovered a great deal about how to structure questionnaires and interviews to elicit useful information. We also learned a lot about methods for analysing qualitative data.

Carol Morris and Sally Organ

One of the really satisfying things about our project is that the findings have been able to shape faculty strategy and policy.

Tom Olney

Being part of eSTEEeM was fundamental to this project.

Linda Robson

This work has fed into numerous staff development sessions.

Katrine Rogers

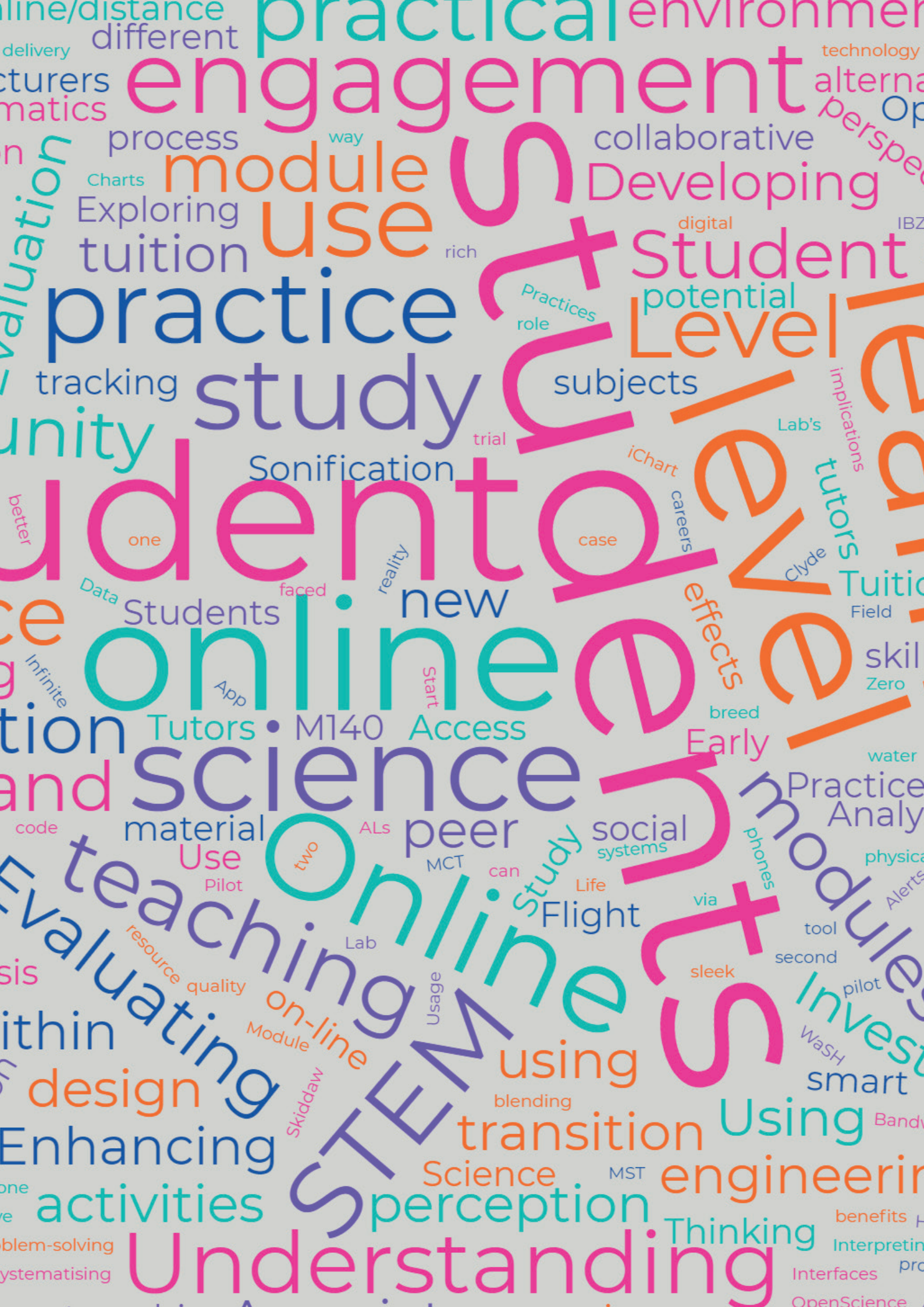
I had not realised how much educational theory was 'out there' and very much enjoyed the background reading necessary. I believe that this will likely impact on all of my teaching.

Hayley Ryder

Working on this project has enabled us to build and foster these relationships, encouraging the development of future scholarship and collaborations.

Karen Vines







ESTEEM
THE OU CENTRE FOR
STEM PEDAGOGY

Web: <http://www.open.ac.uk/esteem>

Email: esteem@open.ac.uk

Twitter: @OU_eSTeEM

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