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Impact of Scholarship of Teaching and Learning: A compendium of case studies

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Impact of Scholarship of Teaching and Learning

A compendium of case studies

Shailey Minocha and Trevor Collins

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We are grateful to Diane Ford (Senior Manager, Scholarship) and current[2] and past Directors[3] of eSTEeM[4], the OU Centre for STEM[5] pedagogy, for their support to Scholarship of Teaching and Learning (SoTL) in the Faculty of STEM over the last twelve years.

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Shailey is the author of the Badged Open Course (BOC), 'Scholarship of Teaching and Learning in STEM'[6], an open educational resource on OU's free learning platform, OpenLearn.

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How to cite this publication[7]

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6   'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.ac.uk/scholarship-of-learning-and-teaching-in-STEM
7   All the URLs (links) to webpages in this document were last accessed on 23 March 2023.

1.   Introduction

This compendium of case studies showcases 16 Scholarship of Teaching and Learning (SoTL) projects carried out in the Faculty of STEM[8] at The Open University (OU), UK: 15 of which were funded and supported by eSTEeM[9], the OU Centre for STEM pedagogy, and one was supported by the School of Mathematics and Statistics.

A case study methodology has been employed to generate an in-depth understanding of the impact of each of the SoTL projects and to present the impact of these SoTL projects as case studies in this compendium.

Each 'impact' case study discusses the context and aim of the SoTL inquiry, the underpinning research, findings, details of the impact, and reflections on SoTL practice guided by the principles of SoTL[10]. Each case study ends with a quote from the project team which captures their reflections on the project and its impact. Project resources including end-of-project reports, videos, papers, presentations, and posters, and literature sources referred to within the case study are listed at the end of the case study.

Although each of the projects has several resources from which the case study of that project could be written, the impact narrative for each of the projects has been developed by the authors of this compendium in association with the respective SoTL project teams. Each SoTL project team conducted a self-evaluation of the impact of their project by applying the Impact Evaluation Framework (IEF) included in **Appendix 1**. In addition, the project team/leads reviewed their case study to validate it and check the case study for completeness. The case studies along with the keywords are listed in **Section 2**. From **Section 3** onwards, each of the case studies is described.

The accompanying document - '*Impact of Scholarship of Teaching and Learning: A guide for educators*'[11] describes the impact evaluation initiative and the case study methodology that led to the 16 case studies included in this compendium. The impact evaluation of the 16 SoTL projects and subsequent analyses and literature review has resulted in several outputs that are captured in the 'guide'. The guide includes:

- the identification of key enablers and strategies for the generation of impact;

- an understanding of eSTEeM's role in supporting SoTL in STEM at the OU;

- a toolkit for planning, generating, monitoring and communicating impact from SoTL; and

- a list of challenges to generating impact of SoTL.

Along with the guide, we have developed two resources[12] as 'workbooks' which the SoTL community may find useful.

- The **'Planning for SoTL impact workbook'** has been designed around the 'Theory of Change'[13] to guide the educator to systematically plan a SoTL project for possible impact. Once a project has been formulated, this workbook can act as a tool for project management, for engaging stakeholders, and for monitoring the impact of the SoTL inquiry.

- The **'SoTL impact evaluation workbook'** is designed around the IEF which we have employed to conduct impact evaluation of SoTL projects. This workbook can be used by educators for planning, reflecting on, monitoring, and evaluating impact of a SoTL inquiry, and recording the evidence of the impact.

In the guide, these two supplementary materials along with other resources are included in the form of a **'Toolkit for SoTL impact'**, which may help SoTL researchers to design, plan, conduct and report impact of their SoTL projects. The 'toolkit' can also be used for the professional development of educators for designing SoTL inquiries for possible impact.

The 'Executive Summary'[14] of the impact evaluation initiative is in a separate document that provides an overview of the initiative and the deliverables.

In **Section 1.1**, details of the terminology and pointers to the Appendices are given.

1.1   Terminology and abbreviations

This document 'Impact of Scholarship of Teaching and Learning: A compendium of case studies' is referred to as the **'Compendium'**.

The accompanying document to the Compendium - 'Impact of Scholarship of Teaching and Learning: A guide for educators', is referred to as the **'Guide'**.

The terms **'SoTL inquiry', 'SoTL project', 'SoTL initiative'** or **'intervention'** for a SoTL research project have been used interchangeably in the compendium and in the 'guide'.

SoTL is often carried out collaboratively; for example, a project team may be constituted by academics and learning designers, academics of different disciplines, a team of learning designers, an educational researcher, a librarian, a media developer, or a member of the careers and employability service working alongside an academic. The term 'educator' in this compendium implies any of these roles conducting a SoTL inquiry or project individually or in collaboration with others. In this context, an **'educator'** is a **'SoTL practitioner'** or a **'SoTL researcher'**.

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12   The two supplementary resources are available along with the guide at: Minocha, Shailey and Collins, Trevor (2023). *Impact of Scholarship of Teaching and Learning: A guide for educators*. The Open University, Milton Keynes, UK, https://doi.org/10.21954/ou.ro.000155c1

13   Centre for Theory of Change, https://www.theoryofchange.org/what-is-theory-of-change/

14   Minocha, Shailey and Collins, Trevor (2023). *Impact of Scholarship of Teaching and Learning: An Executive Summary*. The Open University, Milton Keynes, UK. Available at: https://doi.org/10.21954/ou.ro.000155bf

A **'project team'** implies a group of educators conducting a SoTL project collaboratively, led by one or more **'project leads'.**

The term **'educator'** is also used in this compendium to imply any of the roles detailed above that support learning and teaching and student journey in an institution.

The OU's model of 'supported open learning' involves students being supported by their **'Associate Lecturer'** or **'tutor'** in connection with the module[15] and student learning and progress in the module. The terms Associate Lecturer (AL) and tutor have been used interchangeably in the compendium.

Finally, the authors of this compendium who developed the case studies and the 'guide' are referred to as the **'authors'.**

OU-specific Terminology

In this Compendium, while describing the case studies, we have used several terms that are specific to the OU's context of open and distance education. The OU terminology used in this compendium is listed in **Appendix 2**.

Abbreviations

A list of the abbreviations used in this compendium is given in **Appendix 3**.

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15   A module is the basic building block of Open University study. Modules usually take 9 months to complete. On successful completion of a module, a student earns credits. Students can study a module on its own, or they can study multiple modules to work toward a nationally recognised qualification such as a certificate, diploma or degree.

For more details, please see: Frequently asked questions, How OU study works, https://www.open.ac.uk/courses/what-is-distance-learning/faqs

2. Compendium of case studies

Based on the OfS report[16] and Jisc's Digital Experience insights[17] which discuss the rapid pace with which digital and remote education and blended learning was adopted in 2020 due to the pandemic, we have derived seven pedagogical themes to categorise and present the 16 SoTL projects or case studies. The seven themes capture components of successful digital teaching and learning that may be of interest to the Higher Education (HE) community in the UK and beyond.

We matched these themes with the repository of over 200 SoTL projects[18] funded and supported by eSTEeM over the last 12 years and selected 15 projects, and we chose one which was supported by the School of Mathematics and Statistics. These 16 projects showcase STEM's SoTL at the OU and demonstrate the impact of SoTL.

2.1 Pedagogical themes of the case studies

The seven pedagogical themes underpinning the selected case studies are:

1. *Ensuring accessibility of learning and teaching resources:* SoTL projects focus on designing and evaluating learning materials and environments such that students who rely on assistive technologies to interact with documents and presentations are not disadvantaged. Ensuring accessibility sometimes involves generating effective alternative formats of the learning and teaching resources.

2. *Designing assessment:* SoTL inquiries are concerned with the way the assessment is planned, designed, and conducted.

3. *Building digital skills:* SoTL projects that focus on building digital skills[19] of students.

4. *Supporting the student journey:* A student's journey with an institution or even with a module is composed of stages from student's enquiry, registration, progress during a module and onto the next stage of study and so on, and until the end of the chosen programme of study by the student.

5. *Providing authentic experimental and practical learning:* SoTL projects focus on designing and evaluating authentic learning experiences in physical and virtual learning environments.

6. *Influencing concepts, practices and ways of thinking in a discipline:* Often SoTL research results in outcomes that influence how certain concepts, practices and ways of thinking are taught in a discipline.

7. *Involving students as partners:* Involving students as partners in learning and teaching is a pedagogical approach in which students and educators work collaboratively and in partnership to improve teaching and learning experiences. Students are often involved as partners in SoTL[20].

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16   Gravity assist: propelling higher education towards a brighter future, https://www.officeforstudents.org.uk/publications/gravity-assist-propelling-higher-education-towards-a-brighter-future/

17   Jisc: Digital experience insights, https://www.jisc.ac.uk/digital-experience-insights

18   eSTEeM Projects, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects

19   Jisc's digital capabilities framework has six elements of digital skills or 'capabilities' for students. https://digitalcapability.jisc.ac.uk/what-is-digital-capability/individual-digital-capabilities/

20   'Students as partners in SoTL', in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109324&section=1

2.2 Pedagogical themes, case studies, keywords and codes

In **Table 2.1**, the case studies are listed corresponding to each of the seven pedagogical themes.

The keywords against each of the case studies highlight the key aspects related to learning and teaching to which that case study or SoTL project pertains to. The keywords could be one of the ways for readers of this compendium to select case studies relevant for their situation or academic context for a deeper exploration.

Each case study has been assigned a code. The case studies will be referred to by their codes in discussion in this compendium and in the 'guide'[21], and in cross-case study referencing.

Individual case studies are presented from **Section 3** onwards and the hyperlinks in the **codes** in the Table below can be used to navigate to the individual case studies.

21   Minocha, Shailey and Collins, Trevor (2023). *Impact of Scholarship of Teaching and Learning: A guide for educators*. The Open University, Milton Keynes, UK, https://doi.org/10.21954/ou.ro.000155c1

Table 2.1 Pedagogical themes, case study titles, keywords and codes

Pedagogical theme	Case study title	Keywords	Code
Ensuring accessibility of learning and teaching resources	Remote sighted helper support for visually impaired students	accessibility; remote support; sighted helper; visual impairment; visual programming	[AC]
Design of assessment	Voluntary diagnostic quiz in mathematics modules[22]	diagnostic quiz; learning analytics; predictive analytics; predictive learning analytics; student readiness; student retention	[A1]
	Interactive online quizzes in formative assessment	assessment; formative assessment; online quiz; self-assessment	[A2]
Building digital skills	Online journal clubs	digital skills; employability; online learning communities; skills development; student support	[DS]
Supporting the student journey	The Mathematics and Statistics subject website	employability; online learning communities; participatory design; student support	[J1]
	Qualification subject websites in STEM	employability; online learning communities; student support	[J2]
	A flexible start to a module	student progression; student retention; student success; supporting students	[J3]
	Cross-level engagement between staff and students	community building; Community of Inquiry (CoI); design education; students as partners	[J4]
	On-screen learning	learning resources; on-screen learning; printed resources; student support	[J5]
	Predictions of at-risk students	at-risk students; predictive learning analytics; student retention; student support	[J6]
Providing authentic experimental and practical learning	Interactive virtual visits	employability; student support; virtual visits; widening participation	[P1]
	A 3D virtual field trip	3D simulation; physical fieldwork; physical fieldtrips; virtual fieldtrips; virtual fieldwork	[P2]
	Geology photo blog	geosciences education; peer-to-peer support; photo blog; spatial learning; spatial literacy	[P3]

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22   Other than the SoTL project 'Voluntary diagnostic quizzes in mathematics modules,' which was supported by the School of Mathematics and Statistics, all the other SoTL projects in this compendium were funded and supported by eSTEeM, the OU Centre for STEM pedagogy.

Pedagogical theme	Case study title	Keywords	Code
Influencing concepts, practices and ways of thinking in a discipline	Interactions in OpenStudio across a qualification	design education; social learning; virtual design studio	**[D1]**
	Remote pair programming	employability; pair programming; remote collaboration; remote pair programming	**[D2]**
Involving students as partners	Students as partners in Scholarship of Teaching and Learning	co-designers; co-researchers; participatory design; students as partners	**[SP]**

The individual case studies are presented from the next section onwards and in the order that they are listed in the above Table.

3   [AC] Remote sighted helper support for visually impaired students

Fact box

Title	Remote sighted helper support for visually impaired students: exploring good practice
Aim of the SoTL inquiry	The aim of this project was to investigate how visually impaired students may be supported by a remote sighted helper to interact with a visual programming environment.
Type of inquiry[23]	'What will happen?'
Led by	School of Computing and Communications, Faculty of STEM
Contact	Richard Walker, richard.walker@open.ac.uk
Theme	Ensuring accessibility of learning and teaching resources
Research methods	telephone and online interviews; asynchronous written interviews
Duration	2020
Keywords	accessibility; remote support; sighted helper; visual impairment; visual programming
Webpage	Remote sighted helper support for visually impaired students: exploring good practice: Stage 1, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/technologies-stem-learning/remote-sighted-helper-support-visually-impaired-students or https://tinyurl.com/2wzd3kbt

3.1   Context and aim of the SoTL inquiry

In the entry level computing module *Introduction to Computing and Information Technology 1* (TM111)[24] at The Open University (OU), students use a drag and drop visual programming environment. Novices can produce programs without being frustrated by syntax errors, because the blocks of code only fit together in valid combinations.

Programming environments are increasingly accessible to people with disabilities, or they are accessible in conjunction with assistive technologies (e.g. screen readers). However, visual programming environment as in TM111 (**Figure [AC].1**) can be inaccessible to students who are visually impaired (VI). To resolve this, the sighted helper interacts with the programming environment as per the student's instructions and reports the results to the student.

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23   'Areas of investigation in SoTL', in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109157&section=3.3

24   TM111 Introduction to Computing and Information Technology 1, https://www.open.ac.uk/courses/modules/tm111

Previously, this support would be given by a non-medical helper physically present alongside the student. During the COVID-19 pandemic, an alternative support method was needed and the TM111 module team took emergency steps to provide a remote sighted (RS) helper via a video conference call for several VI students (who were all assisted by the same RS helper).

The aim of this project was to investigate how VI students may be supported by a RS helper to interact with visually complex learning resources. The team's objective was to evaluate whether RS helper support is comparable with or has advantages over physically present sighted helper support for VI students and whether such support may be provided in future.

The outcomes were expected to be of interest to those supporting VI students in other academic areas where sighted helper support is required to navigate visually complex study materials.
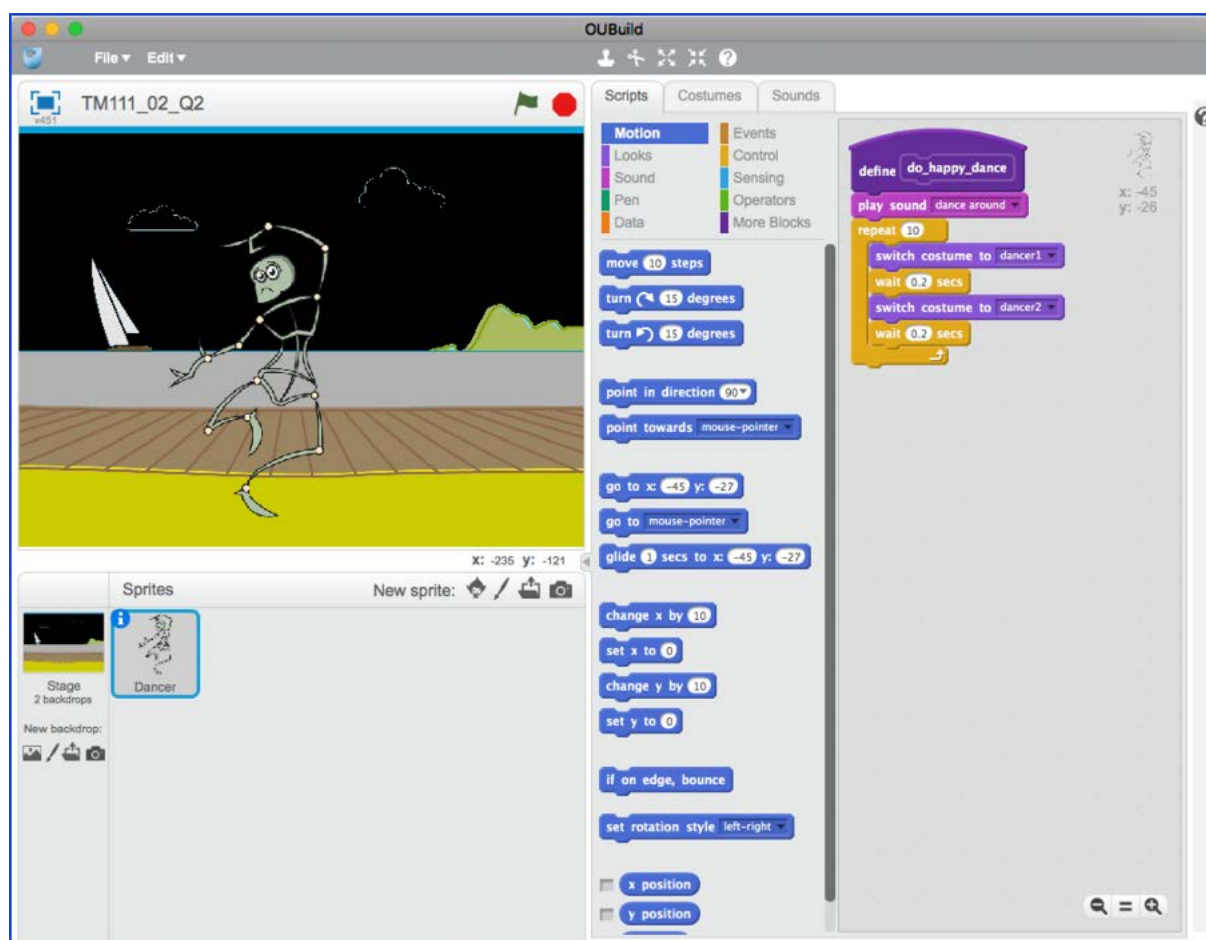
Figure [AC].1 The visual programming environment in TM111

3.2 Underpinning research of the SoTL inquiry

Via an agency a RS helper was recruited and then briefed by the TM111 Module Team Accessibility Lead and the project lead (Richard Walker) about: the TM111 module website, TM111's programming component, the OUBuild[25] programming environment, and the associated assessment. Richard liaised with the helper on a weekly basis for the duration of the block when the students were learning programming.

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25   OUBuild is like Scratch, a free programming language, https://scratch.mit.edu/

Three VI students were supported remotely by the RS helper. Student A was registered blind in 2008 and uses a magnifier for reading the course materials which are provided as a comb-bound book. The magnifier acts as a screen reader, but Student A finds the speech difficult to follow. Student B has limited vision – about 20%. Student B uses a screen reader and audio books. Student C has been blind since birth and uses screen readers: JAWS[26]; NVDA[27]; and Apple's VoiceOver[28].

The sighted helper (Steve) works for a company specialising in supporting university students requiring non-medical help. Steve's work with TM111 was funded by OU's Faculty of STEM. Although Steve has good practical computing skills acquired from everyday use, he had no specialist knowledge of computing or computer science and is not a programmer.

The RS helper initially contacted all three students via email and then followed up with telephone meetings. The mode and extent of subsequent support varied greatly between students, but in each case, some improvisation and inventiveness were required by both the student and the RS helper.

Once the students had completed the visual programming part of the module, the team conducted a short interview with each of them - either written or oral (according to participant preference). The team debriefed the RS helper in detail and collected feedback from the Associate Lecturers/tutors who tutored those students.

3.3   Findings of the SoTL inquiry

As well as the assistance provided by the RS helper the students received extensive support from their respective tutors. Most tutors are very aware of their obligations towards disabled students but may lack prior experience of working with students who have severe visual disability. In addition, they may not know the resources available, as was the case with at least one tutor in this investigation.

Where the subject matter requires the student to manipulate visual elements on screen, as with a visual programming environment, the RS helper should explore with the student the potential for remote desktop control, for example, via Zoom[29], to enable the RS helper to perform the manipulations under instruction from the student. It is apparent from Student A's feedback that the student was unaware that screensharing and remote control was an option, although the RS helper used it successfully with the other two students.

The three students had different needs, expectations, and experiences. Hence, this SoTL inquiry didn't aim to extract specific guidelines from such a highly personalised process. The team, however, hoped to be able to suggest how such differences may be incorporated into a successful support process.

26   JAWS screen reader, https://www.freedomscientific.com/products/software/jaws/
27   NVDA Non-Visual Desktop Access, https://www.nvaccess.org/
28   VoiceOver, https://www.apple.com/uk/accessibility/vision/
29   Zoom Video conferencing, https://zoom.us/

Three TM111-specific recommendations were made to the module team:

- Providing a comprehensive list of the OUBuild code blocks in textual form via the module website: this was suggested by Student A and drawn up by the sighted helper but may well be useful for VI students and all other students on the module.

- Providing textual descriptions of starter projects in TMA02: Questions in TMA02, the programming part of the module assessment, typically have "starter projects", partially constructed OUBuild programs which students are asked to complete. Feedback from the RS helper indicated that VI students would benefit from textual descriptions of these starter projects.

- Embedding video resources within the website: at various points the online module materials direct the student to video resources but without providing a direct link. Although the videos are hosted on the module website, VI students are likely to have difficulty locating them.

These suggestions, which stemmed directly from this project, have all been implemented.

3.4   Key lessons and details of the impact

A forum for sharing relevant information amongst tutors on a particular module would be an effective way of disseminating information and good practice on accessibility. Following on from this project, the module team has set up a tutor forum 'TM111 Accessibility Matters' to share experiences.

One tutor expressed surprise that there was no contact with the RS helper. Tutor and the RS helper have different roles and work independently most of the time, but subject to the consent of the student it would seem sensible for the tutor and RS helper to be in initial contact and liaise where appropriate.

The RS helper should have experience of or be willing and able to quickly assimilate skills in, a variety of forms of communication. Where a student is comfortable with using a specific communication medium (Zoom, WhatsApp[30], phone, and so on) that may facilitate appropriate support, the RS helper should be able to accommodate the student's preference.

Communication about possible support mechanisms needs to be more structured so that RS helpers can make sure that students are aware of all the possibilities. If the support required demands a form of communication that the student is unfamiliar with (screensharing, for example) the RS helper should be capable of suggesting that to the student and guiding them through the basics of using it and as per student's technical capabilities.

Subject to student consent, the RS helper should have access to the student's personal profile just as the tutor does (based on feedback from Student C).

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30   WhatsApp is a free application that allows users to send text and voice messages, make voice and video calls, and share images, documents, user locations, and other content, https://en.wikipedia.org/wiki/WhatsApp

The project team has recommended that:

1. RS helper should have independent access to the module website, associated materials (that is, their own OU account) and individual student profiles, ideally in advance of the main period of support. This enables them to become familiar with the resources the student needs to study and hence to guide the student more readily through them.

2. The briefing of an RS helper should be at the earliest possible stage and sufficient time needs to be allocated for this. The systems at the OU are familiar territory to tutors and to the module team but won't be to someone coming in from the outside. Helping students is difficult without a working knowledge of how the OU works. The helper also needs to be given an overview of the module's structure and content.

The three students in this initiative passed TM111 successfully and have progressed to other modules. Students B and C went on to study TM112[31] and Student A studied on M250[32]. The same RS helper (Steve) aided students B and C. On M250, student A programmed in Java, using the BlueJ[33] development environment provided, which is a relatively accessible package, and has not required extra support. Student C registered for TM129[34] and once again Steve provided support.

The team has concluded that remote help can be easier to facilitate than physically present help, because helpers need knowledge of the module and some familiarity with visual programming environment, in addition to the generic skills needed to assist students with impaired vision. Once this rather particular knowledge has been built up, a helper can assist a series of students on different presentations, whatever their geographical location, whereas finding suitably experienced helpers based close to where the student lives may not always be possible.

The remote support investigated in this project has continued even after the COVID-19 restrictions have been lifted, and the project outcomes have helped shape and improve support for VI students in subsequent presentations of TM111. The project has also been able to influence the support available to VI students on TM112, a sister module of TM111.

The following presentation of TM111 had one student that needed the same form of RS support, and this was provided by the same RS helper, who was by then well-versed in what was required. Thus, no helper briefing was needed, and the helper was able to make the student aware of what kinds of assistance they could give. The student found the spreadsheet of OUBuild Code Blocks (second recommendation in the previous section) originally developed for Student A to be very helpful. Longer term other helpers will be involved and the project team will use a synopsis of their findings when briefing the helpers.

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31   TM112 is a follow-on module of TM111; Introduction to computing and information technology 2, https://www.open.ac.uk/courses/modules/tm112
32   M250 Object-oriented Java programming, https://www.open.ac.uk/courses/modules/m250
33   BlueJ, a free Java development environment, https://www.bluej.org/
34   TM129 Technologies in practice, https://www.open.ac.uk/courses/modules/tm129

In a subsequent presentation of the module, a blind student had their own face to face helper but needed extra tutor support. Richard worked with the tutor and the insights gained from this SoTL inquiry have fed into his interactions; for example, Richard and the TM11 module team have been able to provide accessible version of the 'quick reference' for the software environment used by TM111.

The SoTL project team has reported the need for structured and timely communication and information sharing amongst the main agencies and individuals involved in setting up and delivering support to the VI students, and between the frontline support and the students.

Richard reflects:

"

Pre-registration remains difficult; the SST [Student Support Team] will in principle identify students who need sighted help but it's possible some are missed or there is a delay in the information reaching the module team. It may rely to some extent on students proactively making their needs known. Many visually impaired students will be able to manage without sighted help, or have sighted help they have organised for themselves, such as from family and friends. Usually, the module team won't know which students need sighted help provided by the university until after module start.

"

Richard concluded:

"

The process of arranging support for VI students is complex and involves cooperation between multiple agencies. It should be streamlined if possible and should at a minimum be documented so the path is clear to everyone involved, particularly SST and the Curriculum Manager, as the main points of contact.

"

The project team plan to investigate how VI computing students fare when they progress to Level 2 and how it is affected by the support received at Level 1; and whether there are cross-module issues to address. The lessons from this project can be fed into other modules and disciplines. For example, similar support issues may arise in Science modules, where students might need to use software for molecular modelling (just as an illustrative example).

Based on the facets and attributes of the impact evaluation instrument (**Appendix 1**), the Table below details the impact of this SoTL inquiry.

Impact facet	Attribute	Description
Facet 1: Student experience	Learning design Student engagement with course content Student engagement with the technological intervention	Richard provided the following account: *Many of the attributes for this facet can't really be evaluated with such a small group of [3] students but:* *Work with the students in the study and with a blind student on an earlier presentation of TM112[35] has led to some changes in learning materials and made it easier for blind students to cope with course content, for example where a table is embedded in online materials or assignments it was common practice to make it an image, but this has the effect of making it inaccessible (and requiring a figure description), whereas if it is preserved as an HTML table it will work well with screen reading software.* *The visual programming environment used on TM111 is particularly challenging for blind students and the subset of the module team who author TMA02[36], where all the assessment of programming skills is concentrated, have taken feedback from the students [on this project]on board.*
Facet 2: Student retention and progression	Student retention rate Student progression	Richard notes: *The numbers of blind students on the module are too sporadic to make meaningful comparisons presentation on presentation but all three students in this study were successful on TM111 and have progressed to other modules, and I would expect them to continue their studies.*
Facet 3: Evidence of excellence in teaching	Student skills-set	Richard states: *receiving appropriate help enabled the students concerned to engage successfully with the problem-solving approach taught by TM111.*

35 TM112 is a follow-on module of TM111; Introduction to computing and information technology 2, https://www.open.ac.uk/courses/modules/tm112
36 TMA02, Second Tutor-Marked Assignment

Impact facet	Attribute	Description
Facet 4: Influence on discipline-based teaching, research and practice	Change in the ways in which subject concepts are taught	The outcomes from this project have had an effect by association on TM112[37] and M250[38] because Richard is on the module teams. The same sighted helper has also provided support for TM129[39].
Facet 5: Dissemination of project's outcomes	Number of publications from the project/initiative	The end-of-project report is available on the project's page on eSTEeM's website. The team presented at the 10th eSTEeM annual conference in 2021. Richard has given a presentation to the TM111 module team.
Facet 6: Adoption of the outcomes of the project been adopted by other educators	Adoption of the outcomes internally (within the institution) or externally to improve assessment Curriculum design in the same discipline or in other disciplines.	The findings of this project have influenced the way TM111 is taught and assessed in relatively small ways but on aspects that are very important to blind or VI students. For example, in the second assessment of the module, which assesses programming and problem-solving skills, students are provided with 'starter' projects on which they are asked to build. It was originally assumed that it would be sufficient if a sighted helper described each of these projects but in practice students found it helpful to have figure descriptions as well, so these are now provided routinely.

37   TM112 Introduction to computing and information technology 2, https://www.open.ac.uk/courses/modules/tm112
38   M250 Object-oriented Java programming, https://www.open.ac.uk/courses/modules/m250
39   TM129 Technologies in practice, https://www.open.ac.uk/courses/modules/tm129

Impact facet	Attribute	Description
Facet 7: Mutual stakeholder understanding	A community that SoTL creates and moving outside traditional silos	Richard has reported that this project has led to enhanced tutor understanding of ways to support visually impaired students on TM111. He said: *As a direct result of this project we have set up a tutor forum TM111 Accessibility Matters to share information and this has helped answer several questions, e.g. Can participants in Adobe Connect see an enlarged view? (Yes, but it's hard to find.)* *As another example, a tutor asked on the forum how their student could see an enlarged version of the programming environment, and I and other colleagues were able to explain how this could be done, as illustrated below:* **Figure [AC].2** Using Zoom with OUBuild
Facet 8: Personal and professional development of project team	Improved practice and personal knowledge	This SoTL project has led to an improved understanding within the School of Computing and Communications of the challenges faced by blind and VI students and the diversity of their needs and study strategies.
Facet 9: Recognition of project team members and other stakeholders	Public recognition through awards	This project was 'Highly Commended at the 4th eSTEeM Scholarship Projects of the Year Awards 2021'[40] under the category – Enhancing the Student Experience.
Facet 10: Fostering SoTL culture	Stimulating interest in SoTL Inspiring others to conduct SoTL	Richard has been sharing his experiences with other tutors/Associate Lecturers (ALs). He stated: *I co-presented an online session for ALs considering submitting eSTEeM project proposals, explaining the stages that need to be gone through and the support available, and describing our [project team's] own experience of the process.*

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40   Two for the price of one!, https://www.open.ac.uk/scholarship-and-innovation/esteem/news/two-price-one

Impact facet	Attribute	Description
Facet 11: Financial implications	Effect on costs of modules or programmes	Where a student needs sighted support which is not funded by a Disabled Students' Allowance (DSA)[41], as was the case with the students in this SoTL project, the cost is borne by the faculty; there is no central (institutional) funding pot.
Facet 12: Funding opportunities	Internal (within the institution) funding for follow-on/new projects/initiatives/ events based on SoTL project's success	There hasn't been a follow-on SoTL project yet but this initiative of a remote helper for VI students is continuing to be supported by the Faculty of STEM.

3.5   Reflections on SoTL practice

As action research[42] approach was adopted, the focus of this project was to reflect on specific interventions with the goal of improving practice if required. As members of the TM111 module team, the project team were insider researchers, and well positioned to study the programming experiences of the students. By interviewing the students, their sighted helper and their tutors, the project team had the opportunity to make changes to the support being provided and/or make recommendations to the module team which have all been implemented and the support to the VI students and their tutors continues to improve.

To bring about change in response to a SoTL inquiry, it is important that the SoTL practitioner is an integral part of the team which takes decisions about the changes to be made in learning and teaching based on the evidence from the SoTL inquiry. In this project, Richard and colleagues were core members of the TM111 module team and were able to bring about change. Further, Richard's continuing involvement with the module team has facilitated an ongoing learning process from the interactions of RS helper with VI students which has helped to sustain the initiative and to make improvements wherever necessary.

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41   Help if you're a student with a learning difficulty, health problem or disability, https://www.gov.uk/disabled-students-allowance-dsa

42   Action research is a research methodology which pursues action (or change) and research (or understanding) at the same time. It involves a cyclic or spiral process which alternates between action and critical reflection, and in the later cycles, continuously refining methods, data, and interpretation in the light of the understanding developed in the earlier cycles. https://www.emeraldgrouppublishing.com/how-to/research-methods/carry-out-action-research

To conclude, Richard's reflections are:

❝

Overall, I think the initiative has been very useful and the ability of the TM111 module team to cater for visually impaired students has been considerably enhanced, and the TM111 Accessibility Matters forum we established is a valuable resource for sharing information and supporting tutors who have visually impaired students in their [tutor] groups and has extended its scope to cover accessibility in the widest sense.

❞

3.6 Project resources and references

Project resources

End-of-project report: Remote sighted helper support for VI (visually impaired) students: exploring good practice. Available at: https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/technologies-stem-learning/remote-sighted-helper-support-visually-impaired-students or https://tinyurl.com/2wzd3kbt

Project poster: Remote sighted helper support for visually impaired students: exploring good practice. Available at https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/technologies-stem-learning/remote-sighted-helper-support-visually-impaired-students or https://tinyurl.com/2wzd3kbt

Presentation: Walker, R., Gardner, C. and Mattingly, S. (2021). Remote sighted helper support for visually impaired students, *The 10th eSTEeM Annual Conference: STEM Scholarship for a changing world – Disruption, Innovation and Impact*. Available at https://www.open.ac.uk/scholarship-and-innovation/esteem/events/10th-esteem-annual-conference-stem-scholarship-changing-world---disruption-innovation-and or https://tinyurl.com/3mja5ns8

4   [A1] Voluntary diagnostic quiz in mathematics modules

Fact box

Title	'Are you ready?' Quiz in mathematics modules
Aim of the SoTL inquiry	The aim of this SoTL inquiry was to investigate the relationship between completing a diagnostic quiz and student success and how the uptake of the diagnostic quiz by students who were aiming to register on Level 1 Mathematics modules could be improved.
Type of inquiry[43]	'Does it work?'
Led by	School of Mathematics and Statistics, Faculty of STEM
Contact	Carol Calvert, carol.calvert@open.ac.uk
Theme	Designing assessment
Research methods	predictive analytics; student interactions via phone/email; learning analytics
Duration	2014 - 2016
Keywords	diagnostic quiz; learning analytics; predictive analytics; predictive learning analytics; student readiness; student retention
Webpage	Improving retention for all students, studying mathematics as part of their chosen qualification, by using a voluntary diagnostic quiz, https://journals.gre.ac.uk/index.php/msor/article/view/312 (paper in an open access journal detailing this inquiry)

4.1   Context and aim of the SoTL inquiry

Diagnostic quizzes enable prospective students to self-assess their readiness to study individual modules and to choose modules for which they are adequately prepared. *Essential Mathematics 1* (MST124)[44] is the standard start mathematics module which was introduced in 2014 at The Open University (OU). The diagnostic quiz ('Are you ready for MST124?') (see **Figure [A1].1**) is designed to be ideally taken at the pre-registration stage to aid module choice and as such is available to both current and prospective students.

MST124 serves multiple qualifications, not just Mathematics and Statistics (M&S), and therefore there is a wide range of prior mathematical ability amongst the students taking this module. For many students it may have been several years since they may have formally studied any mathematics, so assessing their readiness to study MST124 is extremely important if they are to succeed. The quiz can help identify any areas of weaknesses, re-consider choice of MST124, and, if necessary, opt for a change of subject or a module.

There are two reasons to believe the quiz would be closely associated with success on the module: the quiz is optional and, hence, taking the quiz is a measure of student engagement; and it is a relatively direct measure of ability in mathematics and hence potentially a measure of mathematical success.

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43   'Areas of investigation in SoTL', in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109157&section=3.3

44   MST124 Essential Mathematics 1, https://www.open.ac.uk/courses/modules/mst124

However, the diagnostic quiz was underused by students and its power, in terms of helping students with MST124, was underrated. The aim of this SoTL inquiry was to investigate how the role of MST124 diagnostic quiz be emphasised and to get more students to engage with the quiz.

Figure [A1].1 Example of a diagnostic quiz question and answer for MST124

4.2 Underpinning research of the SoTL inquiry

The approach taken in this inquiry was to first demonstrate the potential of the quiz as a predictor variable for future success on MST124. Calvert (2014) identified a core set of explanatory variables linked to student success at different milestones in an OU student's journey and the statistical model generated a probability based on performance of similar students in the previous year. For MST124, two new variables were added to the model: attempt (quiz_flag) and the quiz score. The model identified that taking the quiz was a significant variable in predicting if the student would be present at crucial fee-points through the module. A fee-point is where students resident in England become liable to the Student Loan company for a percentage of their study fees.

The next step in the inquiry was to increase the numbers of students taking the quiz for October 2015 presentation. This was achieved through phone calls/emails from tutors and Student Support Team (SST). Students who had taken the quiz but had a low score (<75%), and those who had not taken the quiz were contacted. Contact with registered students commenced around four months before module start, enabling students to better prepare themselves for MST124, or to move to another module.

If students had registered on MST124 and if it was unsuitable for them, Carol (project lead) and her colleagues wanted to see student de-registrations before module-start in October 2015. They also wanted the students who remained on MST124 to be better prepared and hence more likely to stay on MST124.

4.3 Findings of the SoTL inquiry

The October 2014 presentation had 2,972 registered students of whom only 229 had attempted the quiz. There was a substantial difference in the pass rate for those that completed the quiz, just under 60%, and for those who did not, just over 40%. Possible explanations for the differences between the two groups include: students who take the quiz are engaging with the OU and their studies at an early

stage and are, therefore, more motivated. The quiz is tailored to the MST124 content and hence those who have taken the quiz will have more realistic expectations of what MST124 involves.

The number of students who had taken the quiz increased from around 229 for the 2014 presentation of the module MST124 to 700 for the 2015 presentation.

The University has a range of interventions designed to help support and retain students. These interventions were essentially the same for the October 2014 and October 2015 students apart from the intervention of this project. This consistency, until December 2015 when an additional source of support to aid retention was implemented, enabled the team to draw some direct comparisons between the 2014 and 2015 presentations.

In 2014, there were many withdrawals from the module in the two weeks before and after the module started. Potentially this was because students engaged with the materials at that point. This caused issues for students who wanted to consider changing modules as they were then starting any alternative module late and this placed a high demand on Student Support Team (SST) resources in a limited time-period.

However, in 2015, this inquiry was successful in terms of facilitating early withdrawals, and the steep de-registration in the period when module materials are received or when the module formally starts was reduced. Retention at the end of two months into the module was 88% for the October 2015 presentation compared to 81% for the same presentation in 2014 which represents an increased retention of just under 200 students.

Carol says:

The result of the analysis was extremely interesting – it did not matter what score the student got; it was the fact that they had attempted it - that was critical. I would have expected the score to matter- in terms of did we retain and get them to a pass - but... it didn't matter.

It was the fact that it [the inquiry] showed the students engaged early on.

So this inquiry led to a shift in emphasis and the involvement of the tutors when they first established contact – to get the student to try the quiz [if they hadn't thus far] and reassure the students it did not matter what score they got.

This then led us into the space of providing more materials for students to "practise" on pre-module start depending on where the students had found issues [after attempting the quiz].

4.4   Key lessons and details of the impact

This inquiry has shown the importance of using diagnostic quiz and the quiz-results in conjunction with targeted interventions at the pre-module start stage to both inform students of their correct study intentions and to help them to be as well prepared as possible for their chosen module. Analytics and evaluation show that using a diagnostic quiz is of utmost importance for student retention on the

module. The University has a responsibility to provide students with information to make informed choices about their preferred modules and qualifications.

A diagnostic self-assessment quiz and focussed personal contact can enable students to make appropriate choices for study and hence increase the likelihood that they will complete their study. However, the content of the quiz needs to be appropriate, and the timing of the quiz needs to be before students have committed themselves to a particular path of study. Using learning analytics and a process of evaluation, as illustrated in this inquiry, can help educators to monitor and evaluate the effectiveness of their approach.

This inquiry found that students welcomed the contact from advisors (SST) at an early stage and frequently indicated they would try the quiz. However, very few followed up the discussion by either taking the diagnostic quiz or moving to another module where this was available. A possibility, despite issues around ethics and creating psychological discomfort, is to design an intervention based around success rate information to jolt students into using the quiz to establish their readiness for study.

Based on the facets and attributes of the impact evaluation instrument (**Appendix 1**), the Table below details the impact of this SoTL inquiry.

Impact facet	Attribute	Description
Facet 1: Student experience	Student pre-registration Student induction Student engagement with course content	The diagnostic quiz has enhanced the student pre-registration process by guiding them whether they are ready for the module that they wish to study or not. The quiz and the personal contact by the tutor/SST team facilitates the induction and introduces students to the learning and teaching processes of the university. The tutors and SST staff reported in this inquiry that the quiz offered a way to start a conversation with the students. Since, the quiz is tailored to the MST124 content, it provides an early introduction to MST124.
Facet 2: Student retention and progression	Student registrations Student progression Student retention rate	The inquiry has shown that the number of registrations, student progression and retention rate was higher when the quiz and associated interventions were in place in 2015. Carol's recent reflections are: *Yes there was [an impact on student retention and progression] and I believe still is but not so sure now that it is monitored in the same way. We just came to accept it was a good thing to get students to do.*
Facet 3: Evidence-based excellence in teaching	Evidence of research-informed teaching	The inquiry provides evidence of advantages of explicitly preparing students with respect to the knowledge they will be expected to acquire in their new module of study and whether they have the prerequisite skills to succeed in their module of choice.

Impact facet	Attribute	Description
Facet 4: Influence on discipline-based teaching, research, and practice	Change in the ways in which subject concepts are taught	The M&S subject website (see case study **[J1]**[45]) has diagnostic quizzes for students to self-assess their readiness to study individual modules in M&S and to receive targeted support.
Facet 5: Dissemination of project's outcomes	Number of publications from the project/initiative Sharing of novel research methods/ strategies for conducting SoTL	Carol and team have published a journal paper (Calvert *et al.*, 2016) and were invited to write an institution-wide Quality Enhancement report for dissemination of the inquiry across the university (Calvert and Hilliam, 2016). Carol was one of the first educators at the OU to use predictive analytics in SoTL and to demonstrate the role of learning analytics in SoTL.
Facet 6: Adoption of the outcomes of the project by other educators	Adoption of the outcomes internally (within the institution) to improve assessment, curriculum design in the same discipline or in other disciplines	Since 2019, the M&S subject website[46] (Hilliam and Arrowsmith, 2019) has diagnostic quizzes for students to self-assess their readiness to study individual modules and receive targeted support. Diagnostic quizzes have been in use in the Level 1 Science modules since 2007. For example, the module *Cell Biology* (S294)[47] had a 'Are you ready for 294?' booklet in the entry requirements of the module's site. The booklet had a diagnostic quiz with self-assessment questions. Not all diagnostic quizzes were interactive – some were in pdf booklets. Since this inquiry, diagnostic self-assessment quizzes have become prevalent in several courses across STEM[48]. Carol reports: *The 'Are you ready for …quizzes' existed for several modules [prior to this SoTL inquiry] but were massively underused as we had no way to summarise and analyse the data. Once it was done for MST124 it generated a renewed interest in the 'Are you Ready for …quizzes' generally as a way of getting students to be involved early and flagging those who had not tried the quizzes as at a greater risk of dropping out.*
Facet 7: Mutual stakeholder-understanding	Understanding of stakeholders - students, tutors, IT support – e.g. their skills, challenges, requirements	The quiz and the results of the quiz have been a medium for forming strong working relationships between the stakeholders for early student support to the students: module team, tutors, and the SST staff.

45   Reference to the case study [J1] in this compendium.
46   Mathematics and Statistics subject website, https://learn2.open.ac.uk/course/view. php?id=206217 (requires OU login)
47   S294 Cell Biology, https://www.open.ac.uk/library/digital-archive/module/xcri:S294/study
48   Preparing for Study, Faculty of STEM, The Open University, http://stem.open.ac.uk/Preparing-for-Study and http://stem.open.ac.uk/are-you-ready-level-23-modules

Impact facet	Attribute	Description
Facet 8: Personal and professional development of project team and associated stakeholders	Improved practice or personal knowledge	When asked, Carol reported: ❝ *Yes I believe so for myself and for the MST124 team.* ❞ Carol has since developed a strong SoTL profile within M&S and the Faculty of STEM and supports (and inspires) colleagues interested in undertaking SoTL.
Facet 10: Fostering of Scholarship of Teaching and Learning (SoTL) culture	Inspiring others to conduct SoTL	Since this project and over the last 5-6 years, the School of M&S has developed a strong SoTL culture (see case studies **[J1]**[49] and **[J2]** in this compendium). The outcomes of several SoTL inquiries within M&S have directly influenced or contributed to the M&S subject site (see **[J1]**) to support students throughout their journey with the M&S School at the OU. Carol says: ❝ *Yes I think it [this SoTL project] did foster SoTL culture amongst my staff tutor colleagues because this systematic SoTL inquiry gave us an opportunity to make a piece of work visible that we'd just usually kept within ourselves.* ❞

4.5   Reflections on SoTL practice

It is worthwhile to note that analytics played a key role in the design and evaluation of this SoTL inquiry. The project team shared outcomes of this inquiry in an institution-wide quality enhancement report for the internal OU audience, and in an open access journal for educators in other institutions. Sharing the outcomes of a SoTL inquiry[50] is an essential part of being open to critique and disseminating in a way that others can use and build on. It is important to make the outcomes of a SoTL inquiry as accessible as possible, for example, publishing in open access journals, or using social media such as blogs, or via a project website.

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49   References to the case studies [J1] and [J3] in this compendium.
50   'Principles of SoTL', in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109160&section=2

> **To conclude, Carol has this four-point recommendation for diagnostic quizzes:**

"

Get students to take a low stake quiz as soon as possible and preferably prior to course start.

Assume students want to succeed and so make available plenty of materials to help them patch any gaps the low stakes quiz showed.

Get tutors to view the lack of a quiz score at the start of the module as something to follow up with the student and get the students to try it.

Lack of involvement at the start is easier to try and fix at the start than it is 2 months later when first assignment has not appeared.

"

4.6   Project resources and references

Project resources

Calvert, C. (2014). Developing a model and applications for probabilities of student success: a case study of predictive analytics, *Open Learning: The Journal of Open, Distance and e-Learning*, vol. 29, no. 2, pp. 160–173, Available at: https://oro.open.ac.uk/41524/

Calvert, C., Hilliam, R. and Coleman, J. (2016). Improving retention for all students, studying mathematics as part of their chosen qualification, by using a voluntary diagnostic quiz. *MSOR Connections*, vol. 14, no. 3, pp. 32–38. Available at: https://journals.gre.ac.uk/index.php/msor/article/view/312

Calvert, C. and Hilliam, R. (2016). Improving retention for all students studying mathematics as part of their chosen qualification by using a voluntary diagnostic quiz, *Quality Enhancement (QE) Report Series No. 12*. Available at: https://openuniv.sharepoint.com/sites/units/lds/scholarship-exchange/documents/QE%20Report%2012%20%20Improving%20retention%20for%20all%20students%20studying%20mathematics.pdf or https://tinyurl.com/yfu5j49c (requires OU staff login).

References

Hilliam, R. and Arrowsmith, G. (2019). Enhancing the student experience with the use of a dedicated subject website, *MSOR Connections*, vol. 17, no. 2, pp. 39–45. Available at: https://journals.gre.ac.uk/index.php/msor/article/view/947

5   [A2] Interactive online quizzes in formative assessment

Fact box

Title	Assessment analytics of student engagement with, and performance on, S217 online quizzes
Aim of the SoTL inquiry	The aim of the SoTL inquiry was to understand how students on a Level 2 Physics module (S217) use online quizzes and to what extent the quizzes help students prepare for their formative assessment (i.e., the tutor-marked assignments).
Type of inquiry[51]	'What is wrong?'
Led by	School of Physical Sciences, Faculty of STEM
Contact	Andrew Norton, andrew.norton@open.ac.uk
Theme	Designing assessment
Research methods	learning analytics related to use of quizzes and their analysis; student-interviews on telephone; thematic analysis of student-interviews
Duration	2015 – 2016
Keywords	assessment; formative assessment; online quiz; self-assessment
Webpage	Assessment analytics of student engagement with, and performance on, S217 online quizzes, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/innovative-assessment/assessment-analytics-student-engagement-and-performance-s217 or https://tinyurl.com/dvvk4tjf

5.1   Context and aim of the SoTL inquiry

The module, *Physics: from classical to quantum* (S217)[52], was launched in October 2015. It is The Open University's core 60-point, Level 2 physics module and is delivered online.

The assessment model uses a combination of summative and formative assessment. The summative assessment, referred to as the Overall Exam Score (OES), has two parts. The first is an extended Tutor-Marked Assignment (TMA04) worth 25% of the OES. The remaining 75% of the OES is from a standard 3-hour unseen examination at the end of the module. The formative assessment is based on five TMAs (01, 02, 03, 05 and 06) spaced throughout the study calendar. These TMAs provide opportunities for significant formative tutor feedback.

In addition, S217 includes a set of seven interactive online quizzes written using the OpenMark[53] package. To encourage students to complete the formative assessment, a threshold score was placed on the five formative TMAs, such that students must score at least 40% across the five TMAs to be allowed to qualify for a grade based on their OES. To promote engagement with the quizzes, each TMA included a question worth 10 marks which invited students to submit a screenshot of their score from the most recent content-related quiz, and to briefly reflect on their learning from that quiz.

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51   'Areas of investigation in SoTL', in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109157&section=3.3 or https://tinyurl.com/29t7z2my
52   S217 Physics: from classical to quantum, https://www.open.ac.uk/courses/modules/s217
53   OpenMark Examples, http://www.open.ac.uk/openmarkexamples/

The aim of the SoTL inquiry was to understand how students use the online quizzes and whether the quizzes help (or not) in preparing for their formative assessment.

5.2   Underpinning research of the SoTL inquiry

The SoTL inquiry was situated in the 2015 presentation of S217 and involved:

- Analysing analytics to assess when, and in what number, students accessed and completed each of the seven online quizzes.

- Carrying out telephone interviews with a subset of students (those who volunteered to participate) to find out their motivations for the choices they made regarding the timing and completion of the online quizzes.

The analytics evaluation was carried out initially using Tableau Reader[54] workbooks and later using the SAS-VA[55] which provided real-time data on the student population.

The key data product in the SAS-VA system was the "Tool use by module" report which allowed the week-by-week behaviour of students to be tracked for each online quiz, with respect to the associated TMA. The analytics work began in Spring 2016 and ran until after the module presentation ended in June 2016.

The telephone interviews were carried out by one of the team members on a self-selecting cohort of students. Each interview typically lasted for half-an-hour.

5.3   Findings of the SoTL inquiry

From the analytics, it was clear that only a small proportion of students visited each quiz in the several weeks during which they were working through the study units whose material was covered by that quiz. Instead, most students visited the quiz during the week in which the TMA submission due date occurred to complete the self-reflection question at the end of each TMA. Furthermore, Quiz 7, which was not referred to in a TMA, was only visited by a small proportion of students during the exam revision period and did not show a significant peak in visits, like the other quizzes did.

In the telephone interviews, most students said they had accessed the quizzes only shortly before the TMA submission due date (supporting the analytics results) and were prompted to do so by the need to respond to the final self-reflection question in the TMA. The students found the multiple tries at each question and the multiple variants very useful and had attempted each quiz question several times. Some of the students said they planned to re-visit the quizzes again as part of their end of module revision prior to the exam (although the analytics data showed that relatively few did so).

Students said they found the quizzes to be useful in improving their understanding of the topics covered, although they did not find the quizzes particularly helpful as preparation for answering the TMA questions. Students said that they would have done the quizzes anyway, even if not prompted to do so by the TMA (although judging by the few attempts at Quiz 7, this is not borne out by the data), and cited their use in revision as the most likely reason to engage with them. Finally, students stated that the self-reflective TMA questions were not useful as an aid to learning.

54   Tableau Reader, https://www.tableau.com/en-gb/products/reader
55   SAS-Visual Analytics, https://www.sas.com/en_us/software/visual-analytics.html

Based on these findings, two changes were made for the next (2016) presentation:

- To encourage students to engage with the quizzes on a more regular basis, the module team "seeded" the online study calendar for 2016 with links to specific questions of each quiz in the same week as the relevant study unit. This was done to ensure that students receive a weekly prompt to visit the quiz questions and so hopefully use them in the way the module team had intended and as preparation for their TMAs.

- The module team altered the self-reflection questions in the TMAs to be topic specific. The questions instead asked: "In a few sentences, describe one thing that you learned from answering the questions in the Quiz that improved your understanding of XXX" where "XXX" is a topic of relevance to the remaining questions in the TMA.

The module team hoped that the changes would have a positive impact on TMA scores and retention. The team monitored the analytics in 2016 to check if the student usage behaviour of quizzes had changed from 2015.

Project Lead Andrew Norton reports:

in the second presentation [after the intervention], 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 [SoTL] project, and changed student behaviour as a result, but unfortunately this had no effect on student success.

5.4   Key lessons and details of the impact

The combination of research methods, learning analytics and interviews, complemented one another. The analytics helped to guide the student-interviews. The data from student-interviews helped to explain and validate the analytics. The mixed methods research approach of combining quantitative and qualitative research approaches enhanced the understanding and corroboration of student behaviour.

Although the follow-up intervention based on the outcomes of SoTL inquiry in 2015-2016 changed student behaviour in the use of quizzes, it didn't lead to an improvement in student performance. However, the experiences gained on the SoTL project influenced the assessment strategy of a new module *Astronomy* (S284)[56] designed by Andrew and his colleagues in 2020.

Andrew says:

in retrospect, I'm not sure that the S217 told me much about how to design the assessment for S284, other than how not to do it!! But I guess that was a valuable lesson learned. The structure in S217 really did not work well in the end, despite the investigations we did, and the tweaks subsequently made.

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56   S284 Astronomy, https://www.open.ac.uk/courses/modules/s284

The advantages of engaging with SoTL are that the experiences and resultant researcher mind-set continue to influence academic practice long after the inquiry has been completed.

Andrew adds:

The assessment strategy in S284 however is really great and I'm very pleased with it (and the students seem to be liking it too). I've been really impressed with the versatility of the Moodle Quiz questions that we've used to make the online Exam (Part 1 & Part 2) for S284. We designed this pre-COVID, but it turned out to be just what we needed in the current remote open-book exam environment. In practice all students will see a different exam paper so removing collusion opportunities and enabling questions to be re-used year-on-year.

Figures [A2].1 to **[A2].3** are examples of questions from the Parts 1 and 2 of the Specimen Exam Paper of S284.

Question 1 Not yet answered

Marked out of 5.00   ⚑ Flag question   ⚙ Edit question

The binary star Achird in the constellation of Cassiopeia consists of two stars (Eta Cas A and Eta Cas B) with positions as follows:

Eta Cas A: RA 00h 49m 06.29s, Dec $+57°$ 48′ 54.7″
Eta Cas B: RA 00h 49m 05.19s, Dec $+57°$ 49′ 04.2″

Both stars are at a distance of $d = 5.95$ pc.

a. What are the differences in the RA and Dec coordinates between the two stars?
(NB. Calculate the difference as: Eta Cas A minus Eta Cas B in each case.)

$\Delta\alpha = $ [____] seconds

$\Delta\delta = $ [____] arcseconds

(1 mark)

b. Convert the difference in RA into an angular separation in arcseconds.

$\Delta\alpha \cos\delta = $ [____] arcseconds (1 d.p.)

(1 mark)

c. What is the overall angular separation between the two stars.

$\theta = $ [____] arcseconds (1 d.p.)

(1 mark)

d. Calculate the linear separation between the two stars in parsec.

$D = $ [x^2 ____] pc (3 s.f.)

(1 mark)

e. Convert the linear separation between the two stars into astronomical units and solar radii.

$D = $ [____] AU (3 s.f.) or [x^2 ____] $R_\odot$ (3 s.f.)

(1 mark)

Figure [A2].1 Sample question from Specimen Exam Paper of S284

Question 8 Not yet answered

Marked out of 5.00   ⚑ Flag question   ⚙ Edit question

(This question has multiple variants)

This question examines the evolution of galaxies and their metallicity using stars in globular clusters. You may assume that the solar metallicity is $Z_\odot = 0.02$ and the hydrogen fraction is the same for all stars, $X = X_\odot = 0.7$.

a. The chemical evolution of galaxies is often measured by abundance ratios like oxygen to iron. A globular cluster star (Star A) is observed, and found to have [O/Fe] = 0.3 dex and [Fe/H] = −1.3 dex. How abundant are iron and oxygen in Star A compared to the Sun?

(i) Iron in Star A is [   ] times as abundant as in the Sun. (2 s.f.)

(ii) Oxygen in Star A is [   ] times as abundant as in the Sun. (2 s.f.)

(2 marks)

b. The Sun formed 9.0 Gy after the Big Bang. Another globular cluster star (Star B) has a metallicity of [Fe/H] = −1.0 dex.

(i) If the Universe has been accumulating iron at a constant rate, about how old (in Gy) was the Universe when Star B formed?

Age of the Universe when Star B formed = [   ] Gy (2 s.f.)

(ii) Which population is Star B from?

○ Population I   ○ Population II   ○ Population III   ○ Population IV

(2 marks)

c. Complete the following sentence to explain the colours of globular clusters relative to open clusters.

Looking through an optical telescope, we would expect globular clusters to be [Choose... ▾]

the younger population of open clusters, because the light of globular clusters is dominated by

[Choose... ▾] .

(1 mark)

Figure [A2].2 Sample question from Specimen Exam Paper of S284

Question 12 Not yet answered

Marked out of 7.00   ⚑ Flag question   ⚙ Edit question

The following labels describe some spectral components detected from an active galaxy. Drag and drop the labels (which you will find below the figure) onto the schematic diagram of the active galaxy to indicate *where* each of the spectral components originate from. All wavelengths have been corrected to the rest-frame of the galaxy (i.e. the effect of redshift has been removed).

A: A point source non-thermal component with wavelengths in the range 0.3 nm to 30 nm

B: A point source thermal component with wavelengths in the range 30 nm to 3 μm

C: A spatially extended thermal component with wavelengths in the range 300 nm to 30 μm

D: A point source of emission lines near a wavelength of 500 nm with a width of about 1 nm

E: A point source of emission lines near a wavelength of 500 nm with a width of almost 10 nm

F: A point source thermal component with wavelengths in the range 3 μm to 300 μm

G: A spatially extended non-thermal component with wavelengths in the range 3 mm to 30 cm

(7 marks)

Figure A schematic diagram of an active galaxy: (a) shows the innermost regions, (b) is an intermediate view, and (c) shows the entire galaxy.
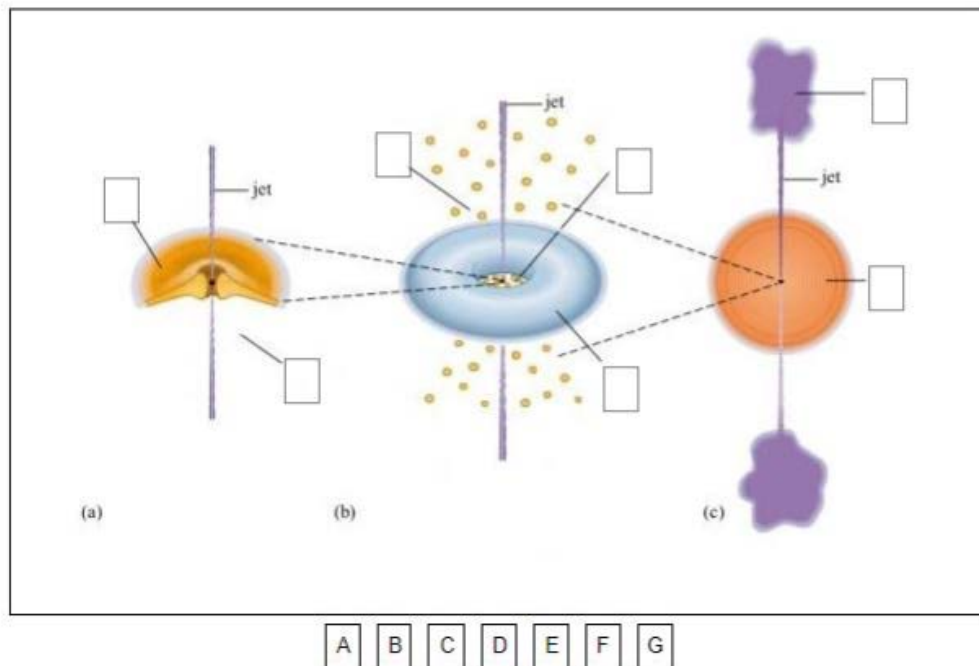

Figure [A2].3 Sample question from Specimen Exam Paper of S284

Based on the facets and attributes of the impact evaluation instrument (**Appendix 1**), the Table below details the impact of this SoTL inquiry.

Impact facet	Attributes	Description
Facet 1: Student experience	Student engagement with course content Student engagement with technological intervention	Student engagement with the quizzes was enhanced via the changes made in S217. Overall, the student experience was perceived to be better than before as the design of the TMAs was changed in S217 to meet their requirements or preferences.
Facet 2: Student retention and progression	Student progression Student retention rate	There was no measurable impact on the retention and progression on S217. However, the retention on the Level 2 module *Astronomy* (S284) whose design of assessment strategy was influenced by this SoTL project, was significantly higher than that of its predecessor module (S282)[57], in its first two years of presentation in 2020-2021 & 2021-2022. S284 statistics: 2020-21: 215 students sat Exam Part 2 out of 232 students active at the time (i.e., 92.7%), or 270 students at 25% Fee Liability Point (FLP) (i.e., 79.6%). 2021-22: 194 students sat Exam Part 2 out of 212 students active at the time (i.e., 91.5%), or 241 students at 25% FLP (i.e., 80.5%).
Facet 6: Adoption of the outcomes of the project by other educators	Adoption of the outcomes internally (within the institution) to improve assessment, curriculum design in the same discipline	The design and implementation of the assessment structure S284 (launched in 2020) has been driven by the experiences gained by Andrew on this SoTL inquiry. In S284, quizzes are included as an examinable component. Andrew says: *Using multi-variant iCMA [interactive computer marked assignment] 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.* Andrew notes too that these developments are timely [in the post-COVID-19 era]: *I can see that, with the current move towards at-home, open-book exams more widely across the OU [The Open University], this experience is likely to prove useful and find wider applicability.*

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57   S282 Astronomy, https://www.open.ac.uk/library/digital-archive/module/xcri:S282/study

5.5 Reflections on SoTL practice

In this case study, the SoTL inquiry didn't yield the impact, as intended. However, the SoTL project team's understanding of students' requirements and behaviour towards quizzes and how the quizzes should be designed and scheduled in the study calendar of the module contributed towards the design and implementation of assessment strategy of another module (S284) a few years later.

Andrew reports:

"

The design of the assessment for S284 Astronomy was influenced to some extent by this [SoTL] project. That module comprises a single component assessment with 6 half-weight TMAs (one per Topic), each of which mainly assesses student performance on the core Topic Activity and its relevant Learning Outcomes and Employability Skills and comprises 6 x 8% = 48% of the [Overall Examination Score] (OES).

In addition, there is a low-weight mid-course Moodle quiz-based online exam (worth 12% OES) and a high-weight end-of-course Moodle quiz-based online exam (worth 40% OES). Each of the latter use multi-variant questions, resulting in billions of exam combinations. There are no internal thresholds for the assessment components.

"

The assessment strategy of S284 is already showing a notable impact on student retention and has proved to be suitable for remote (and online) examinations.

> **To conclude, Andrew's thoughts on the SoTL inquiry are:**
>
> **"**
>
> *It is always instructive to discover what the students' understanding and interpretation of the module's assessment strategy actually is, rather than assuming that they share the same vision of it as the module authors [educators].*
>
> *...students do not necessarily understand the purpose of the assessment in the way that it was designed. It is important to convey to them that formative assessment is intended to help students achieve the module's learning outcomes; it is not a barrier or hurdle to be overcome with the least possible effort.*
>
> **"**

5.6   Project resources and references

Project resources

End-of-project report: Assessment analytics of student engagement with, and performance on, S217 online quizzes. Available at: https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/innovative-assessment/assessment-analytics-student-engagement-and-performance-s217 or https://tinyurl.com/dvvk4tjf

Video: Andrew Norton explaining the S217 project in an eSTEeM video, Assessment analytics of student engagement with online quizzes, https://youtu.be/owYBf05ivQQ

Case study: 'Assessment analytics of student engagement', in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109159&section=5.2

References

Online exams are mentioned in the module description of S284, http://www.open.ac.uk/courses/modules/s284#details

6   [DS] Online journal clubs

Fact box

Title	Online journal clubs in distance higher education: an opportunity to develop skills and community
Aim of the SoTL inquiry	The aim of this SoTL inquiry was to investigate the role of student online journal clubs in developing digital skills of students, building their online confidence, and in fostering an online academic community.
Type of inquiry[58]	'Does it work?'
Led by	School of Life, Health & Chemical Sciences, Faculty of STEM
Contact	Fiona (Fi) Moorman, fiona.moorman@open.ac.uk and Karen New, karen.new@open.ac.uk
Theme	Building digital skills
Research methods	usage analytics; analysis of forums usage; student survey; focus group
Duration	2018 - 2020
Keywords	digital skills; employability; online learning communities; skills development; student support
Webpage	Online journal clubs in distance higher education: an opportunity to develop skills and community?, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/onlineonscreen-stem-practice/online-journal-clubs-distance-higher-education or https://tinyurl.com/bdpptkpr

6.1   Context and aim of the SoTL inquiry

Anecdotal evidence from tutors had suggested that many students lack skills associated with digital and information literacy and have low confidence in an online environment. Furthermore, evidence from a few SoTL projects in eSTEeM[59] and the internal quality control processes at The Open University (OU) indicated that student attendance in online tutorials was decreasing and, where students attend, there was a reluctance to fully participate. This information coupled with the fact that face-to-face tutorials were diminishing, meant that there were fewer opportunities for peer-to-peer interactions resulting in a possible sense of isolation for students and low student satisfaction.

The SoTL project team created a dedicated Online Journal Club[60] (OJC) platform (**Figure [DS].1**) to support students' skills development. The platform on OU's Virtual Learning Environment (VLE) included an online room (in Adobe Connect[61]) for OJC events and an online space for the development of an OJC community. OJC events were flexible and were run in a variety of ways, e.g. intra-module,

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58   'Areas of investigation in SoTL', in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109157&section=3.3
59   'Projects', eSTEeM, The OU Centre for STEM pedagogy, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects
60   A sample article on journal clubs: Journal Clubs: 2. Why and how to run them and how to publish them, https://ebm.bmj.com/content/22/6/232
61   Adobe Connect, https://www.adobe.com/uk/products/adobeconnect.html

-level, -qualification and cross-disciplinary. Discipline-focused biology and health clubs were offered as well as university-wide clubs, supporting an interdisciplinary community of learners. Clubs were 'facilitated' rather than 'run' by tutors and had a student-centred, informal, and supportive ethos. Participation was optional and events were not recorded or assessed.

The project's aim was to investigate the role of OJCs in developing online and digital skills of students, building their online confidence, and in fostering an online academic community.

Figure [DS].1 A dedicated space for the online journal club[62]

6.2   Underpinning research of the SoTL inquiry

Traditional journal clubs tend to operate where a single participant presents an academic paper to a group for subsequent critical discussion. However, the SoTL project was set up differently. Several clubs were set up to suit different contexts of student-participation. For example, where students were new to study, they might feel confident to share an item of news relevant to their field of study (e.g. BBC News, or a popular science magazine), whereas students further along in their study journey might wish to share an academic journal article with others.

During the duration of this SoTL inquiry, 34 students (25% of whom had a declared disability) prepared and delivered a presentation during OJC events. Club events were 'facilitated' by tutors. At the end of each live OJC event, student participants were invited to complete an online questionnaire comprising of 8 questions (a range of mixed response, free text questions). Tutor-facilitators took part in a focus group to share practitioner-perspective and experiences. The focus group transcript was analysed using NVivo[63] software. To examine the nature of discussions, the project team observed the usage of forums. Further, to determine the footfall, the analytics gave information about the visits to the OJC platform.

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62   Online journal club, https://learn1.open.ac.uk/course/view.php?id=100179 (requires OU login)
63   Qualitative Data Analysis, NVivo, https://lumivero.com/products/nvivo/

6.3   Findings of the SoTL inquiry

Survey feedback from participants was overwhelmingly positive; students enjoyed the friendly and supportive environment, felt that their presentation skills and online confidence had improved, and valued the opportunity for peer-peer interaction and a sense of community. **Figure [DS].2** shows students' inputs before and after an OJC event.

Figure [DS].2 Wordle based cloud on student feedback before and after participation in an OJC event

Fi and Karen (project co-leads) report:

…uptake of OJCs and feedback from students wildly surpassed our expectations.

Some (sample) quotes from students:

I think my research skills improved and it also increased my confidence in the area of presenting as it gave me an opportunity to try it out and I also learned how online presentations work as I had never given one before.

I didn't feel confident talking in a tutorial but now I do.

… but the most useful thing to me was to face my fear of presenting. I never use the microphone during tutorials and avoid speaking in public, but I would like to overcome this fear, and OJC provided the first step to tackling this.

[OJCs gave me an] opportunity to interact with my fellow students and tutors in a safe, non-judgmental and open online environment.

Key findings from the focus group involving tutor-facilitators indicated that their teaching was positively impacted by the OJC experience resulting in their tuition becoming more facilitative with a student-centred approach, rather than a top-down, tutor-led approach. Additionally, the project team tentatively suggests that OJC may offer the opportunity for tutors to enhance their own academic currency and deepen connections with other tutors as part of an academic community.

Facilitators reported personal challenges, including how they felt nervous before their first club as the experience of facilitating OJC was new to them and concerns over their expected levels of knowledge regarding the different presentations. Other concerns included administrative difficulties recruiting students and receiving their slides, prospective presenters being discouraged by the time taken to prepare for their club, and the prospect of dealing with inappropriate content of presentations. The OJC platform had a high footfall, although the project team was unable to measure whether passive visitors to the OJC website directly benefited from the resources provided even if they did not actively post in the forum or participate in an OJC live event.

6.4   Key lessons and details of the impact

Based on this SoTL inquiry, the project team proposes OJCs as a vehicle to develop core competencies, including critical evaluation, communication, and collaboration, for both undergraduate and postgraduate students. OJC events could be run where students are all on the same module, qualification pathway, level of study, or be provided as cross-level, cross-discipline university-wide events.

The student-led approach of OJCs may empower both tutors and students and it offers a mechanism for increasing student ownership of their learning within the context of a rich online academic community. Furthermore, participation may motivate and encourage transition to further modules, thereby aiding retention. Communication and critical thinking skills are highly rated by employers and through development of transferable professional skills, OJC may also enhance student employability.

OJCs have now been included within other STEM modules. For example, the module *Cell Biology* (S294)[64] set up an online journal club as a part of the early start programme[65], and the module *Investigative approaches in biology and chemistry* (S285)[66] has embedded online journal club events as part of the core tuition strategy. Further scholarship[67] is currently underway to evaluate the impact of the S285 OJC on the development of employability skills, confidence and sense of community for students studying this module. Finally, an ongoing series of OJC events for STEM tutors provides space for these educators who work remotely to enjoy community and develop academic currency.

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64   S294 Cell Biology, https://www.open.ac.uk/library/digital-archive/module/xcri:S294/study
65   To know more about the early start programme in a module, please refer to the case study [J3] in this compendium.
66   S285 Investigative approaches in biology and chemistry, https://www.open.ac.uk/courses/modules/s285
67   Evaluation of online journal club (OJC) in S285: to what extent does this help students develop employability skills?, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/other/evaluation-online-journal-club-ojc-s285-what-extent-does-help-students-develop or https://tinyurl.com/2p9a8845

The project team concluded that an OJC offers a mechanism to support students' development of online and digital skills and confidence, as well as facilitating peer-to-peer student learning within academic disciplines. Most importantly, OJC offers space for students to develop networks within online communities of practice – an aspect that has become pivotal within the online or blended education landscape in the post-COVID-19 era. The project team has developed a 'user pack' (available from this project's webpage on eSTEeM's website) to provide advice and guidance to educators who are interested in running OJCs.

Based on the facets and attributes of the impact evaluation instrument (**Appendix 1**), the Table below details the impact of this SoTL inquiry.

Impact facet	Attribute	Description
Facet 1: Student experience	Student engagement with the technological intervention Student satisfaction Student engagement with the course content	The feedback from student-participants has indicated that OJC provided a positive student experience, enabling students to build online confidence and develop key skills such as searching, selecting, evaluating, and presenting information; communication; and critical analyses. Although formal analysis of long-term skills development and effects on retention / progression was outside the scope of this project, the sense of belonging to a community has been shown to impact positively upon student satisfaction and confidence. Participants developed increased ownership for their learning and enjoyed peer-to-peer interaction and connection with other students as part of the OJC community. OJC events have been offered across the university, enabling students to work with peers studying other disciplines. The project team suggest that OJC participation may encourage students to become more active participants in online tutorials as a part of their formal study.

Impact facet	Attribute	Description
Facet 2: Student retention and progression	Student retention rate Student progression	Student retention and progression are impacted by multiple aspects such as tutor and module support, personal circumstances, and Student Support Team interventions. Students who participated in OJC were studying on different modules, at different levels and were registered on different qualifications across the University, making it unfeasible to formally evaluate the impact that participation on OJC may have had on retention and progression of these students. However, OJC events were routinely included within an early start pre-module start initiative on the Level 2 module, *Cell biology* (S294)[68]. So, it is reasonable to infer that the experience of participation in OJC is beneficial to increase student engagement during the key period between registration and module start.
Facet 3: Evidence-based excellence in teaching	Student skills-set Student employability	OJCs are increasingly being adopted in STEM modules to support peer-to-peer learning in an informal environment and for implicit development of digital skills and competencies. The skill set of communication, critical analysis, and digital literacy not only benefits students' academic studies but are also highly prized by employers.
Facet 4: Influence on discipline-based teaching, research and practice	Change in the ways in which subject concepts are taught	OJCs were included within early start initiative in S294. OJCs were integrated in the Science capstone project module, *Researching biology and health science*, (SXL390)[69]. OJC is embedded in a Level 2 module, *Investigative approaches in biology and chemistry* (S285)[70], where students can discuss news stories related to food safety and develop key cognitive and communication skills. Further scholarship is currently underway to evaluate the impact of OJCs in S285[71] on development of employability skills, student confidence, and sense of community for students studying this module.

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68 S294 Cell biology, https://www.open.ac.uk/library/digital-archive/module/xcri:S294/study

69 SXL390 Researching biology and health science, https://www.open.ac.uk/library/digital-archive/module/xcri:SXL390/study

70 S285 Investigative approaches in biology and chemistry, https://www.open.ac.uk/courses/modules/s285

71 Evaluation of online journal club (OJC) in S285: to what extent does this help students develop employability skills?, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/other/evaluation-online-journal-club-ojc-s285-what-extent-does-help-students-develop or https://tinyurl.com/2p9a8845

Impact facet	Attribute	Description
Facet 5: Dissemination of project's outcomes	Number of publications from the project/ initiative Sharing of novel research methods/ strategies for conducting SoTL	This SoTL project has been showcased in workshops in the newsletters of the School and Faculty of STEM. The project has featured in university-wide (internal) Quality Monitoring and Enhancement Reports in 2017/2018 and 2019/2020 as a 'good practice' initiative. In addition, the team disseminated the project in conferences: at the annual SoTL conference in OU's Faculty of STEM, and externally at the Advance HE Teaching and Learning Conference, July 2019. OJC has featured in Snowball (Edition 87, 2019), the newsletter for Associate Lecturers (ALs)/tutors, and in the 'Scholarship Help Area for Regional and National Scholars' (SHARE)[72] First Friday (online) meeting in December 2019. The project team has developed a user pack to provide advice and guidance to staff across the University to offer the experience of OJCs to a wider student audience.

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72 SHARE – **S**cholarship **H**elp **ARE**a for Regional and National Scholars, The Open University, UK, https://learn3.open.ac.uk/course/view.php?id=300463 (requires OU staff login). From the site: 'We are building a bank of resources and a network of support for colleagues who wish to develop their practice, and that of their colleagues, through the SoTL.'

Impact facet	Attribute	Description
Facet 6: Adoption of the outcomes of the project by other educators	Adoption of the outcomes internally (within the institution) or externally	Fi and Karen reflecting on their SoTL project state: *several interdisciplinary clubs were offered to students studying any module at any level across the University. Feedback from students who participated in these clubs indicated that they valued the opportunity to take part in this interdisciplinary model of OJC.* The project team has received enquiries related to OJC's approach and experience from another UK's university. This interest may lead to incorporation of OJC models into tuition at other HE institutions. In **Facet 4**, the modules in the School of Life, Health and Chemical Sciences in OU's Faculty of STEM in which OJCs are embedded are mentioned. Fiona has reported about recent developments: *OJCs have been offered to students studying on the modules S317[73] and SD329[74] and to students studying on the BSc Biology qualification.* *Approximately 200-300 students have presented at OJC events. Bimonthly OJC sessions for ALs/tutors are now offered as part of the STEM-ByALs-ForALs programme.* The STEM-ByALs-ForALs programme[75] has been set up (in OU's VLE environment) to give STEM Associate Lecturers (ALs) or tutors opportunities to share good practice, and to help to build a supportive community spirit amongst the STEM AL network.
Facet 7: Mutual stakeholder understanding	Understanding among stakeholders about requirements	Creation of the 'one stop shop' OJC website required collaboration with a range of teams across the university, for example, to build the website/platform and to create the OJC quiz and micro-badge. This has facilitated a deeper understanding of processes within the university.

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73   S317 Biological science: from genes to species, https://www.open.ac.uk/courses/modules/s317
74   SD329 Signals and perception: the science of the senses, https://www.open.ac.uk/courses/modules/sd329
75   STEM-ByALs-ForALs Online Programme, https://learn3.open.ac.uk/course/view.php?id=300723 (**requires OU staff login**). From the website: 'The aim of the programme is to give STEM ALs opportunities to share good practice, and also to help to build a supportive community spirit amongst the STEM AL network.'

Impact facet	Attribute	Description
Facet 8: Personal and professional development of project team and associated stakeholders	Improved practice or personal knowledge Promotions Fellowships or memberships of professional associations nationally and internationally Public recognition through publications/ awards	Both project leads developed their knowledge of 'systems' and processes at the OU as a direct result of this project. Additionally, both PIs joined the SHARE Scholarship Team, to promote and encourage SoTL amongst Staff Tutors/ Student Experience Managers across the university. The tutors valued the OJC experience (as facilitators) in terms of their own development. Feedback suggested that the experience was transformative for their tutoring practice, resulting in their tuition becoming more facilitative with a student-centred approach, rather than being solely tutor-led. Beyond the direct pedagogical considerations, tutors commented on feeling 'energised' listening to the enthusiasm projected by the students, reaffirming their own passion for their respective specialities (and expertise). • This SoTL inquiry on OJCs was included in a successful promotion case for one of the project leads. • Both project leads, as well as an additional member of the OJC project team, included the OJC scholarship experience within successful SFHEA[76] applications. • The OJC project won the 2020 eSTEeM Award for Innovative/Original Approach to Teaching[77.] • OJC has been cited as demonstrating good practice for developing student academic and communication skills in the 10th anniversary report (Collins *et al.*, 2020) of eSTEeM, The OU Centre for STEM pedagogy. Fi and Karen say: *OJC has been a transformative experience - for students and ALs, as well as for us as project leaders!.*

76   Senior Fellowship Higher Education Academy (HEA), Advance HE, https://www.advance-he.ac.uk/fellowship/senior-fellowship

77   Innovative/Original Approach to Teaching, 9th eSTEeM Annual Conference, 2020 https://www.open.ac.uk/scholarship-and-innovation/esteem/events/9th-esteem-annual-conference-informing-student-success---scholarship-practice or https://tinyurl.com/nhkrxzh8

Impact facet	Attribute	Description
Facet 12: Funding opportunities	Funding for follow-on/new projects based on SoTL project's success	Following on from the success of OJC, as a part of a follow-on eSTEeM-funded project, the OJC model was adapted to transfer the enriching experience of journal club to a face-to-face setting for students in secure environments[78].
		Students in secure environments have few opportunities for peer-to-peer learning and, unsurprisingly, may be more isolated from any learning-community. The objective of the follow-on project was to investigate whether journal clubs could facilitate a sense of community amongst the students.
		This SoTL project focussed on students in secure environments was showcased in OU's Employability best practice guide 2022[79].
		Fi and Karen were invited to develop a report of their project for the Centre for Social Justice (a policy think tank based in Westminster)[80] concerning prison rehabilitation in terms of education and employment.

6.5   Reflections on SoTL practice

Disseminating the outcomes of a SoTL inquiry enables educators in the same or other disciplines and institutions to apply the activities in their contexts, thereby enhancing the scope for impact of the original SoTL inquiry. Further, the dissemination and sharing experiences of conducting a SoTL project can help foster a SoTL culture. The project team presented their OJC 'scholarship journey' in events, which are advertised to all Staff Tutors or Student Experience Managers across the University to encourage cross-faculty scholarship projects.

Fi and Karen reflect on their dissemination strategy:

Our dissemination activities have been very fruitful. Informal conversations as well as conference presentations have enabled us to identify opportunities to develop and expand our OJC model. For example, following discussions with colleagues from the OU library, we were able to host adverts for our interdisciplinary OJC events on the Library's Training and Events[81] page to offer the opportunity of participation to students across the University. More formal dissemination of our OJC project findings via conference presentations and eSTEeM reports have led to the incorporation of OJC into the tuition strategy of modules within our faculty [of STEM].

78   Summer Series of Journal Clubs: an opportunity to develop employability skills and a sense of community amongst students in secure environments, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/supporting-students/summer-series-journal-clubs-opportunity-develop-employability or https://tinyurl.com/yfptsnfw

79   Employability best practice guide 2022, https://learn3.open.ac.uk/course/view.php?id=300840&cmid=165566 (**requires OU staff login**)

80   Centre for Social Justice, https://www.centreforsocialjustice.org.uk

81   The OU Online Journal Club (OJC), Library Services, The Open University, https://www.open.ac.uk/library/training-and-events/the-ou-online-journal-club-ojc

Sharing of project's outcomes such as toolkits, user packs and similar artefacts facilitates the adoption of outcomes by other educators – which can help towards generating impact of a SoTL inquiry. Fi and Karen have developed a 'user pack' (available from their project's webpage on eSTEeM's website) to provide advice and guidance to educators who are interested in running OJCs.

Sometimes the SoTL project team who led the original inquiry can consider setting up another SoTL inquiry to build on the outcomes of the previous inquiry. This could be for enhancing the evidence-base of impact or for applying the intervention (for example, OJCs in this case) to different or novel contexts and assessing the effectiveness of the intervention. Based on the positive outcomes of this SoTL project on OJCs, the project team set up a follow-on SoTL project (New *et al.*, 2021) to investigate the role of journal clubs to develop employability skills and a sense of community amongst students in secure environments and in a face-to-face setting. Feedback from students in prisons indicates that students valued the opportunity to discuss their passions and be part of a community of learners.

To conclude, Fi's and Karen's thoughts on OJCs are:

We would recommend the OJC model as an authentic learning experience, where students can develop digital and information literacy and communication skills as well as employability skills, while enjoying peer-peer interaction and connection with other students as part of the OJC community.

Most importantly, OJC offers scope for learners to develop networks within online communities of practice - an aspect that will likely remain pivotal within the online/blended tertiary education landscape.

6.6 Project resources and references

Project resources

End-of-project report and the toolkit/user-pack for running online journal clubs: Online journal clubs in distance higher education: an opportunity to develop skills and community? Available at: https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/onlineonscreen-stem-practice/online-journal-clubs-distance-higher-education or https://tinyurl.com/bdpptkpr

Video: Fiona Moorman and Karen New - Online journal clubs in distance higher education. Available at: https://www.youtube.com/watch?v=JTMsPKCTANY

Case study: 'Online journal clubs in distance higher education', *in* 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109326&section=2.6

Journal article: New, K., Moorman, F., Fox, K., Church, H. The development and evaluation of an online journal club: perspectives from student participants and practitioners. Submitted to the journal: *Open Learning: The Journal of open and Distance Learning*[82].

References

Collins, T., Berry, E., Davies, S. J. and Kear, K. (2020). *eSTEeM – Ten years of scholarship and innovation. eSTEeM Report*. 10th December 2020. The Open University, Milton Keynes, UK. Available at: https://oro.open.ac.uk/74204/

New, K., Gauci, H. and Moorman, F. (2021). Summer Series of Journal Clubs: an opportunity to develop employability skills and a sense of community amongst students in secure environments. ***End-of-project report*** to eSTEeM, the OU Centre for STEM pedagogy. Available at: https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/supporting-students/summer-series-journal-clubs-opportunity-develop-employability or https://tinyurl.com/yfptsnfw

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82   Open Learning: The Journal of Open, Distance and e-Learning, https://www.tandfonline.com/journals/copl20

7   [J1] The Mathematics and Statistics subject website

Fact box

Title	The Mathematics and Statistics community of learners
Aim of the SoTL inquiry	The aim of this SoTL inquiry was to evaluate the effectiveness of the Mathematics and Statistics (M&S) subject site for students, and for staff who support students studying M&S modules.
Type of inquiry[83]	'Does it work?'
Led by	School of Mathematics and Statistics, Faculty of STEM
Contact	Rachel Hilliam, rachel.hilliam@open.ac.uk
Theme	Supporting student journey
Research methods	telephone and online interviews; asynchronous written interviews
Duration	2019 - 2020
Keywords	employability; online learning communities; participatory design; student support
Webpage	The Mathematics and Statistics community of learners, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/supporting-students/the-mathematics-and-statistics-community-learners or https://tinyurl.com/35kap4vs

7.1   Context and aim of the SoTL inquiry

In 2018, The Open University (OU) created 'subject websites'[84] to complement module websites. Staff, including tutors and in recruitment, support, and careers were consulted in the design of Mathematics and Statistics (M&S) subject website to map the student-lifecycle outlined in Morgan (2012). The participatory design approach was built on the partnership model which had already proved successful in supporting M&S students (Hilliam and Arrowsmith, 2019a).

The aim of the M&S site is to provide resources which students and staff could use for any M&S related query regardless of the qualification the student is studying. The outcomes of some of M&S' SoTL projects are integrated in the design of the site, such as module choice based on diagnostic quizzes **[A1]**[85], early start to a module **[J3]**[86], revise and refresh materials prior to module start, and careers advice.

The generic layout of a subject site has six top-level menus. The design of the sub-menus differs across subject sites. The top-level menus map information/ guidance to student journey (**Figure [J1].1**): **Study home** – current news, social media; **Connect** – M&S advice forums, links to library and external societies;

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83   'Areas of investigation in SoTL', in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109157&section=3.3

84   We have used the term 'subject sites' or 'subject websites' in this case study and in the case study [J2] in this compendium as this is the term that is now being used at the OU. In Rachel's project materials and in the materials of the case study [J2], you may find references to the term 'study sites' or 'study websites'.

85   Reference to the case study [A1] in this compendium.

86   Reference to the case study [J3] in this compendium.

Discover – induction, Are You Ready? (quizzes), discover your module and make a head start; **Skills** – how to learn M&S effectively, and accessibility of M&S modules; **Plan** – pre-requisite knowledge, qualifications, and accreditation; **Succeed** – careers and employability. The community is built around a discussion-forum (Hilliam and Goldrei, 2019), where students and staff contribute.

The aim of this SoTL inquiry was to evaluate the effectiveness of the site for students, and for staff who support students studying M&S modules.
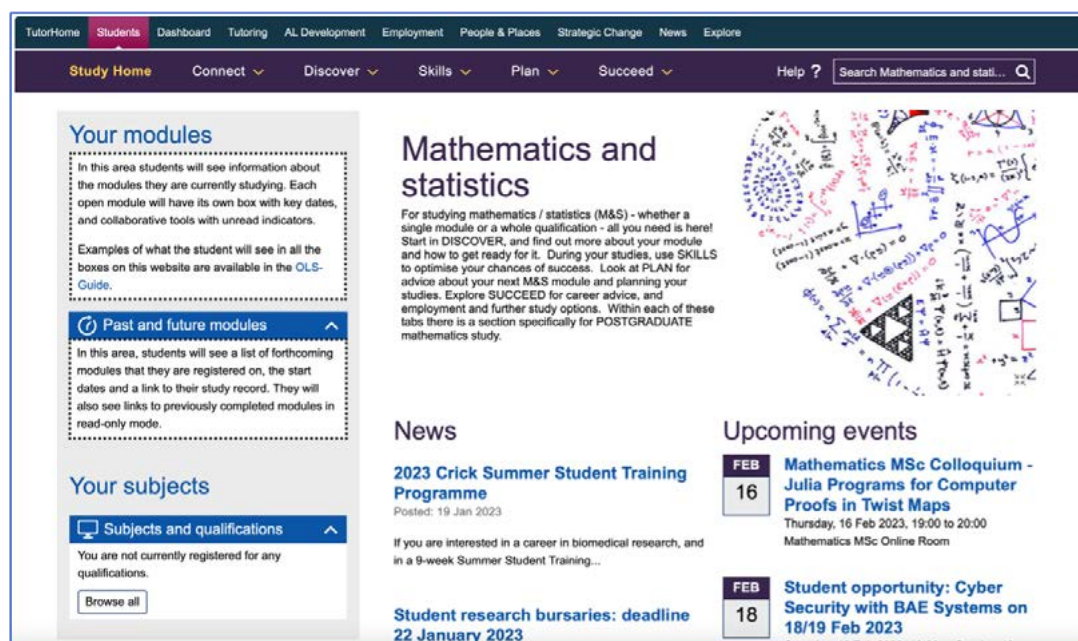

Figure [J1].1 Mathematics and statistics subject website[87]

7.2   Underpinning research of the SoTL inquiry

The subject site is hosted on the OU's virtual learning environment (VLE) which enables the university to monitor the way in which students use the site. Since all students log into the VLE to access the subject site, information such as diagnostic quiz scores (see **[A1]**[88]) can be linked to individual students, and such information can in turn be used by Student Support Team (SST) to inform their conversations with students regarding their readiness to study certain modules.

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87   Mathematics and Statistics subject website, https://learn2.open.ac.uk/course/view.php?id=206217 (**requires OU login**)
88   Reference to the case study [A1] on voluntary diagnostic quizzes in this compendium.

The SoTL inquiry involved evaluating the usage of the M&S site by applying the following research methods:

- Analysing the analytics related to levels of activity on the subject site. However, analytics are only available for students who study one of the qualifications linked to M&S and not for non-M&S qualifications. Analysing the website usage still provides useful information but must be interpreted with the knowledge that the resulting conclusions are based on biased/incomplete information.

- Two questionnaires, one for students and one for support staff, were distributed during June/July and November 2020. The student questionnaire had a wider remit beyond the subject site to solicit feedback on various events that the School of M&S had delivered over the last 6 years. The response rate of the student-questionnaire was 14%. The questionnaire was sent to all M&S tutors and, STEM educational and senior advisors. There were 97 responses: 66 from tutors and 31 from Student Recruitment and Support Centres (SRSC). There were 38 Student Recruitment and Fees (SRF) staff who completed the questionnaire.

7.3   Findings of the SoTL inquiry

The analyses of analytics were for students who were registered on a M&S qualification. Since the website went live on 19th September 2017 there have been 7,500–8,000 students who could use the site and for whom analytics would have been recorded. Roughly half of the students use the site monthly. **Figure [J1].2** shows the number of different students who visit the site each month: this is referred to as the number of unique monthly visits. Each of these individual students may go on to visit the site several times within each month: this is referred as the total monthly visits.

The questionnaire results show that students find all the 'Discover Your Module' resources helpful, both in terms of choosing their next module, making a head start ahead of the module presentation and updating their existing knowledge with the revise and refresh material. Ensuring students are studying a module for which they are well prepared helps with completion, retention, progression, and satisfaction.

The SoTL inquiry found that there was a problem with students initially finding the site. However, once students discover the subject site they use it on a reasonably regularly basis, particularly for help in choosing their next module and for using the resources between module study.

Early feedback gathered in the project fed into the creation of a communication strategy to highlight the subject site to all students studying the M&S modules, which took the form of a series of emails over the summer months. In September 2020 there was a noticeable jump in the number of students using the subject site. Both M&S and non-M&S qualification students found the resources useful. The most popular use of the site is choosing their next module, making a head start, and revising and refreshing their knowledge. However, students found the navigation and wayfinding on the site quite cumbersome.

The advisors in the M&S SST found the site particularly useful and regularly used the resources in their conversations with students. However, most of the SRF staff who work across all faculties, and are the front-line staff, were unaware of the existence of the site. There needs to be induction and staff development for SRF staff regarding subject sites. There is also a lack of awareness of the site amongst the tutors and this needs to be addressed through staff development and in staff appraisal conversations.
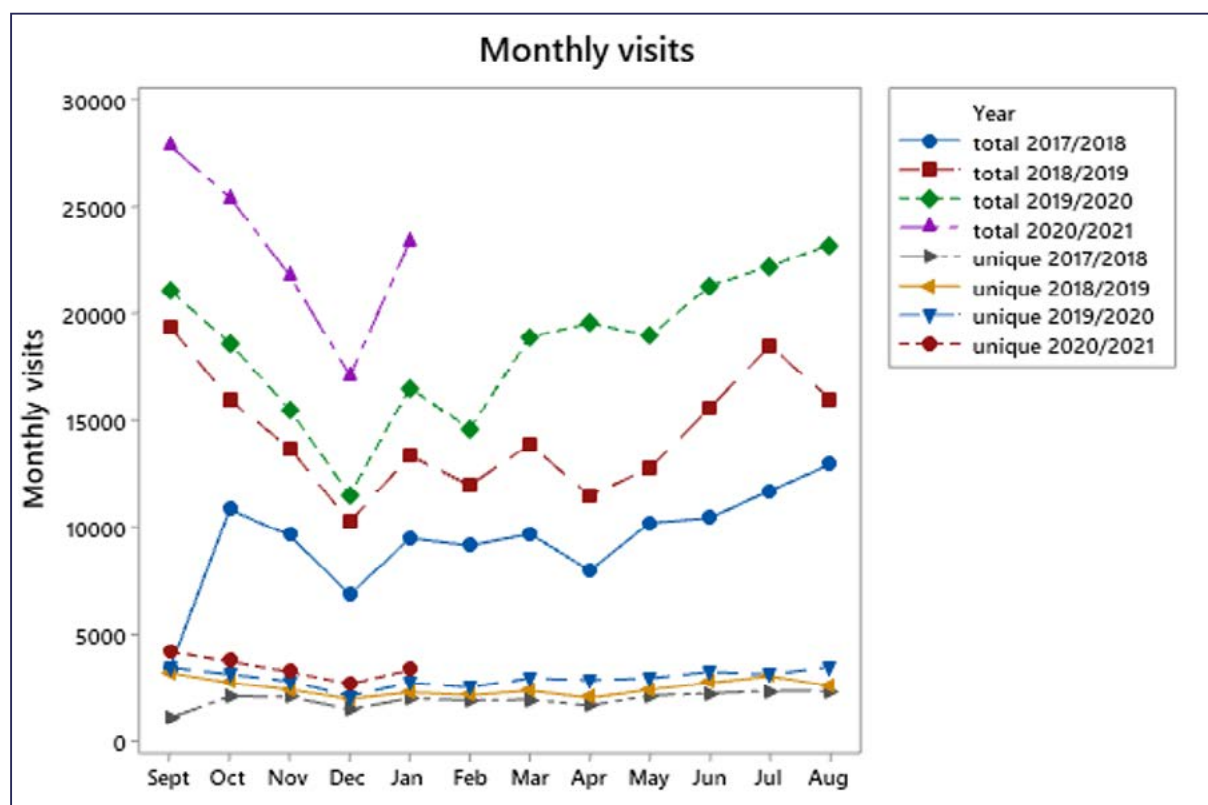

Figure [J1].2 Unique and total number of monthly visits to the M&S subject site from September 2017 and until September 2020

7.4   Key lessons and details of the impact

The key recommendations and the actions taken based on the findings of this SoTL project are:

- Improving the usability of the site by making the menu items meaningful; and improving the wayfinding through a sitemap or A–Z. Following on from this SoTL inquiry, a new functionality of providing a short (online) page-tour has been added to the subject website (see **Figure [J1].3**).

- Informing students about the subject site: in 2019/2020 through a variety of student-communications in print/online including a student newsletter; via social media and in training events. Consequently, there was a large increase in numbers of students using the subject site in September 2020, with 4,176 unique monthly visits and 27,800 total monthly visits.

- Students would like to see short online talks to help with module choice, longer online talks on research and general mathematical interest topics, and careers advice. They expressed preference for face-to face-events for module choice and careers. In 2020 and 2021 online module choice events were delivered and recorded for students.

- Informing tutors about the subject site during induction and in staff development meetings; M&S tutors now receive an email each summer to encourage them to contact their students and highlight the resources on the subject site to them.

- Training SRF staff on the use of subject sites for themselves and for students. Following this SoTL project, a resource was established in the SRF Knowledge Management System (KMS) in 2021 to increase the awareness of subject sites amongst SRF staff. The KMS resource has links to the subject sites embedded within module pages in the KMS (an online repository).

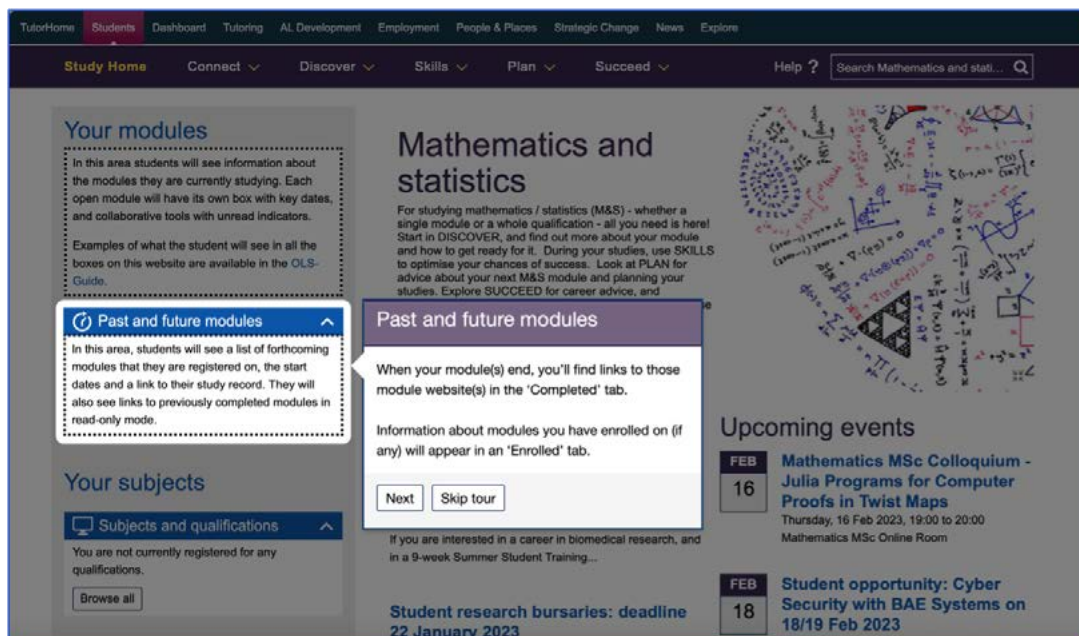- Involving staff and students in a participatory approach to the design of subject sites.

Figure [J1].3 One of the steps within the page tour of the subject website

Based on the facets and attributes of the impact evaluation instrument (**Appendix 1**), the Table below details the impact of this SoTL inquiry.

Impact facet	Attribute	Description
Facet 1: Student experience	Pre-registration Induction Student engagement with course content	This SoTL inquiry has shown that unique and total number of monthly visits by students on the subject site have constantly increased.
		Students can self-assess their readiness for a module by accessing the materials of individual modules and trying the diagnostic quizzes (see **[A1]**[89]) and avoid registration on modules for which they are not prepared.
		Further, access to a subset of individual module materials on the M&S subject site contributes to students' readiness for their study.
		A survey of SST staff has shown that the M&S subject site is not only an invaluable source of information for them when advising students, but also a place where they point students towards for students to self-serve. The support from SST staff enhances student experience. Typical feedback comments from SST staff include:
		I find the 'discover your module' pages and 'Are you ready for …Quiz' pages incredibly useful and will always send links through to students if they want to decide whether to take a particular module or explore the modules open to them.
		…What is provided really does assist us in doing our job and, I feel massively helps students with prep, course choice and accessing help when needed.
		The subject site is a very useful resource with information specifically about M&S modules and qualifications, collected in one place. It does much better than many OU websites in having everything (for M&S students) all together in one place, without having to scroll through reams of generic information first.
		From these comments the fact that the M&S subject site is so embedded into the advice given by the SST, it will have improved both pre-registration, induction, student early engagement with course content and career progression.

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89   Reference to the case study [A1] on voluntary diagnostic quizzes in this compendium.

Impact facet	Attribute	Description
Facet 2: Student retention and progression	Student retention rate Student progression	It is difficult to measure directly as many students take M&S modules, not necessarily as part of any of the M&S qualifications. Based on qualitative feedback such as those from students which comment on having information to help with module choice and the ability to get a head start on modules over the summer[90] (due to availability of early material) suggest that planning a pathway through qualifications and retention on modules is increased. It would be safe to assume that a greater readiness for study and preventing registrations on modules that students are not prepared for through the resources on the site help towards student retention and progression.
Facet 3: Evidence-based excellence in teaching	Data for assessments (e.g. UK's TEF[91]) Inform policy development internally at the level of the sub-unit, faculty, or University	The subject site was highlighted in the 2018 subject level pilot TEF which received a Gold rating. Through evaluation of M&S subject site in STEM, this SoTL inquiry has provided evidence that improved design and visibility of subject sites can help generate a community of learners, enhance student engagement with subject-wide resources (beyond what individual module sites provide), yield improvements in student retention, and influence employability. Through evaluations, the inquiry has raised awareness of good practice in the design of subject sites (see, case study **[J2]**[92]). One area of the subject site links to professional societies, one of these being the Royal Statistical Society (RSS) and outlines how students can gain accreditation of the RSS (and indeed of the IMA, Institute of Mathematics & its Applications[93]). The RSS has introduced a new professional award of Data Analyst[94], which was publicised on the M&S subject site. There were several current OU students who were amongst the first to gain the professional award of Data Analyst from RSS.

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90 See case study [J3] in this compendium which relates to 'early start' on a module.
91 About the TEF, Teaching Excellence Framework, https://www.officeforstudents.org.uk/advice-and-guidance/teaching/about-the-tef/
92 Reference to the case study [J2] in this compendium.
93 Institute of mathematics & its applications, https://ima.org.uk/
94 Royal Statistical Society (RSS), Data Analyst, https://www.rss.org.uk/membership/professional-development/data-analyst/

Impact facet	Attribute	Description
Facet 4: Influence on discipline-based teaching, research and practice	Change in the ways in which subject concepts are taught	The subject site provides specialised skills for M&S – for example, through the Skills section on the site (**Figure [J1].4**). The content such as related to 'studying mathematics and statistics effectively', problem solving, writing mathematics and statistics; and software used in M&S modules facilitate self-directed learning by students in their own time. As a result of this SoTL inquiry, all M&S modules now contribute to the 'Discover Your Module' area of the subject site which involves including ways to help students engage before module start. In 2020-2021, each sub-discipline provided 'choose your Level 3' online evenings in which they have highlighted the resources on the subject site.
Facet 5: Dissemination of project's outcomes	Number of publications from the project/initiative	The team has presented in internal and national events and published both internally (e.g. OU's internal quality enhancement report), blogpost for Advance HE website[95] and in journals.
Facet 6: Adoption of the outcomes of the project by other educators or stakeholders	Adoption of the outcomes internally within the institution	Other Schools in STEM, in particular School of Computing and Communications are using the M&S subject site as a template for updating and enhancing their School's subject site. Also see the case study **[J2]**. The outcomes of the project have led to the development of a page on subject sites in the Knowledge Management System (KMS). The KMS is used by student advisors across the university to provide information to students. Prior to this SoTL project, none of the advisors were aware of subject sites. Rachel (project lead) has reported that work to increase Associate Lecturer (AL)/tutor knowledge of subject sites is ongoing, as are other issues around routing of students to subject sites and greater visibility of subject sites.
Facet 7: Mutual stakeholder understanding	Understanding among stakeholders about requirements	The project team consisted of Rachel, an AL/tutor, a student, a member of curriculum staff and a member of the SST. The collaborative and participatory design approach has led to understanding of requirements of staff such as tutors, SST, SRF, SRSC and in careers, and the challenges they face in supporting student's journey. Further, the project has shown that a greater awareness of the subject site is required for tutors, students and SRF staff.

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95 Hilliam, R. (2020). The online student experience: more than learning online, https://www.advance-he.ac.uk/news-and-views/online-student-experience-more-learning-online

Impact facet	Attribute	Description
Facet 8: Personal and professional development of project team and associated stakeholders	Improved practice or personal knowledge	The design of the subject site and the subsequent evaluation of the site via this SoTL inquiry has uncovered the extensive use of the subject site by educational and senior advisory staff in the SRSC. The SRSC staff use the site both to enhance their own knowledge about the curriculum but also when they are having conversations with students. Making sure students are on the correct module and having this wrap-around support is helpful not just in terms of retention, but also in strengthening the link between the SST team and the School. The publications from this SoTL inquiry have a range of co-authors many of whom had no previous experience of academic writing. The collaborative SoTL experience and dissemination has led to the skills development of the SoTL team members.
Facet 9: Recognition of the project team members and associated stakeholders	Fellowship of HEA or membership/fellowship of any other body in your discipline Invited speaker to events/conferences internally and externally Public recognition through publications, conference presentations	Rachel's SoTL projects including this inquiry were included in her case for PFHEA[96]. Rachel's SoTL practice has led to her become a founding member of the Royal Statistics Society's Teaching Statistics Special Interest Group[97]. Rachel's SoTL practice has led to invitations to chair discussion panels at external workshops. She has published about this inquiry extensively (listed at the end of this case study).
Facet 10: Fostering SoTL culture	Increased involvement of stakeholders in SoTL	Rachel reports: *…disseminating findings from this project, so that colleagues understand that SoTL can encompass a range of different projects.* She goes on to say: *The [M&S] School now sees scholarship as a natural part of their work. The range of different SoTL projects is testament to the fact that colleagues now think about how to evaluate changes and initiatives around both teaching and the student experience.* This project has paved the way for the conversations around how students can engage as part of the project team in SoTL (and SRSC/SST staff).

96 Principal Fellowship, Advance HE, https://www.advance-he.ac.uk/fellowship/principal-fellowship

97 Royal Statistics Society (RSS), The Teaching Statistics special interest group (SIG), https://www.rss.org.uk/membership/rss-groups-and-committees/special-interest-groups/teaching-statistics/

| Impact facet	Attribute	Description
Facet 11: Financial implications	Effect on costs	Although not measured, the resources on the site help students to register on the module which is the correct one for them which hopefully reduces de-registration.
Facet 12: Funding opportunities	Funding for follow-on/new projects based on SoTL project's success	Rachel has continued to grow her SoTL practice[98] with support from eSTEeM, the OU Centre for STEM pedagogy.
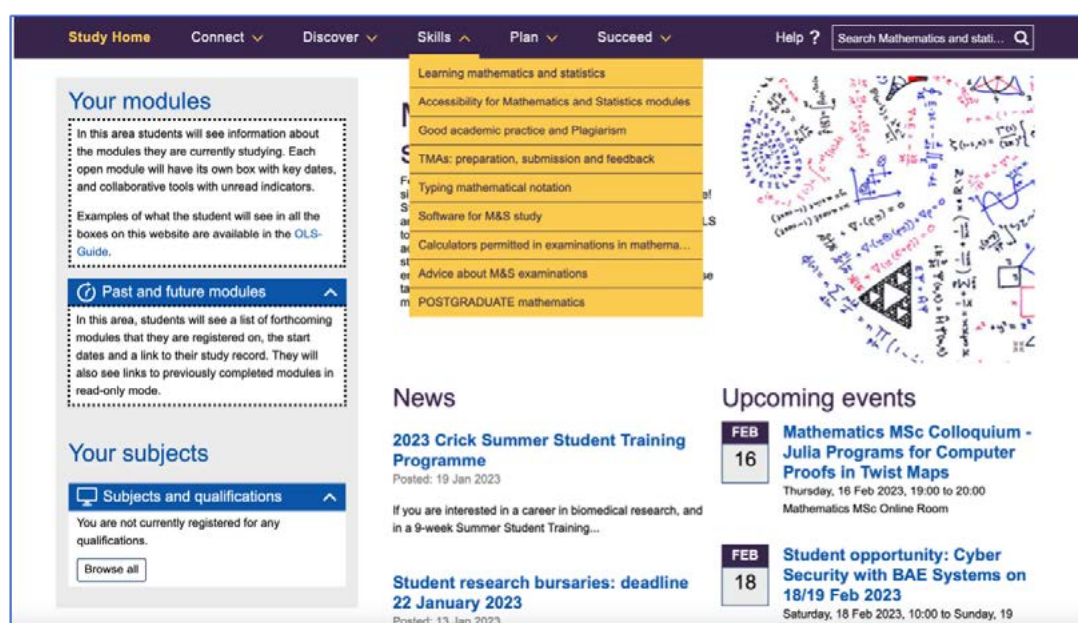
Figure [J1].4 Skills menu on the M&S subject website

7.5 Reflections on SoTL practice

The SoTL project team involved a participatory design approach for the design of the website involving stakeholders who are in direct interaction with students at various touchpoints, including tutors, SST, SRSC and careers staff, building on the partnership model, which had already proved so successful in supporting M&S students (Hilliam and Goldrei, 2019). This partnership way of working ensured the themes in Morgan's model were incorporated in the design of the subject site (Morgan, 2012).

It is important to design and evaluate subject sites in partnership with stakeholders who are involved in supporting student journey. As a result, the content of the site not only helps students but provides useful information for the student support staff. One of the main successes of the M&S subject site is the way SST staff (not just in M&S) constantly use the site for their own information and point students towards the resources.

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98   Rachel's profile on eSTEeM's website that lists her SoTL projects, https://www.open.ac.uk/scholarship-and-innovation/esteem/people/rachel-hilliam

A collaborative SoTL inquiry can ensure that needs of different stakeholders are met in the design, implementation, and evaluation of the SoTL project. The outcomes of the SoTL inquiry were disseminated in internal and external events, in a blogpost, internal university-wide quality enhancement report (Hilliam and Arrowsmith, 2019b) and in journals including an open access journal (Hilliam and Arrowsmith, 2019a) for wider dissemination in the external community. Sharing the outcomes of SoTL facilitate peer review and uptake of the outcomes in other contexts, and most importantly foster SoTL culture.

To conclude, Rachel's advice on dissemination of SoTL for impact…

Impact does not happen from writing one report and giving a few presentations. These have to be followed up with people who express interest in your work. This takes time and ongoing energy. My advice is if you truly believe in your work then be prepared to be in this for the long haul. Always look for opportunities to engage people throughout the university in the findings. It is helpful to have a 2-page version of the report, ideally one page of results and one page of recommendations.

… and on subject sites in other institutions

Providing relevant subject based information for students from enrolment to graduation is difficult in all institutions. The subject site shows one way in which this can be done. Having something like the subject site (online) is useful for all institutions where students don't always engage with f2f 'outside classroom' support. I was invited to write a blogpost for Advance HE after the presentation on this topic at the HE STEM conference (Hilliam, 2020).

Whilst a blogpost in Jan 2020 on this topic didn't seem particularly relevant, in March 2020 when Covid-19 struck and universities were moving their teaching online, highlighting the need for an online student experience suddenly was of utmost importance.

I wrote the following blogpost in response:

Hilliam, R. (2020) The online student experience: more than learning online, Advance HE, Available at https://www.advance-he.ac.uk/news-and-views/online-student-experience-more-learning-online and https://s3.eu-west-2.amazonaws.com/assets.creode.advancehe-document-manager/documents/advance-he/6.5b%20-%20Hilliam_1580724721.pdf or https://tinyurl.com/ymt2rjbr, 25 March.

7.6   Project resources and references

Project resources

End-of-project report: The Mathematics and Statistics Community of Learners. Available at: https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/supporting-students/the-mathematics-and-statistics-community-learners or https://tinyurl.com/35kap4vs

Case study: 'The Mathematics and Statistics community of learners', *in* 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109325&section=4

Hilliam, R., Goldrei, D., Arrowsmith, G., Siddons, A. and Brown, C. (2021). Mathematics and statistics distance learning: more than just online learning, *Teaching Mathematics and Its Applications: An International Journal of the IMA*. Available at: https://academic.oup.com/teamat/advance-article/doi/10.1093/teamat/hrab012/6364484?guestAccessKey=da3edf21-59b2-4e46-aa85-bbb0afcdeed7 or https://tinyurl.com/kwpc77xu

Hilliam, R. and Arrowsmith, G. (2019a). Enhancing the student experience with the use of a dedicated subject website, *MSOR Connections*, vol. 17, no. 2. Available at: https://journals.gre.ac.uk/index.php/msor/article/view/947

Hilliam, R. and Arrowsmith, G. (2019b). Behind Closed Doors: Using a dedicated subject site to create a community of learners in mathematics and statistics. Quality Enhancement Report Series no. 29. Available at: https://sway.office.com/KfprXQHrAH78OZ1L?ref=Link&loc=play or https://tinyurl.com/rtkmxumw (requires OU staff login)

Hilliam, R. and Goldrei, D. (2019). Creating an online mathematics and statistics community of learners, *New Directions in the Teaching of Physical Sciences*, no. 14. Available at: https://journals.le.ac.uk/ojs1/index.php/new-directions/article/view/2824

Presentations at external events

Hilliam, R. (2022). Supporting mathematics and statistics students: is it all about the teaching?; Invited talk at Royal Statistical Society, https://rss.org.uk/training-events/events/events-2022/sections/supporting-mathematics-and-statistics-students-is/ - fulleventinfo

Hilliam, R., Arrowsmith, G., Siddons, A., Goldrei, D. and Brown, C. (2020). Supporting mathematics and statistics students at a distance from beginning to end, *Horizons in STEM Higher Education Conference (2020)*, The Open University.

Hilliam, R. (2020). Providing skills through an online Mathematics and Statistics learning community' *Advance HE STEM conference (2020)*, Manchester (contributed talk, speaker), Available at https://www.advance-he.ac.uk/knowledge-hub/stem2020-providing-skills-through-online-mathematics-and-statistics-learning and the file from https://s3.eu-west-2.amazonaws.com/assets.creode.advancehe-document-manager/documents/advance-he/6.5b%20-%20Hilliam_1580724721.pdf or https://tinyurl.com/ymt2rjbr

Hilliam, R., Arrowsmith, G. Brown, C., Goldrei, D. and Siddons, A. (2019). Creating an online mathematics and statistics learning community. *Royal Statistical Society Conference*, (2019), Belfast.

Hilliam, R. and Arrowsmith, G. (2018). Using a dedicated subject website to create a mathematics and statistics community of learners, *Horizons in STEM Higher Education Conference: Making Connections and Sharing Pedagogy*, (2018), University of Hull.

Hilliam, R. and Arrowsmith, G. (2018). Creating an online mathematics and statistics community of learners, *CETL-MSOR: Evidencing Excellence in the Mathematical Sciences*, University of Glasgow.

Presentations at internal events

Holden, G. and Hilliam, R. (2021). Supporting students through their study journey: the use of qualification wide subject websites, *10th eSTEeM Annual Conference,* The Open University. Available at: https://www.open.ac.uk/scholarship-and-innovation/esteem/events/10th-esteem-annual-conference-stem-scholarship-changing-world---disruption-innovation-and or https://tinyurl.com/3mja5ns8

Hilliam, R., Arrowsmith, G., Siddons, A., Goldrei, D. and Brown, C. (2021). How do students and staff use the Mathematics and Statistics study site? *The 2nd Annual STEM Teaching Conference* (2021), The Open University. Recording available at: https://stem.open.ac.uk/stem-teaching-2021

Hilliam, R., Arrowsmith, G., Brown, C., Goldrei, D. and Siddons, A. (2020). The Mathematics & Statistics study site: Facts, figures and further plans, *9th eSTEeM Annual Conference*, The Open University. Available at: https://www.open.ac.uk/scholarship-and-innovation/esteem/events/9th-esteem-annual-conference-informing-student-success---scholarship-practice or https://tinyurl.com/nhkrxzh8

Hilliam, R. and Arrowsmith, G. (2020). Building a study site community', The Open University, *The 1st STEM Annual Teaching conference: Celebrating our success*.

Hilliam, R. and Arrowsmith, G. (2018). Using a dedicated subject website in the continuing evolution of the mathematics and statistics community of learners. *7th eSTEeM Annual Conference*, The Open University. Conference booklet available at: https://www.open.ac.uk/scholarship-and-innovation/esteem/sites/www.open.ac.uk.scholarship-and-innovation.esteem/files/resources/eSTEeM_2018_conf_booklet_FINAL_0.pdf or https://tinyurl.com/43k9u6b9

References

Morgan, M. (2012). *Improving the Student Experience: A practical guide of universities and colleges.* Abingdon: Routledge.

8   [J2] Qualification subject websites in STEM

Fact box

Title	Qualification subject websites: uptake and practice
Aim of the SoTL inquiry	The aim of this SoTL inquiry was to investigate how the undergraduate subject websites in STEM were being used and how they were being perceived by students.
Type of inquiry[99]	'What works?'
Led by	School of Design and Innovation, Faculty of STEM
Contact	Georgina (Georgy) Holden, georgina.holden@open.ac.uk
Theme	Supporting student journey
Research methods	usage analytics; analysis of forums usage; student survey; analysis of good practice and related reports and papers
Duration	2019 – 2021
Keywords	employability; online learning communities; student support
Webpage	Qualification study websites: uptake and practice, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/supporting-students/qualification-study-websites-uptake-and-practice or https://tinyurl.com/5ff2ewee

8.1   Context and aim of the SoTL inquiry

In 2018, The Open University (OU) created subject sites[100] to complement the module sites that students are familiar with. The new sites were welcomed by many in the OU who considered this as an opportunity to gather information including career planning that is useful throughout the student journey. Importantly, the sites offered the possibility for creating spaces for engagement which might support student retention and progression through the development of communities of learning and practice (Wenger 1998).

Whilst each of the subject sites[101] has the same top-level menu structure (Study Home, Connect, Discover, Skills, Plan, Succeed; **Figure [J2].1**), each of the menus leads to a set of pages which are unique to the subject. The subject sites also pull in related OpenLearn[102] content (free short courses and other resources from the OU), and include feeds from social media (for example, Twitter, Facebook). The home page of each site pulls in information from the student's record allowing access to their current and past modules and showing any future module registrations. The site thus can become a hub for students throughout their studies. The aim of this SoTL inquiry was to investigate the efficacy of the subject sites across the Faculty of STEM.

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99 'Areas of investigation in SoTL', in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109157&section=3.3 or https://tinyurl.com/29t7z2my
100 We have used the term 'subject sites' or 'subject websites' in this case study and in the case study [J1] in this compendium as this is the term that is now being used at the OU. In Georgy's project materials and in the materials of the case study [J1], you may find references to the term 'study sites' or 'study websites'.
101 Qualification subject sites in STEM, https://learn2.open.ac.uk/blocks/subjectlist/ (requires OU login)
102 OpenLearn, Free online learning from The Open University, https://www.open.edu/openlearn/

The impetus for this work was project lead's own experience of a subject website which, despite a large amount of effort having been put into content-generation, did not, as gauged by student engagement with forums, appear to be reaching the audience for whom it was designed.
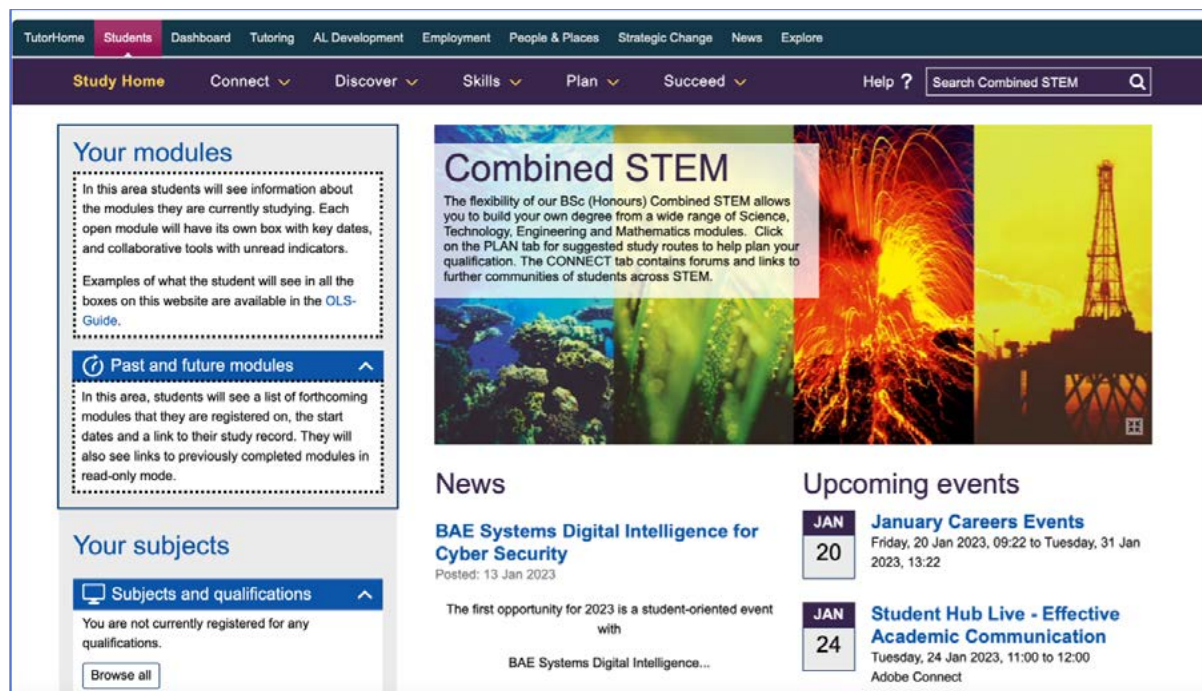

Figure [J2].1 Common menu structure of the 'subject' websites

8.2   Underpinning research of the SoTL inquiry

The SoTL inquiry involved evaluating students' use of the subject sites by applying the following research methods:

- *Analysing the analytics related to levels of activity on the subject sites*: Data was obtained on the number of views for each subject site for every week between August 2018 and August 2019. The data showed the overall number of unique visits to the site.

- *An analysis of forums on subject sites to gauge levels of activity*: This involved looking at the number of threads and posts in two academic years running from September to the end of August. The number of forums, threads and posts was counted to gain an understanding of the activity in forums for each site. Instances of forums, threads and posts were all manually counted as access to data analytics proved difficult.

- *A survey to gather students' perceptions of subject sites*: Six hundred students from across the STEM faculty were invited to complete the survey. The response rate was low, with only 4.5% (27 individuals) completing the survey.

- *Analysis of good practice and related reports and papers:* One of the best examples of the use of the subject site for student support is that of Mathematics and Statistics, efficacy of which was investigated in a SoTL project: The Mathematics and Statistics Community of Learners[103] and the results are reported in publications (Hilliam and Arrowsmith, 2019a; Hilliam and Arrowsmith, 2019b; Hilliam and Goldrei, 2019). Outside of STEM, another example of good practice that was analysed was the Psychology and Counselling subject site.

8.3   Findings of the SoTL inquiry

Each of the research activities in this inquiry contributed to a picture of the usage of STEM subject sites. The analytics and analysis of forum use supported the view, gained from the student survey, that there is the potential to increase student use of sites for all subjects, but at present many students are either unaware of the sites or use them too infrequently to remember how to access them when they may be useful.

One of the recommendations of this inquiry is to consider using the subject site as the student's landing page instead of StudentHome (which is the portal that the student logs in to the university pages), in other words to reconceptualise the subject site as the spine of the study journey. In addition, in recognition that many students focus only on their module sites, it is important to include signposts and direct links to subject sites from individual module sites. On the subject site, the provision of module information which is of immediate value to the student, alongside links and access to past modules, makes the subject site an attractive starting point.

One issue of particular concern is that students who have not yet committed to a qualification pathway do not have access to the subject sites, even though this group of students could benefit enormously from being able to gain greater insights into subjects and where they might lead. A recommendation is that either students should be able to opt for access to a subject site when they first sign up to the OU, or they should be automatically allocated to one related to their first module, with the option to change sites if automatic allocation does not reflect their interests.

The sites are used by all subject teams to provide qualifications and subject information, particularly around module planning and careers. However, the Mathematics and Statistics and the Psychology and Counselling subject sites demonstrate the potential for subject sites to be relevant throughout the student journey and to go beyond being repositories of information to be points of contact, information, guidance, and advice for all. The Succeed section on the Mathematics and Statistics site is the most detailed amongst the subject sites in STEM for enhancing student employability (**Figure [J2].2**).

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103 The Mathematics and Statistics Community of Learners, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/supporting-students/the-mathematics-and-statistics-community-learners or https://tinyurl.com/35kap4vs This SoTL project is reported as a case study [J1] in this compendium.

Considering the current content of the subject sites, this inquiry found that there were no obvious reasons why most of the information should not be publicly available. Hence, one of the recommendations of this inquiry is to make subject sites available to students, or potential students, as early as possible - by reviewing permissions across the site.
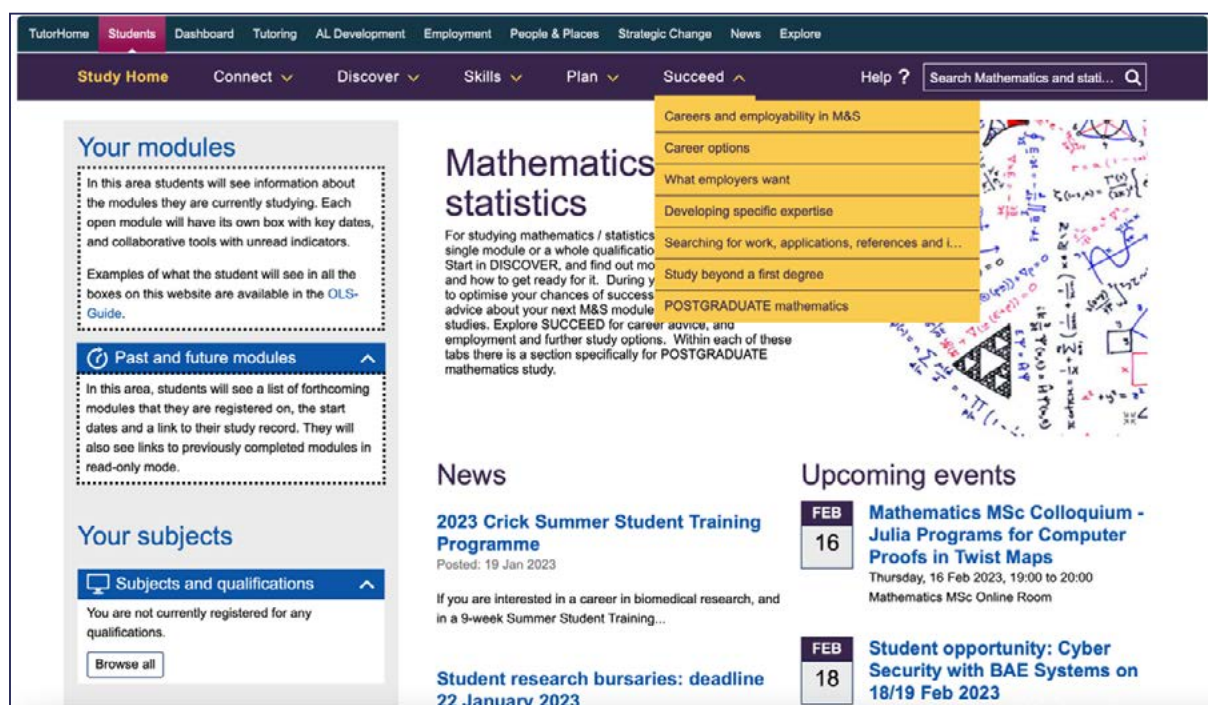

Figure [J2].2 The 'Succeed' menu on Mathematics and Statistics 'subject' website

8.4   Key lessons and details of the impact

The combination of complementary quantitative and qualitative methods in a mixed methods research approach has enabled capturing multiple perspectives from analytics, analysing good practice, and perceptions of different stakeholder groups. The inquiry has shown that the subject sites have the potential to improve retention and to prepare students for employment throughout their studies. The recommendations from the inquiry are increased visibility/awareness of the sites and universal access to all students irrespective of their registration on a single module or on a qualification.

Based on the facets and attributes of the impact evaluation instrument (**Appendix 1**), the Table below details the impact of this SoTL inquiry.

Impact facet	Attribute	Description
Facet 3: Evidence-based excellence in teaching	Inform policy development internally at the level of the sub-unit, faculty or University	Through evaluation of subject sites in STEM, the inquiry has provided evidence to support the recommendations of the inquiry. These recommendations include improved design and visibility of subject sites in STEM for student retention, for employability, and for student engagement with resources on subject sites. This inquiry built on, validated and reinforced the results of another SoTL inquiry **[J1]**[104] which investigated the effectiveness of the Mathematics and Statistics (M&S) subject site in student support. This inquiry has, thereby, facilitated the uptake of the recommendations of both the inquiries (**[J1]** and **[J2]**) for improvement of the design of subject sites and for integrating subject sites within student's journey. Through evaluations, the inquiry has raised awareness of good practice of subject sites, Mathematics and Statistics, and Psychology and Counselling, enabling replication of design in subject sites across the OU.

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104 Reference to the case study [J1] in this compendium.

Impact facet	Attribute	Description
Facet 5: Dissemination of project's outcomes	Number of publications/ presentations from the project/ initiative	Georgy (project lead of this SoTL project) and Rachel of case study **[J1]** (who carried out an inquiry related to the design and effectiveness of Mathematics and Statistics (M&S) subject site) disseminated their findings together. Collaboration on a common cause – in this case, the design and effectiveness of qualification or subject sites – may help to trigger change sooner than from an individual working alone to effect change. Georgy says: *I have joined forces with Rachel Hilliam who has a complementary project focused on the Maths and Stats subject site. Together we have disseminated our reports and talked to various managers within the university who have an interest in subject sites and may be able to effect changes in the future.* *We also conducted a joint workshop on the topic at the eSTEeM conference[105]. Because of the systemic nature of the issues no immediate impact has yet happened but we hope that this will inform future developments. The workshop we ran disseminated good practice and widened the conversation around issues, which again we hope to be carried forward into practice and developments.*
Facet 7: Enhanced mutual stakeholder-understanding	Understanding among students, tutors, learning designers, IT support; for example, their skills, challenges, requirements	Georgy has reported that this inquiry has led to dialogues with colleagues in IT, learning design, Student Experience, Student voice, Associate Lecturers (ALs) or tutors, students, academics, and academic support staff. *This has enhanced understanding of the issues and the potential of study/ subject sites and will, hopefully, lead to greater interest and investment in developing these sites as the 'glue' that holds qualifications and subjects together during the student's learning journey.*

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105 The 10th eSTEeM Annual Conference, The Open University, 2021, https://www.open.ac.uk/scholarship-and-innovation/esteem/events/10th-esteem-annual-conference-stem-scholarship-changing-world---disruption-innovation-and or https://tinyurl.com/3mja5ns8

Impact facet	Attribute	Description
Facet 8: Personal and professional development of project team and associated stakeholders	Collaborative or team-working skills Continuity in SoTL activity by individual educators Improved practice or personal knowledge	Georgy, the project lead, mentions that through this inquiry, she has recognised the significance of the following attributes of SoTL: participatory and user-centred approach in SoTL; collaborative SoTL; and working across disciplines and with a wide variety of stakeholders to encourage change. Georgy says: *As a part of the project I talked to a few academics across the university about their best practice in relation to subject sites.* *This led to me, on completion of the project, joining forces with Rachel Hilliam who had completed an eSTEeM project [J1] around the development of the Maths and Stats subject site, so that we could, together, present our work both at the eSTEeM conference and to managers in different roles across the university who have an interest or investment in this interface with students.* *I welcome what I have learnt from Rachel and think the idea of working across disciplines but with common objectives is something that I would like to pursue further.*

8.5   Reflections on SoTL practice

In this case study, Georgy examined subject sites in STEM and highlighted the good design practice of the Mathematics and Statistics (M&S) site as a model for others to follow for the design of subject sites. This SoTL inquiry was built on the results of a previous SoTL project which investigated the effectiveness of M&S subject site **[J1]**.

It can be often useful in SoTL practice to build on and extend previous SoTL projects to arrive at outcomes that provide further evidence for the focal area of investigation, or to highlight the limitations of the previous SoTL investigation. Such follow-on investigations strengthen the SoTL knowledgebase which the educators can refer to for improving their academic practice.

Further, in her reflections, Georgy has highlighted the significance of collaborative SoTL: how different project teams and stakeholders with a common aim across disciplines can come together to disseminate the outcomes and make a stronger case for change or for enhancing stakeholder understanding.

Georgy reflects on the time and patience it can take to make a change and to generate impact:

It is difficult to gauge exactly how much influence has been wielded but the meetings so far have met responsive audiences. When seeking to bring about systemic change, as we are doing, rather than, for example, an innovation in a specified area of teaching, it is inevitable that the time scales will be longer and impact less immediate. However, reflection on the systemic bigger picture is critical to improving the student and staff experience and ensuring that efforts are well placed and fruitful.

To conclude, Georgy's thoughts on the SoTL inquiry are:

In order to understand the effectiveness of systems and initiatives, evaluation is really important. Sometimes, as in the case of the study/subject site project, it is really helpful to step back and look at broader comparisons, across a faculty, or even across the university, to gain perspective on the topic and to identify practice that works, and practice that is less effective.

The provision of study/subject sites is, in many senses, peculiar to the OU because other institutions already organise their information on a programme basis. Nevertheless, the project findings about the value students place on active engagement and information finding and their attitudes towards community and subject identity, could provide insights for the wider academic community.

8.6 Project resources and references

Project resources

End-of-project report: Qualification Study websites: uptake and practice. Available at: https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/supporting-students/qualification-study-websites-uptake-and-practice or https://tinyurl.com/5ff2ewee

Project poster: Qualification Study websites: uptake and practice, Available at: https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/supporting-students/qualification-study-websites-uptake-and-practice or https://tinyurl.com/5ff2ewee

Holden, G. and Hilliam, R. (2021). Supporting students through their study journey: the use of qualification wide subject websites, *10th eSTEeM Annual Conference*, The Open University. Available at: https://www.open.ac.uk/scholarship-and-innovation/esteem/events/10th-esteem-annual-conference-stem-scholarship-changing-world---disruption-innovation-and or https://tinyurl.com/3mja5ns8

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Wenger, E. 1998. *Communities of Practice: Learning, Meaning, and Identity*. Cambridge: Cambridge University Press.

Hilliam, R. and Arrowsmith, G. (2019a). Enhancing the student experience with the use of a dedicated subject website, *MSOR Connections*, vol. 17, no. 2. Available at: https://journals.gre.ac.uk/index.php/msor/article/view/947

Hilliam, R. and Arrowsmith, G. (2019b). Behind Closed Doors: Using a dedicated subject site to create a community of learners in mathematics and statistics. *Quality Enhancement Report Series no. 29*. Available at: https://sway.office.com/KfprXQHrAH78OZ1L?ref=Link&loc=play (requires OU staff login)

Hilliam, R. and Goldrei, D. (2019). Creating an online mathematics and statistics community of learners, *New Directions in the Teaching of Physical Sciences*, no. 14. Available at: https://journals.le.ac.uk/ojs1/index.php/new-directions/article/view/2824

9   [J3] A flexible start to a module

Fact box

Title	A flexible start to the 'Introducing Statistics' module
Aim of the SoTL inquiry	The aim of this SoTL inquiry was to investigate whether the early start to a Level 1 module of Statistics will contribute towards student retention and student progression.
Type of inquiry[106]	'Does it work?'
Led by	School of Mathematics and Statistics, Faculty of STEM
Contact	Carol Calvert, carol.calvert@open.ac.uk
Theme	Supporting student journey
Research methods	online questionnaires embedded within the study website; analytics; post-experience survey
Duration	2017 – 2018
Keywords	student progression; student retention; student success; supporting students
Webpage	A Flexible Start to M140, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/supporting-students/flexible-start-m140 or https://tinyurl.com/bdcrv658

9.1   Context and aim of the SoTL inquiry

Students who register early like to take advantage of a facility to start their study on a flexible basis. Students have expressed views that it is "good" to get ahead with study if possible. This pilot SoTL project gave students an opportunity to start their study on an introductory statistics module *Introducing Statistics* (M140)[107] on a rolling basis, at a time of their choosing and up to three months in advance of the usual module start (in October). This approach to an 'early start' is different to that of the 'revise and refresh' options in The Open University's (OU) Faculty of STEM because the early start on M140 was tutor-supported, had a flexible start, and used actual module materials.

Around 400 students were offered the opportunity of a flexible early start and just over 200 responded by email to say that they would like to take up this offer. Students who registered early, compared to those who did not, tended to already have some OU credits. The sub-group of students who registered early and took part in the programme were even more likely to already have some OU credits. It might be argued that such students were already aware of the high October workload, and they seemed keen to manage it by using time over the summer for their preparations. A special website for the programme was built with a subset of the actual module materials.

The aim of this SoTL inquiry was to investigate whether the early start contributes towards student retention and progression.

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106 'Areas of investigation in SoTL', in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109157&section=3.3

107 M140 Introducing Statistics, https://www.open.ac.uk/courses/modules/m140

9.2   Underpinning research of the SoTL inquiry

Ahead of conducting this SoTL inquiry, an analysis of M140's 2016 data was undertaken to understand the potential demand for an early start on M140 and to help shape the content. Tailoring of contents and processes, to help improve retention and achievement, was also informed by insights from cohorts prior to 2016. This analysis was essential to provide evidence about an issue of drop-out between registration and module start.

Early in the programme, an online questionnaire within the website enabled student views on the programme to be requested, and again just before the programme ended. A separate survey, six months into the main module, enabled student views "with hindsight" to be collected. Responses were overwhelmingly positive from students, and many attended online tutorials, contributed to forums, loaded and used module software, and studied with Associate Lecturer (AL)/tutor support.

The number of students at the 25% fee point is usually taken as the base for calculation of pass rates. The pass rate for M140 using this definition was 73.2% for 2016 and 73.4% in 2017. However, in 2017 there was an improvement in retention in the period between student-registration and the 25% fee point. The increase of 4.1% was largely maintained throughout the module with an additional 40 students passing M140 out of the just over a thousand initially registered. The increased retention occurred so early in the module that the only new initiative operating was the early start programme. The increase in retention is therefore highly likely to be directly attributable to the programme.

9.3   Findings of the SoTL inquiry

Student responses to the questionnaire showed that they valued tutor-support and the tutorials, and yet the uptake of tutor-support seemed low. This may simply be that it was important for the student to know the AL/tutor was there if needed, but that the materials were well within the understanding of most of the students. Neither students nor ALs/tutors feel that there are strong benefits for most students of having the same tutor on the early start programme as they do on the main presentation.

An important consideration was equality of access to the pilot. The pilot was designed to be open to all students registered before a certain date, regardless of the student's geographical location. However, by online delivery, it was not possible for some groups of students to participate such as some disabled students, and students in secure environments (SiSE). This limitation would need to be addressed for flexible start programmes.

The costs involved were for the programme manager's time to set up website, for the project lead to develop and administer the programme, and AL/tutor-appointments. The administrative efforts have reduced since the site was first set up. The continuing costs are, however, offset against a potential retention of students, for example, an additional 30 students in 2018. Thus, the early start programme represents a cost-effective way of increasing retention.

The 'Early Start on M140' programme is now embedded within the subject website/portal of Mathematics and Statistics (**Figures [J3].1a** and **[J3].1b**).
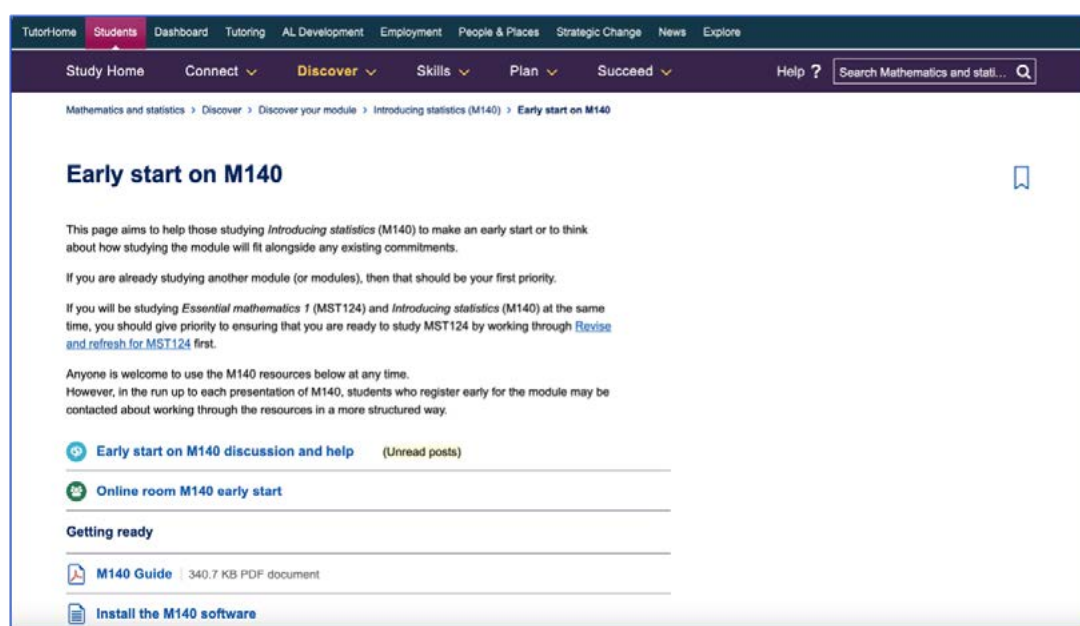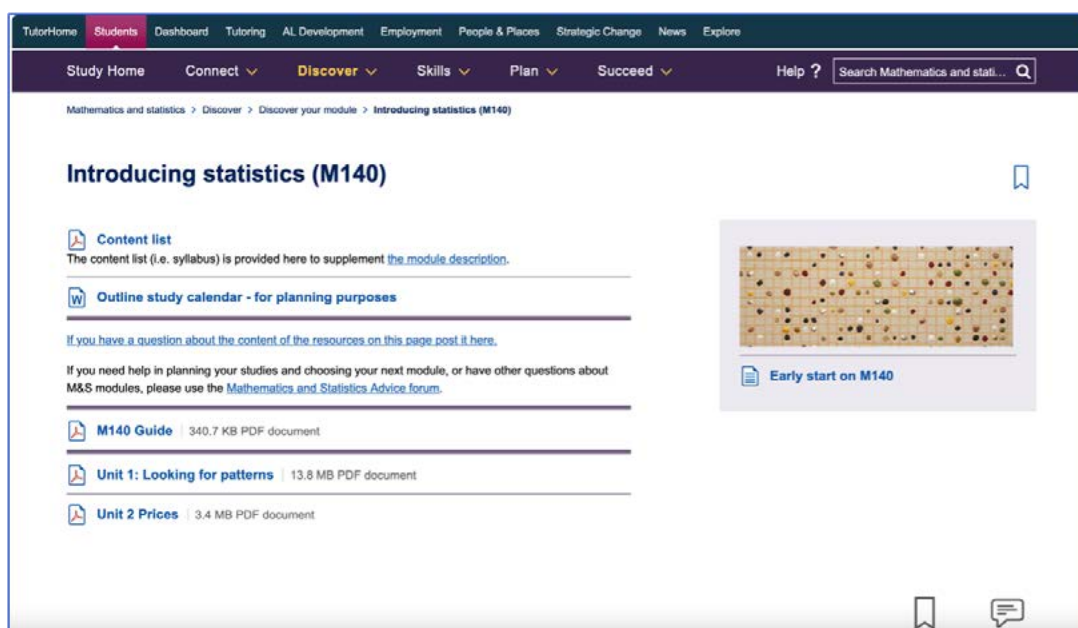
Figures [J3].1a and **[J3].1b** 'Early Start on M140' can be accessed from the Discover menu of the subject website of Mathematics and Statistics

9.4　Key lessons and details of the impact

This SoTL project provided evidence of demand, organisational, and assessment aspects associated with non-standard starts.

Carol (project lead) reflects on the outcomes of the inquiry:

The anxiety level for some students starting and continuing study is easy to underestimate.

Most of the time the early start was really a "comfort blanket" for the students – they wanted to load the software and skim the materials to reassure themselves all was fine for October and that was it. But for others they wanted to get ahead so they had built a "space" for later in the year that was a safety net if they encountered issues that reduced their study opportunities. And for a relatively small proportion they really used the time to think about study skills and get help with gaps in their knowledge. That meant we had fewer students drop out at the start of the module.

Inspired by this success and based on the ethos of M140, other modules in OU's Faculty of STEM and in other units have provided early start and transition materials to support students ahead of the actual module start date. The aim of initiatives that have built on the M140 project has been to improve student retention by providing students with opportunities to engage with their studies prior to module start, revise key concepts or skills, and to build confidence and possibly time management.

Based on the facets and attributes of the impact evaluation instrument (**Appendix 1**), the Table below details the impact of this SoTL inquiry.

Impact facet	Attribute	Description
Facet 1: Student experience	Student engagement with the course content Student satisfaction	Students have identified the benefits in terms of reduction in stress, better time management and a better understanding of how study at the OU is organised. Carol reports: *The most rewarding aspect is the enthusiasm it generated. Both from the students and from the tutors. Students regularly said how much they valued access to the materials and support in starting to study. That was rewarding for the tutors as they knew they were making a real difference for some students.*

Impact facet	Attribute	Description
Facet 2: Student retention and progression	Student registrations Student retention rate	Student retention has improved by 2–3 percentage points between registration and module start. 40 more students passed M140 than would have been expected compared with registration numbers in 2015 and 2016.
Facet 3: Evidence-based excellence in teaching	Inform policy development internally at the level of the sub-unit, faculty, or University	The project has established that a substantial number of students are keen to take part in an opportunity to start M140 on a more flexible basis prior to the October module start.
Facet 5: Dissemination of project's outcomes	Number of publications from the project/initiative Number of citations	The project team has disseminated their initiative in internal events, end-of-project report and a video that captures their experiences. This project has been cited in other publications by Mathematics and Statistics (M&S) colleagues, for example, Pawley and Hughes (2018) and Hilliam and Arrowsmith (2019).
Facet 6: Adoption of the outcomes of the project by other educators	Adoption of the outcomes internally or externally (within the institution) to improve assessment, curriculum design in the same discipline in same or different contexts	In the M&S module *Analysing data* (M248)[108], students who have demonstrated they have engaged with these early units, and successfully completed an online quiz based on the units' content, gain access to additional units and resources. This initiative has enabled engaged students to make an early start on the module (supported by a programme-wide forum), whilst limiting the availability of material. The module *Astronomy* (S282)[109] ran a programme called Headstart until it's last presentation in 2019, which provided students with online access to a subset of the module materials, online tutorials, and tutor support through a forum. Another module *Cell Biology* (S294)[110] provided early start and transition materials including an 'Are you ready?' diagnostic quiz for students to check their preparedness for the module. The module *Perspectives in Health and Social Care* (K118)[111] in the OU's Faculty of Wellbeing, Education and Language Studies has set up an early start programme based on the outcomes of the M140 SoTL project.

108 M248 Analysing Data, http://www.open.ac.uk/courses/modules/m248
109 S282 Astronomy, https://www.open.ac.uk/library/digital-archive/module/xcri:S282/study
110 S294 Cell Biology, https://www.open.ac.uk/library/digital-archive/module/xcri:S294/study
111 K118 Perspectives in Health and Social Care, http://www.open.ac.uk/courses/modules/k118

Impact facet	Attribute	Description
Facet 8: Personal and professional development of project team	Improved practice and personal knowledge	Carol has reported that for the ALs involved in the SoTL initiative, the project provided an opportunity for their professional development.
Facet 10: Fostering SoTL culture	Increased involvement of stakeholders in SoTL	Carol's initiative has encouraged ALs and staff tutors to engage in SoTL. There is now a strong community of SoTL practitioners in the School of M&S[112], Faculty of STEM.
Facet 12: Funding opportunities	Funding for follow-on/new projects based on SoTL project's success	Following on from the success of this project on M140, the project team received funding from eSTEeM, the OU Centre for STEM pedagogy, to examine the effectiveness of early start on the module, *Discovering Mathematics* (MU123)[113]: 'Early Start MU123'. Carol has continued to grow her SoTL practice[114] with support from eSTEeM.

9.5　Reflections on SoTL practice

Carol reflects on the time, patience, and a phased approach it takes to receive funding for SoTL practice:

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Wide discussion with interested parties can be productive but the "what-if" scenarios that you cannot answer until you start are daunting.

So, I now think of the first phase a very small "private" exercise to get answers to many of the unknowns and that sadly has to be unfunded. Then a second phase of this looks like a promising idea and collecting views as widely as possible – still un-funded and then a final, funded-phase of actually doing the project as per initially intended but now with enough answers to get funding and wider support and interest.

"

Sometimes it may be helpful to run a few pilots and/or have conversations with peers and stakeholders to determine the value of conducting a full-scale SoTL inquiry ahead of seeking funding and to get support from the management and other stakeholders. Carol received funding from eSTEeM to conduct the initiative reported in this case study after a few initial (unfunded) attempts of exploration to understand the problem and the possible 'solution'.

112　Scholarship of Teaching and Learning, School of Mathematics and Statistics, Faculty of STEM, https://www.open.ac.uk/stem/mathematics-and-statistics/research/research-groups/scholarship-teaching-and-learning
113　MU123 Discovering Mathematics, https://www.open.ac.uk/courses/modules/mu123
114　Carol's profile on eSTEeM's website that lists her SoTL projects, https://www.open.ac.uk/scholarship-and-innovation/esteem/people/carol-calvert

Sharing the outcomes and evidence of student retention and student satisfaction of this SoTL project has influenced the adoption of an early start strategy in the School of Mathematics and Statistics, in other disciplines in STEM and in one another Faculty at the OU.

Carol laments that embedding change is not always easy, even when the evidence of impact exists. For example, funding constraints can hamper sustainability of the initiative and long-term change and the original intervention may have to adapted to sustain the initiative. Carol says:

It is difficult to embed change. In this case when student numbers increased a lot, and hence the numbers eligible for an early start more than doubled, it proved impossible to get the extra time [of tutors] required. However, we have been able to maintain a modified version of the programme which still makes materials, forums, and tutor support available. The key difference is that two tutors support the whole group of early start students rather than students being allocated their own named tutor. Perhaps because there are only two tutors involved, the students seem quite happy to hold discussions with either tutor. The modification to the approach means students still feel they have access to a tutor, but it has addressed the fact that in the original version the availability of individual tutor support was underused [and more expensive to run].

To conclude, Carol's thoughts on the SoTL inquiry are:

The impact in M140 was on pre-registration - in particular we reduced the number of students we "lost" between registration in May and module start in October.

The idea of using the early start idea then grew to using the summer period to give continuing students access to materials and support them for their upcoming October study. The perceived wisdom was our students would not want to study in the summer but this, if ever true, is no longer always true of our students.

9.6   Project resources and references

Project resources

End-of-project report: A flexible start to M140. Available at: https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/supporting-students/flexible-start-m140 or https://tinyurl.com/bdcrv658

Video: A flexible start to M140, https://youtu.be/OdanA-pudEU

Case study: 'A flexible start on a statistics module', *in* 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109326&section=2.1

Calvert, C. and Hilliam, R. (2019). Student feedback to improved retention: Using a mixed-methods approach to extend specific feedback to a generalisable concept. *Open Learning: The Journal of Open, Distance and e-learning*, vol. 34, no. 1, pp. 103-117. Available at: https://oro.open.ac.uk/58116/

Related resources

Hilliam, R. and Arrowsmith, G. (2019). Enhancing the student experience with the use of a dedicated subject website, *MSOR Connections*, vol. 17, no. 2. Available at https://journals.gre.ac.uk/index.php/msor/article/view/947

Pawley, S. and Hughes, C. (2018). Bridging the study gap: Provision of support for mathematics students during breaks in study. N*ew Directions in the Teaching of Physical Sciences*, vol. 13, Issue 1. Available at http://oro.open.ac.uk/59312/

10 [J4] Cross-level engagement between staff and students

Fact box

Title	Developing a sense of community through cross-level engagement between staff and students in creative industries subjects
Aim of the SoTL inquiry	The aim of the project was to pilot and evaluate innovative programme-level blended engagement events with the goal of creating a community of learners across a qualification.
Type of inquiry[115]	'What will happen?'
Led by	School of Engineering and Innovation, Faculty of STEM
Contact	Nicole Lotz, nicole.lotz@open.ac.uk and Georgina (Georgy) Holden, georgina.holden@open.ac.uk
Theme	Supporting student journey
Research methods	survey; interviews; data captured from forums, emails and social media; thematic analysis
Duration	2017 - 2020
Keywords	community building; Community of Inquiry (CoI); design education; students as partners
Webpage	Developing a sense of community through cross-level engagement between staff and students in creative industries subjects, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/supporting-students/developing-sense-community-through-cross%E2%80%90level-engagement or https://tinyurl.com/bdhksy9k

10.1 Context and aim of the SoTL inquiry

Understanding the role of sense of community at qualification level is significant for student attainment and retention for students studying at a distance. 'Sense of community' is a feeling of belonging, a shared emotional connection to, as well as influence from and on, other members of a community. A community in the context of distance higher education, such as at The Open University (OU), is a projected community, not rooted in one place or aligned to a particular lifestyle. A community is imagined and socially constructed based on a shared purpose. Being a member of a community fulfils a specific need and is purposeful.

At the OU, learning designs and use of innovative and emerging technologies in learning have facilitated social engagement, critical discourse, and community building within individual modules. However, establishing a sense of a community at the programme level is still underdeveloped. This gap is not unique to the OU, but it has been reported in distance and blended learning literature. Students that engage in educational events of an institution which are beyond module-specific activities feel a part of a 'Community of Inquiry' (CoI, that is, a group of individuals involved in a process of empirical or conceptual or scientific inquiry into a problem). A sense of community has been linked to increased student retention and attainment.

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115 'Areas of investigation in SoTL', in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109157&section=3.3

This SoTL project set out to pilot a series of innovative programme-level blended engagement events in Design education and to investigate whether, and if so, how, these cross-level qualification events create a sense of community across the Design and Innovation qualification (Q61)[116] that inspires, supports and empower students and educators alike.

10.2   Underpinning research of the SoTL inquiry

The approach was to run a series of qualification-wide events and evaluate student engagement and experiences, emergent sense of community, and to understand the impact on student progression through the qualification. The events were co-facilitated by 1-2 tutors and central academics. They were open to any student registered on the OU's Design and Innovation qualification (Q61) or studying a Design module (that is, U101[117], T217[118]/T218[119] and T317[120]). A Facebook group was set up to (live) broadcast events as they happened. A post-event blog entry was posted on the Design@Open blog[121], linking to the videos for those who could not attend in person.

The Annual Students Design Exhibition was an exception to the usual events. Students worked alongside staff to organise and design the exhibition. Three to four student-curators designed the physical exhibition of selected student-posters, guided by an exhibition designer and tutor. A virtual exhibition was set up for members of the public and those who couldn't attend in person.

Three cycles of Action Research[122] were carried out (**Figure [J4].1**). Data from students was collected by surveys and interviews. Further quantitative data was collected about the number of people participating at the events, the number of participants on Facebook Live or catch-up, and the number of visits to the Design@Open blog. Student feedback was collected by email, module or subject site forum posts, and Facebook group posts. The surveys were analysed using descriptive statistics. The qualitative data was imported into NVivo[123] for thematic analysis.

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116   Q61 qualification, BA/BSc (Honours) Design and Innovation, https://www.open.ac.uk/courses/design/degrees/ba-bsc-design-and-innovation-q61

117   U101 Design thinking: creativity for the 21st century, https://www.open.ac.uk/courses/modules/u101

118   T217 Design Essentials, https://www.open.ac.uk/courses/modules/t217

119   T218 Design for Engineers, https://www.open.ac.uk/courses/modules/t218

120   T317 Innovation: Designing for change, https://www.open.ac.uk/courses/modules/t317

121   Design@Open blog, http://www.open.ac.uk/blogs/design/

122   What is action research and how do we do it?, https://infed.org/mobi/action-research/

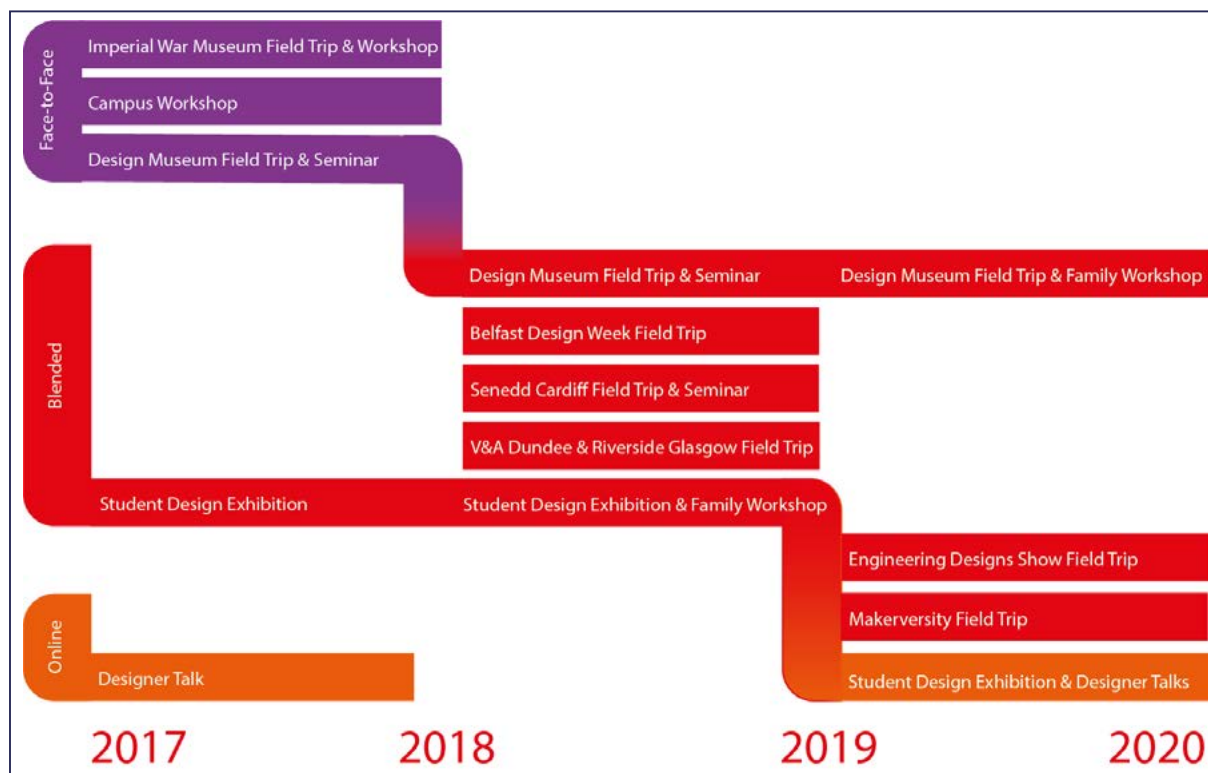123   NVivo, Qualitative data analysis software, https://lumivero.com/products/nvivo/

Figure [J4].1 Q61 cross level engagement events between 2017 and 2020

10.3 Findings of the SoTL inquiry

The analysis of the data provided evidence that the cross-level engagement events created a community of learners across a qualification amongst the participants. Indicators for a sense of community, such as membership, shared experience and emotional connection were detected in the attendees' feedback. Students commented on their sense of belonging, an understanding of what they are heading for in the qualification, and an opportunity to learn about the good practices in the Design discipline.

The themes 'peers' and 'discussion' were frequently coded in the feedback on any cross-level event. The opportunities for dialogues offered connections with staff and students and reinforced a sense of community membership which is essential for study progression.

A student said:

Thank you and everyone that made it happen. Getting to meet you all and getting to share a bit of the OU experience with my peers was wonderful and highly motivating.

Meeting the module/design innovation team 'for real' was marvellous. Talking with other OU students inspired me. I feel motivated after this group event. Will attend in future.

There is no way of establishing a causation between attendance at events and progression. Attendees at the events were self-selecting, however, the team found a positive relation between participation in community events and study progression is indicated by the much higher progression rate of those who took part in events (81%) compared to the overall cohort (51%).

The most successful event was the annual exhibition, which provides a spectrum of engagement through poster completion and the curation/design of the exhibition itself. The shared experience of demonstrating and applying skills as exhibition designers was valued the most by students. The experience at the exhibition helped students to gain confidence in their design skills. With confidence students can influence others, especially in dialogues with peers, educators, and potential employers.

10.4 Key lessons and details of the impact

The blending of face-to-face and online engagement was important. The events were used as catalysts to generate content that was distributed on social media channels including the blog to achieve maximum impact, to attract new students and to inform the public. The Facebook engagement numbers have been continuously rising.

This SoTL inquiry has shown that developing a community of learners, with a common academic interest helps students who wish to, to feel a part of the qualification community, and leads to high levels of student-satisfaction. Further, working and connecting with students from across all levels in a qualification has given the educators involved valuable insights into student aspirations, concerns and experiences, and has revealed the skills and knowledge students bring to their studies from their work and life experiences.

The learning from this project has influenced qualification-wide strategic changes in Design and Innovation. For example, the new Bachelor of Design (BDes) qualification proposes an innovative design space for students across the qualification to connect and collaborate, share resources, and engage in events. Having recognised the value of building a sense of community especially for marginalised students, the Design Group extended opportunities for direct engagement and collaboration with students co-designing module materials and extra-curricular events.

Associate Lecturers (ALs) or tutors were equal partners in organising and running the events alongside central academics. They suggested venues and organised some of the most successful events. There were exceptions in which ALs put in a lot of effort, but few attended the event. This was often associated with parallel disrupting events, such as bad weather, a remote location, or the timing of the event.

The eSTEeM funded SoTL project reported in this case study ran prior to the COVID-19 pandemic. The SoTL initiative is continuing with funding from the School of Engineering and Innovation. Students have been co-designing the Annual Shows. Many of the participants are now 'go-to-students', who can easily be contacted with a guaranteed response (for example, for accreditations or to spread the word of events, and so on). This ongoing engagement with students as partners creates strong advocates for Q61.

The events that would have been face-to-face opportunities became online events during the COVID-19 pandemic. Online events enabled people to participate who could not otherwise have done so. This was seen most clearly in the Annual Exhibition event, which, formerly had taken place on the OU's campus with student volunteers and ALs setting it up.

The move to an online platform meant that more students were able to participate in the design of the exhibition, the creation of the exhibition (online) space, the creation of the catalogue and design of the launch event. In 2020, six students volunteered, who participated from as far afield as the Outer Hebrides and the South of Spain. Likewise, attendance at the launch event for the exhibition, in 2020, 2021 and 2022 was significantly higher than attendance at previous face-to-face events. It is therefore likely that these changes will be permanent and that all future exhibition events will be held online. In addition to this event, a series of online talks were held where previously visits to places of interests for designers would have been held. These were well attended and rated highly by attendees.

The drawback of online events is that students do not have as much informal interaction with one another as they would in a face-to-face event. Initially the platform used for the online events was Microsoft Teams™ but in 2022, events moved to the Zoom™ platform where, perhaps because of its greater familiarity and association with more informal communication, greater numbers of students have participated using video.

Future events will go even further. The cross-level events for the coming year will trial employability workshops to offer student applied experience in solving real-world problems through design thinking (Designathon). A Black Designers' Reading Group will be run that has been co-designed by a student and ALs. Such events will generate new ideas for the Bachelor of Design, the OU's new Design qualification, with a truly cross-level and qualification-wide approach to curriculum design.

The project team has organised 27 events since 2018. Five events in 2017-2018 were supported by eSTEeM; 5 events were funded by the More Students Qualifying (MSQ) intervention in 2018-2019; since 2020, the School of Design and Innovation has supported 17 events. The evidence from the eSTEeM-funded SoTL inquiry enabled funding successes from other sources including the School of Engineering and Innovation – thereby helping to sustain the initiative.

Based on the facets and attributes of the impact evaluation instrument (**Appendix 1**), the Table below details the impact of this SoTL inquiry.

Impact facet	Attribute	Description
Facet 1: Student experience	Student engagement with course content Student satisfaction Learning design Curriculum design	The evaluations have shown high student satisfaction and students have reported a positive experience. A student emphasised the opportunity to create a community and contribute to shared tasks, and to work on personal goals at the same time: *… nice to be able to take part in a real design sort of event rather than just something in an assessment… And also get some real experience. … students and lecturers and academics have all sort of met on a level playing field and it's nice to be able to just talk to them without the hierarchies.* *I've also thought it would be a good experience to put on my CV and also decide whether perhaps exhibition design might be an area that I might like to go into.* Applying design concepts and skills to a real-world task of curating/organising an exhibition gave the students confidence in their abilities and provided a platform from which to influence others, thereby, reinforcing a sense of community. *… to come to the OU and get involved and chat to everyone on the Q61[124] team boosted my confidence no end. … I feel the project in the summer was invaluable work experience and gave me the confidence to speak up about my experiences. It took me from not being particularly confident in how I would take my degree into the world of work, to realising that the degree and the exhibition has given me a huge amount of applied experience that I can apply to almost everything I do. I wouldn't ever have applied had I not been asked to and that was all down to having something to talk about, the exhibition being that something!* *… I've recommended to other students to get involved with anything that comes up in the future as from chats/their posts online on social media they seem to want to gain work experience in design roles.* A student who participated twice in the annual show, and who won a special mention in the 2018 show and the first prize in 2019 commented: *What wonderful news to be one of the winners!!! Was a lovely surprise indeed and a brilliant end to my OU journey!* Some students became advocates of the qualification to other students and the public. The community building aspect of the cross-level events has been embedded as an ongoing process and is now considered routine by the Qualification team. The cross-level events have facilitated the generation of new ideas for the Bachelor of Design (BDes), with a truly cross-level and qualification-wide approach to curriculum design.

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124 Q61 qualification, BA/BSc (Honours) Design and Innovation, https://www.open.ac.uk/courses/design/degrees/ba-bsc-design-and-innovation-q61

Impact facet	Attribute	Description
Facet 2: Student retention and progression	Student progression	Attendees at the events were self-selecting; however, the team found that those who participated in the events had a much higher chance of progressing (81%) compared to the overall cohort (51%). Bringing educators and students together in cross-level engagement events and working as partners in organising and running these events offered an excellent experience for everyone. Students felt more confident about their study direction, skills, and abilities, and they became more aware about their progression pathways in the design qualification.
Facet 3: Evidence-based excellence in teaching	Student skills-set Student employability	The qualification wide events have had a positive impact on teaching the Q61 curriculum. For years, the qualification team was discussing about implementing an end of year show, which is a common practice in conventional design schools. This SoTL project helped to realise that aspiration. The Annual Show demonstrates the achievements of Design students, but it also offers a baseline for new students to aim at. In particular, the SoTL initiative has had an impact on the Design group's ability to teach the hidden curriculum, that is, the values, norms, and good practices in Design, to better enculturate students into the domain of design and prepare them for professional use of their skills and knowledge of the design discipline. Students gained experiences that proved valuable for employability and building their CVs.
Facet 4: Influence on discipline-based teaching, research and practice	Change in the ways in which subject concepts are taught	The project has undoubtedly influenced approaches to curriculum development in Design and will continue to do so as new curriculum is developed. The online annual shows (websites)[125] have been incorporated into the learning materials at Level 1 study and help novice students understand the breadth of work being undertaken in Design at the OU. The online exhibitions have visitor numbers in the thousands.
Facet 5: Dissemination of project's outcomes	Publications from the project	The project has been disseminated at a few events within the OU. A journal paper has been submitted for possible publication. In addition, the events or parts of the events were recorded and are shared with students who could not attend to catch up with. Social media resources have been created on: YouTube[126]; Facebook group[127]; Design@Open Blog[128]. These resources inform prospective Design students of what studying design at the distance might involve.

125 The Open University, Annual Design Show, https://www.oudesignshow.org/
126 Design at Open, https://www.youtube.com/channel/UC5dwgQTcTO0bCgA1Oiu-TBQ
127 design@open, https://www.facebook.com/groups/1599710346973999
128 Design@Open blog, A blog about design at the OU, http://www.open.ac.uk/blogs/design/

Impact facet	Attribute	Description
Facet 6: Adoption of the outcomes of the project by other educators	Adoption of the outcomes internally or externally (within the institution) to improve assessment, curriculum design in the same discipline in same or different contexts	Through both informal discussions and presentations/ workshops at the eSTEeM's (the OU Centre for STEM pedagogy) annual conference, the project team has made colleagues across the university aware of this initiative. The team has encouraged workshop participants to reflect on potential events in their own discipline. The project team is not aware of a similar initiative yet being taken. In parallel to this project, in 2018, Nicole (the project lead) developed a research collaboration with an academic from a German distance university, called Diploma University. The interviews were conducted with the German partner, who published a comparison between progression in a design qualification in Germany and in the UK (Lanig, 2019). The methodology that the team developed during this project will now be used to organise employability workshops at the OU with Design students (Designathon). This will feed into the BDes development and wider changes in Career Development support at the University.
Facet 7: Mutual stakeholder understanding	Understanding among students and staff: a community that SoTL creates and moving outside traditional silos	Mutual understanding has been one of the main benefits of the project, facilitating closer and better relationships between central and regional staff (including ALs or tutors) and students at all levels. The project team said: *We were aware of some historical feelings of disconnect between part-time ALs or tutors and Central Academics, and we were looking ahead to building new relationships [in this SoTL inquiry]. ALs were included in the planning and running of the events which aimed at developing a stronger sense of community of practice amongst them and Central Academics.*
Facet 8: Personal and professional development of project team	Improved practice and personal knowledge; collaborative or team-working skills	The project team has learnt a lot about the capabilities and interests of students and about co-creation and collaborative working in design.
Facet 9: Recognition of project team members and other stakeholders	Fellowships or memberships of professional associations nationally and internationally (e.g. Advance HE fellowships)	The project supported the HEA (Advance HE) Senior Fellowship[129] application of Nicole Lotz (project lead).

129 Advance HE, Senior Fellowship, https://www.advance-he.ac.uk/fellowship/senior-fellowship

Impact facet	Attribute	Description
Facet 10: Fostering SoTL culture	Stimulating interest in SoTL Increased involvement of students in SoTL projects A move towards staff-student collaboration in curriculum design, development, and evaluation	Students who have participated in one or more of these events have generally kept in touch, participated again, and are interested in ongoing collaboration, for example in the Bachelor of Design (BDes) degree's curriculum development.
Facet 12: Funding opportunities	Internal (within the institution) funding for follow-on/new projects based on SoTL project's success External funding (from outside the institution) for follow-on/new projects based on SoTL project's success.	Although the SoTL project ended in 2019, the initiative has continued to receive funding from the School of Engineering and Innovation to organise and run the annual design shows and other engagement events. In fact, these events have become a permanent part of curriculum delivery. In 2019, the team secured funding from the British Council Mexico, to run design-led Employability workshops in Yucatan, which involved small and medium enterprises and governmental institutions.

10.5 Reflections on SoTL practice

This case study is an example of collaborative SoTL[130] where tutors, academic staff and students came together and worked as partners in organising and running cross-level engagement events which provided an excellent experience for everyone. This project contributed towards the primary motive of the team to investigate whether cross-level engagement events create a sense of belonging and community. However, the SoTL inquiry went beyond this primary motive and led to a positive change amongst students.

Students were partners[131] in this SoTL inquiry. Their involvement as participants in events and a Facebook group, and as co-designers of an exhibition enhanced their understanding of the Design discipline, increased awareness of their own skills and abilities, and they gained employability skills. As a result of this SoTL initiative, students felt confident about their study journey through the Design qualification, and they became more aware of the progression pathways. Moreover, some students became advocates of the qualification to other students and the public.

Further, this collaborative SoTL inquiry has facilitated better relationships and understanding between central and regional staff (including ALs/tutors) and students at all levels. The community building aspect of the cross-level events has been embedded as an ongoing process and is now considered routine by the Qualification team.

> **To conclude, Nicole's and Georgy's thoughts on the project are:**
>
> *It is difficult to establish trusting relationship and a sense of belonging at a distance. Working on a meaningful activity across the qualification alongside students and ALs [tutors] as co-creators and equals can empower all those concerned and lead to stronger relationships which facilitate improvements in teaching and learning.*

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130 'Collaboration in SoTL', in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109159&section=2

131 'Students as partners in SoTL', in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109324&section=1

10.6   Project resources and references

Project resources

End-of-project report: Developing a sense of community through cross-level engagement between staff and students in creative industries subjects, Available at: https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/supporting-students/developing-sense-community-through-cross%E2%80%90level-engagement or https://tinyurl.com/bdhksy9k

Project poster: Developing a sense of community through cross-level engagement, Available at: https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/supporting-students/developing-sense-community-through-cross%E2%80%90level-engagement or https://tinyurl.com/bdhksy9k

Lotz, N. and Holden, G. (2019). Time to think bigger? Can qualification f2f events succeed where module tutorials fail? *Presentation at the 8th eSTEeM Annual Conference*, 8-9 May 2019. Available at: https://www.open.ac.uk/scholarship-and-innovation/esteem/resources/nicole-lotz-and-georgy-holden-time-think-bigger-can-qualification-f2f-events-succeed-where or https://tinyurl.com/26hp9was

Lotz, N. and Holden, G. (2019). Developing a sense of community through cross-level engagement between staff and students in creative industries subjects. *Presentation at the 1st eSTEeM Online Student Conference*, 20 November 2019. Available at: https://www.open.ac.uk/scholarship-and-innovation/esteem/resources/nicole-lotz-and-georgy-holden-developing-sense-community-through-cross%E2%80%90level-engagement or https://tinyurl.com/uvwa6jyt

References

Lanig, A. K. (2019). Educating designers in virtual space: A description of hybrid studios. In N. A. G. Z. Börekçi, D. Ö. Koçyıldırım, F. Korkut, & D. Jones (Eds.), DRS Learn X Design (pp. 247–256). METU Department of Industrial Design. Available at https://www.science.de/sites/default/files/article/2020-03/Lanig-2019-Handout-Design-Ankara.pdf

11 [J5] On-screen learning

Fact box

Title	An investigation into how STEM students use learning resources in different formats, and how this use develops over time
Aim of the SoTL inquiry	The aim of the project was to investigate how distance learning STEM students use on-screen and paper-based learning resources on a range of Level 2 (second year undergraduate) modules.
Type of inquiry[132]	'What is wrong?'
Led by	Schools of Physical Sciences (SPS) and Computing & Communications (C&C), Faculty of STEM
Contact	Laura Alexander, Laura.Alexander@open.ac.uk and Alexis Lansbury Alexis.Lansbury@open.ac.uk
Theme	Supporting student journey
Research methods	survey; telephone interviews
Duration	2017 - 2021
Keywords	learning resources; on-screen learning; printed resources; student support
Webpage	An investigation into how STEM students use learning resources in different formats, and how this use develops over time, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/supporting-students/investigation-how-stem-students-use-learning-resources-different or https://tinyurl.com/59dv4k6x

11.1 Context and aim of the SoTL inquiry

The Open University (OU) has always offered a blend of study formats or media to its distance education students. Alongside physical books and online learning materials, learning resources have been accessed as: broadcast television programmes (on the BBC); recordings on audio tapes, CD-ROMs and DVDs; online podcasts; and virtual reality and augmented reality via mobile apps.

There has been an increasing shift towards online learning resources via OU's Virtual Learning Environment (VLE) and with fewer physical books to provide learning resources and lesser opportunities for face-to-face tuition. Some modules are designed to be studied entirely online, that is, on-screen. There has been a strong student voice about students not enjoying a fully online experience.

The aim of this SoTL project was to investigate:

- The impact on students being required to develop different learning strategies part-way through their programme of study, due to encountering modules which rely on different media for learning resources.

- Whether this experience affects student progression and retention, and could there be ways to mitigate the impact on student experience?

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132 'Areas of investigation in SoTL', in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109157&section=3.3

The project involved investigating the formats of learning resources (physical and on-screen) students use on a range of STEM modules, how students use these learning resources, and how this use evolves over time.

11.2 Underpinning research of the SoTL inquiry

The project team chose three Level 2 (second year undergraduate degree) modules in Computing, Mathematics and Science modules, M269[133], MST224[134], and S217[135]. Students on M269 experience a blend of digital resources, texts in the public domain and those specifically developed for the module. At Level 1, students on M269 experience a blend of online materials and physical books. MST224 has purpose-written textbooks. Students on MST224 primarily experience physical books at Level 1. S217 is an entirely online module. At Level 1, students on S217 experience fully online modules or a blend of online materials and physical books based on their choice of modules.

The first survey was sent out to 599 students on these three modules in 2017. Due to curriculum changes a far higher proportion of students (than 2017) on the three chosen modules on Level 2 in 2018 would have studied on an entirely online module at Level 1. Hence, the SoTL project team repeated the survey (n=599) in 2018.

In the survey, students were asked to reflect on the learning strategies they developed while studying on Level 1 modules, and, if and how these strategies had changed during their Level 2 modules. In all, 225 students responded to the survey.

In the follow-up interviews, there were students from each of the three chosen Level 2 modules. 12 students participated, and in each phone-interview lasting 30 minutes, the team enquired about how the students studied, how they took notes, any external resources they used, and any constraints on studying on-screen or on paper. Each student was then asked, 'What do you think makes a well-integrated package of learning resources?'

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133 M269 Algorithms, Data Structures and Computability,
     https://www.open.ac.uk/courses/modules/m269
134 MST224 Mathematical Methods, https://www.open.ac.uk/courses/modules/mst224
135 S217 Physics: from classical to quantum, https://www.open.ac.uk/courses/modules/s217

11.3　Findings of the SoTL inquiry

The project team found that:

- Students use a mix of paper-based and on-screen study methods, regardless of whether a module is presented entirely online or has a mix of physical or paper-based and online resources.

- Students who had previously studied an entirely online module at Level 1 were less likely to need to change the way they study when they meet an entirely online module at Level 2. However, even when the students are attuned to an entirely online Level 2 module, this SoTL inquiry revealed that students had a desire for physical books, showing that even though previous experience of entirely online study helps students with subsequent online study, most students still prefer having access to physical books and resources alongside online materials.

- Students studying an entirely online module at Level 2 but who had encountered a module which was not entirely online at Level 1 shift from annotating module textbooks to annotating printed pdfs of online content and making more notes on paper, rather than developing ways to annotate information online or making online notes. Students don't seem to find digital note-taking easy or effective.

  A student remarked:

  I'm less likely to take notes when I'm reading it digitally [on-screen].

- Students value online resources, particularly audio-visual content (for example, videos, animations), online quizzes and iCMAs (interactive Computer-Marked Assignments)[136], and would like more of such resources alongside physical books and online materials.

- Students mentioned that they need two devices with relatively large screens to study entirely online materials, and it is expensive to procure additional equipment and to maintain it.

- For some students, too much time spent looking at a screen does cause issues, but that is not the case for all students. This is not age related but seems to be particularly an issue for those who use a screen all day at work.

  A student said:

  I find it easier to learn from a book than I do from looking at a screen. I look at a screen all day long at work.

136　How will I be assessed?
　　https://www.open.ac.uk/courses/what-is-distance-learning/assessment

11.4   Key lessons and details of the impact

The project team of this SoTL inquiry concluded that the qualification leads, and module teams should consider the following:

- Students prefer a combination of books and digital resources to entirely online resources. Age is not a predictor of whether students would prefer physical (or paper-based content) or digital content[137].

- Students encountering an entirely online module for the first time are likely to have problems adapting their study methods, particularly if this happens after Level 1.

- Students reported that entirely online modules seem to require at least two different digital devices for effective study, as well as a good broadband connection and access to a printer and this may have an adverse impact on students from poorer backgrounds.

- Students would like to access digital versions of physical books. They would also like digital content of these books to be available offline. Students find offline digital books better for studying when travelling, both for ease of use and because of poor/no internet connectivity while travelling.

- Students would like more audio-visual digital content, and online quizzes than are currently provided.

- Students of all ages would benefit from learning about strategies to study online. Students will need support to develop skills to study online materials, such as online notetaking, or using multiple devices and apps.

At the end of this SoTL inquiry, the team have reflected that for many STEM subjects (and perhaps in other disciplines too), the core content should ideally be provided in physical books, and the VLE should be used to provide the visual, interactive resources, for example, screencasts, interactive quizzes. Students also want the option to access the content of physical books and resources digitally, both online and offline.

Alexis (project co-lead) reflects on how the project was initiated and how the evidence from this SoTL inquiry has helped to bring about change:

This project has its origins in S217, a Level 2 physics module. I started teaching on S217 in its first presentation when the module was delivered entirely online (in contrast to the predecessor S207[138] which provided several textbooks). There were a seemingly large number of student complaints about the purely digital format of S217; students told us that they wanted books.

So, I wanted to set up this project to try and understand whether the feedback I received from my own students was representative of student views more widely. We investigated students' learning experiences on S217, MST224 and M269 over a two-year period. Laura Alexander [project co-lead] was able to use the data we gathered to provide evidence for a return to books for S217.

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137   Digital resources are materials that have been created digitally or by converting analogue materials to a digital format. In contrast, online resources, in this context, implies resources that are accessible via the Internet.

138   S207 The physical world, https://www.open.ac.uk/library/digital-archive/module/xcri:S207/study

For the 2019/20 cohort of S217, books of the core module teaching material were printed and sent to every student. One print run was carried out, printing enough books to cover the next 3-4 years. The estimated cost per student was around £20, because the module materials had been written to be pdf compatible from the start.

As a result of this SoTL inquiry, evidence was available to argue for the inclusion of some printed materials in several modules of School of Physical Sciences and the retention of books for the core content in Level 3 modules.

Based on the facets and attributes of the impact evaluation instrument (**Appendix 1**), the Table below details the impact of this SoTL inquiry.

Impact facet	Attribute	Description
Facet 1: Student experience	Learning design Student engagement with course content Student engagement with the technological intervention	The project leads have reported that with the introduction of printed materials based on the outcomes of this project, students are much happier as they have the choice of printed materials and online resources. Students have printed material to study and annotate on more School of Physical Sciences (SPS) modules than before, allowing them to build on their knowledge and refer to their earlier studies. (It may be useful to note that students have access to module VLE-based websites for only 3 years after completing a module but are likely to take 6 years to complete their degree part time.)

Impact facet	Attribute	Description
Facet 2: Student retention and progression	Student registrations Module completion rate Module pass rate Student retention rate Student progression	Due to the disruption during COVID-19 and when this project was being run, the project team has not been able to conclusively demonstrate that giving students printed materials improved their success on the module. However, additional data analysis was done to test the hypothesis that students who had completed the entirely online S111[139] at Level 1 perform better on S217[140] than those who had completed S104[141] which has both physical books and digital content. The suggestion was that despite S104 providing more physics content, and more opportunities to apply mathematics skills to solving physical problems S111 prepares students better for S217 because the material is supplied entirely online. This appears to indicate that having experience of studying entirely online at Level 1 is a better preparation for entirely online Level 2 study than covering more relevant content at Level 1. Therefore, students on S217 who had not previously completed S111 (an online module) were more likely to fail, and less likely to get a good pass if they did pass.

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139 S111 Questions in Science, https://www.open.ac.uk/courses/modules/s111
140 S217 Physics: from classical to quantum, https://www.open.ac.uk/courses/modules/s217
141 S104 Exploring Science, https://www.open.ac.uk/library/digital-archive/module/xcri:S104/study

Impact facet	Attribute	Description
Facet 3: Evidence of excellence in teaching	Student skills-set Inter-disciplinary collaborations in teaching Informing policy development internally at the level of department, Faculty or University	Laura (project co-lead) remarked on how the project enabled them to identify the required study skills, such as note-taking when reading materials onscreen. The project has informed policy development for supplying physical books at School and Faculty levels. Alexis reflects: *The project gave me a better understanding of how our students learn in the blended distance-learning environment we provide, and particularly how cognitive load theory[142] might provide a framework to identify why learning technologies can sometimes appear to provide a barrier to learning.* *Laura and I shared our results with colleagues in M&S [Mathematics and Statistics] and these perhaps reinforced decisions they were making. In C&C [School of Computing and Communications], particularly in programming modules, the learning outcomes are often more focussed in students developing digital skills and here our results had rather less impact.*
Facet 4: Influence on discipline-based teaching, research and practice	Change in the ways in which subject concepts are taught	Laura reports: *Our [in SPS] Level 3 rewrites were always intended to include printed materials, but the evidence from my project helped to reinforce this decision.* This project has influenced how teaching of physics and astronomy is approached at the OU. Alexis reports: *This [project] has enabled me to frame questions on how students learn and extend this to other areas and technologies, for example, the recent project on the usability and accessibility of Jupyter notebooks[143] when used for teaching [Computing].*

142 Cognitive Load Theory, https://www.sciencedirect.com/topics/psychology/cognitive-load-theory; also, Sweller, J. (2010). Element interactivity and Intrinsic, extraneous, and germane cognitive load. *Educational Psychology Review*, vol. 22, no. 2, pp. 123–138.

143 Accessibility of Jupyter Notebooks on M269, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/other/accessibility-jupyter-notebooks-m269 or https://tinyurl.com/uhexesst; M269 Algorithms, data structures and computability, https://www.open.ac.uk/courses/modules/m269

Impact facet	Attribute	Description
Facet 5: Dissemination of project's outcomes	Number of publications from the project/initiative	Several publications including the end-of-project report have resulted from this project. The project leads state: *Dissemination of these [project's] results at internal and external conferences has helped other schools, faculties and universities to justify their decisions about the balance of digital vs paper-based materials for distance learning modules.*
Facet 6: Adoption of the outcomes of the project by other educators	Adoption of the outcomes internally or externally (within the institution) to improve assessment, curriculum design in the same discipline in same or different contexts	The Faculty of STEM has a better understanding of the importance of student skills-development such as onscreen study skills and note-taking skills[144]. The faculty will incorporate these lessons into future module and curriculum design. The evidence that students take time to learn to study online material and in fact to change their way of studying is feeding into discussions about online exams, particularly how students can be prepared for them. This project continues to influence how the curriculum in the School of Physical Sciences (SPS) is being developed.
Facet 7: Mutual stakeholder understanding	A community that SoTL creates and moving outside traditional silos	Alexis and Laura note: *While we have been undertaking the project, we have had heightened awareness of findings from other scholarship projects. We have learned that having a sense of belonging increases student success. Any initiative that encourages students to interact and network safely with fellow students in a formative way can contribute to a range of related positive outcomes, including those of a social nature.*
Facet 8: Personal and professional development of project team	Improved practice and personal knowledge Becoming a mentor to others Becoming a champion for SoTL Continuity in SoTL activity by individual educators	Laura has reported that the project helped sharpen her SoTL practice including developing more confidence in dealing with quantitative data. Laura is a mentor to several eSTEeM-funded SoTL projects/project-leads in her School. Since this project, Alexis has been involved in other eSTEeM funded SoTL projects.

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144 Making notes online, https://help.open.ac.uk/making-notes-online

Impact facet	Attribute	Description
Facet 9: Recognition of project team members and other stakeholders	Career trajectory that can be attributed to SoTL such as promotions Fellowships or memberships of professional associations nationally and internationally (e.g. Advance HE fellowships) Public recognition through awards	The completion of this SoTL project featured in promotion cases to Senior Lecturer of both the project leads. Soon after this project, Laura was appointed Associate Dean, Tuition Delivery in the Faculty of STEM. This project won an award[145] from eSTEeM (the OU Centre for STEM pedagogy) in the category '*Enhancing the Student Experience*' at the 4th eSTEeM Scholarship Projects of the Year Awards at the 10th eSTEeM Annual Conference or the 'eSTEeM Fringe'[146], 30 June–1 July 2021.
Facet 10: Fostering SoTL culture	Stimulating interest in SoTL Inspiring others to conduct SoTL	Laura encourages ALs and academics within SPS to lead SoTL projects, essentially acting as a scholarship champion within her School. Inspired by the SoTL practice and the possible impact of SoTL, Alexis volunteered to become a reviewer for the journal Open Learning: The Journal of Open, Distance and e-Learning[147].
Facet 11: Financial implications	Effect on costs of modules or programmes	The cost of providing the printed books for S217 was under £20 a student, providing strong justification based on this project's results that cost should not be a driver when deciding whether to include books on a module.

145 Two for the price of one, https://www.open.ac.uk/scholarship-and-innovation/esteem/news/two-price-one

146 The 10th eSTEeM Annual Conference: STEM Scholarship for a changing world – Disruption, Innovation and Impact, https://www.open.ac.uk/scholarship-and-innovation/esteem/events/10th-esteem-annual-conference-stem-scholarship-changing-world---disruption-innovation-and or https://tinyurl.com/bde8amye

147 Open Learning: The Journal of Open, Distance and e-Learning, https://www.tandfonline.com/action/journalInformation?journalCode=copl20

Impact facet	Attribute	Description
Facet 12: Funding opportunities	Internal (within the institution) funding for follow-on activities or further initiatives or new projects or events based on SoTL project's success	Alexis has continued to grow her SoTL practice[148] with support from eSTEeM. Alexis states: *For me, a clear project outcome is that cognitive load theory provides a useful framework for understanding how students learn from the materials that we provide.* *At present, with Sharon Dawes in C&C, I am running an eSTEeM project focussing on the usability and accessibility of Jupyter notebooks for learning, teaching, and assessment[149]. Sharon and I hope to understand the feedback we receive from students and tutors in the context of intrinsic, germane and extraneous cognitive load.*

11.5   Reflections on SoTL practice

For realising changes or improvements based on the outcomes of a SoTL inquiry, sometimes having an influence of the SoTL practitioner through position or a particular role helps to implement the change for generation of possible impact.

For example, Laura reflects on the change to physical books and her membership of an important decision-making group (Board of Studies) that enabled her to argue for physical books. In the meetings of this group, she presented the evidence (students' requirements) from her SoTL project, and she was able to justify the additional expense that the faculty would have to incur in sending printed books to students for a positive student experience.

Laura said (underlined text in the quote is to add the emphasis):

This [return to physical books] was already under discussion by the BoS [Board of Studies] Exec [Executive] and the module team, as many students had requested them. The evidence from his project helped us to justify the expense of doing this. I do feel that this was easier because as Lead Staff Tutor in SPS. <u>I am a member of the BoS Exec, not sure how easy it would have been if I had 'just' been a ST [staff tutor]</u>.

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148 Alexis' profile on eSTEeM's website that lists her SoTL projects, https://www.open.ac.uk/scholarship-and-innovation/esteem/people/alexis-lansbury

149 Accessibility of Jupyter Notebooks on M269, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/other/accessibility-jupyter-notebooks-m269 or https://tinyurl.com/uhexesst; M269 Algorithms, data structures and computability, https://www.open.ac.uk/courses/modules/m269

Laura has further reflected on how her membership of Board of Studies helped to initiate change (underlined text in the quote is to add the emphasis):

> *We are currently updating much of our Level 2 and Level 3 curricula. The new S284 [Astronomy] module was originally conceived as an entirely online module. However, based on the evidence from this study I argued strongly for a paper summary/handbook to be included, and this has been very popular in the first presentation in 20J. Again, though, <u>I had the opportunity to do this as a member of the BoS, not all STs [Staff Tutors], and certainly very few ALs [Associate Lecturers] are members of the BoS</u>.*

To conclude, the project team's reflections are:

> *Covid has shifted this debate [online learning resources and physical books] considerably, and there is a risk that this work gets lost in the wider changes. Most other institutions who have moved to 'online/distance learning' because of Covid think of online learning as making X lectures available every week to teach the content, with copies of the slides used for reference. i.e., the teaching is done through the lectures. That is completely different from the OU approach, and we really need to focus on communicating this.*
>
> *OU study is largely a flipped classroom, i.e., we expect students to study the material themselves first, and then attend tutorials/ contact their tutor if they have questions about it. There is a risk that other institutions will take our findings out of context and try and apply them to their understanding of distance teaching.*

The team added:

> *We have evidence that age is not a predictor of whether students will prefer, or cope well with, on-screen study.*

11.6 Project resources and references

Project resources

End-of-project report: An investigation into how STEM students use learning resources in different formats, and how this use develops over time. Available at: https://oro.open.ac.uk/78170/

Poster: Alexander, L. and Lansbury, A. (2017). What is the impact of students being required to develop different learning strategies part way through their studies, due to meeting modules which rely on different media for learning resources? Available at: https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/supporting-students/investigation-how-stem-students-use-learning-resources-different or https://tinyurl.com/59dv4k6x

Alexander, L. and Lansbury, A. (2020). Should virtual learning mean on screen learning? In: *Variety in Chemistry Education / Physics Higher Education Conference* (VICEPHEC) 2020. Available at: https://oro.open.ac.uk/78172/

Alexander, L. and Lansbury, A. (2019). How do STEM students use digital and non-digital learning resources? In: *Advance HE STEM Conference*, 30–31 Jan 2019, Birmingham UK. Available at: https://oro.open.ac.uk/69107/

12 [J6] Predictions of at-risk students

Fact box

Title	Predictions of at-risk students
Aim of the SoTL inquiry	The aim of this project was to investigate the possible errors made by Machine Learning models in predicting students as risk of not submitting their assignments.
Type of inquiry[150]	'What is wrong?'
Led by	Knowledge Media Institute[151], Faculty of STEM
Contact	Martin Hlosta[152], martin.hlosta@ffhs.ch
Theme	Supporting student journey
Research methods	predictive learning analytics, interviews, thematic analysis
Duration	2019 – 2020
Keywords	at-risk students; predictive learning analytics; student retention; student support
Webpage	Disproved predictions of at-risk students: Some students fail despite doing well, others succeed despite predicted as at-risk, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/supporting-students/disproved-predictions-risk-students-some-students-fail-despite or https://tinyurl.com/ycxnr9z4

12.1 Context and aim of the SoTL inquiry

Most of the research around the identification of at-risk students and the prediction of their performance by Predictive Learning Analytics (PLA) using Machine Learning (ML) models focuses on developing the most accurate model. Despite recognising the importance of these models in improving academic practice and student outcomes, little effort has been made to investigate the errors made by these models. The accuracy, and related errors, of PLA systems can negatively influence their adoption (Hlosta *et al.*, 2022).

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150 'Areas of investigation in SoTL', in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109157&section=3.3

151 Knowledge Media Institute, https://kmi.open.ac.uk/

152 Dr Martin Hlosta is a former member of the Knowledge Media Institute (KMi). In KMi, Martin was a Research Fellow leading the OU Analyse project team, https://kmi.open.ac.uk/people/member/martin-hlosta. Martin is now a Senior Researcher at the Institute for Distance Learning and eLearning Research (IFeL), leading research and teaching in Learning Analytics https://www.ffhs.ch/en/ffhs/people-finder/person/hlosta-martin.

The aim of this project was to analyse errors of predicting students at-risk and investigating the reasons for predictions provided by ML models sometimes not corresponding to reality. More specifically, the project team examined the predictions made by OU Analyse[153] (OUA) for The Open University (OU) students that were at risk of not submitting or failing their first Tutor Marked Assignment (TMA).

OUA predicts on a weekly basis whether a given student will submit their next TMA. It uses a traffic light system to indicate in red students at risk, in amber those with a moderate probability of failing, and in green those who are unlikely to fail. The data from OUA is visualised in Early Alert Indicators (EAI) Dashboard, a predictive analytic modelling tool, available to Associate Lecturers (ALs) which combines information for the student cohort that an AL is assigned to support and individual student predictions and their justification. EAI provides insight into students' online study engagement levels, so that timely AL support can be offered when student engagement appears to have waned. The goal of making predictions (within the EAI dashboard) is to help ALs plan and implement intervention(s) to provide personalised and targeted support and, thereby, help towards student retention. The models are updated weekly to capture the changes in student learning behaviour.

12.2   Underpinning research of the SoTL inquiry

The focus of the inquiry was on predictions for the first TMA on undergraduate Level 1 modules in the STEM faculty. The first assignment in the first year is when dropout is more likely to happen, hence it was selected as the focus of this inquiry. Moreover, greater similarity in the learning design of modules could be achieved by selecting modules from a single faculty, hence the selection of modules from STEM.

The project team analysed two groups of errors:

(a) students predicted to submit their assignment, yet they did not (False Negative; FN); and

(b) students predicted not to submit their assignment, yet they did (False Positive; FP).

A mixed-method analysis was conducted to combine quantitative analysis of predictions for more than 25,000 students with follow-up online semi-structured interviews with 27 students whose predictions presented FN or FP errors. The interviews were analysed by applying thematic analysis. The underlying predictive model which was used to predict which students are at risk of not submitting their next assignment, used four types of data:

- *Static demographics* - Index of Multiple Deprivation (IMD) of the area where the student lives, ethnicity, and gender.

- *Other static data known at the start of a course* - previous study results, study workload, i.e. the number of courses studied, and indicators of whether the course is repeated.

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153 OU Analyse is a system powered by ML methods for early identification of students at risk of failing. All students with their risk of failure in their next assignment are updated weekly and made available to the course tutors and the Student Support Teams to consider appropriate support. The overall objective is to significantly improve the retention of OU students. For more details, please visit: OU Analyse, https://analyse.kmi.open.ac.uk/

- *Virtual Learning Environment (VLE) interactions* - weekly aggregated number of clicks per different activity types (e.g. forum, pdf resources, HTML content, homepage visit, tutorial attendance), and weekly summary activity.

- *Previous assignment scores* - only used for predicting the TMA02 and onwards.

The project team selected the predictions two weeks before the first TMA, where the predictions were deemed to be accurate, yet there was still time for a possible intervention that could result in a change in student's behaviour such as incentivising students to submit their TMA. To analyse the interviews, the participants were grouped as follows:

(a) students predicted to submit TMA01, yet they did not submit (FN; n=13); and

(b) students predicted not to submit TMA01, yet they submitted (FP; n=14).

12.3 Findings of the SoTL inquiry

The quantitative analysis revealed that both types of errors (FPs and FNs) were associated with a change of student activity after the predictions were generated and in the last week before the TMA was due. There was either a drop for students that seemed on track, or a steep increase in at-risk students. The presence of younger and more educated students in FP might suggest that for these groups it can be easier to put in last minute effort and succeed, while for the older and less education students, it might be harder to do that (for example, they may have limited time available or other obligations).

Interviews revealed that the most prevalent themes were students that were working last minute and were able to overcome last-minute problems, students that had high study workload and dropped some of their other modules, or students who had either the knowledge required for the TMA or studied outside the VLE. In FPs, non-submission of assignments was explained mostly by financial reasons, family responsibilities, or deferring the module because of high study workload.

The interviews with 14 FPs revealed the reasons for the predictions to be inaccurate were in four themes: a) students catching up on their studies last minute, b) prior student knowledge about the topic of the assignment, c) using external (non-VLE) resources and d) decrease of workload (that is, number of enrolled credits). Students' prior or existing knowledge implies that students don't need to study as much as other students and are found to be much less active in the VLE, and this triggers at-risk predictions.

The 13 FNs revealed the significance of unexpected events during studies that explain why students did not submit, despite their high chances of submitting, which cannot be foreseen and accounted for in PLA: 1) financial problems, 2) deferral to focus on another module, 3) changes in family and work responsibilities, and 4) other issues included aspects such as a lower weighting for the first assignment (so the student did not feel it was worth submitting), language issues, not being able to access the internet, or illness.

12.4 Key lessons and details of the impact

The project team was aware of the role that OUA and the subsequent AL intervention can play in student retention. Several pilots in the previous years (for example, Herodotou *et al.*, 2017, 2019a, 2019b and 2020) had identified that ALs accessing OUA at least 41% of the weeks a module runs had better student retention rates (56%) compared to 48% retention of the low engagement group (<=8% weekly usage); ALs had better student outcomes the year they were accessing OUA than the previous years when they had no access to it, with particular benefit for economically disadvantaged students (Hlosta *et al.*, 2021).

Interview data helped identify new data sources, which could be integrated into predictions to mitigate some of the errors, such as study loan application information. For example, flag whether a student has applied for a loan for the module; status of the application for a loan; and the price area (England, Wales, Scotland). Despite the student being active on the VLE, not obtaining the student loan can mean they are at risk of deferral. This can enable ALs to identify that the student does not need study help but rather some financial advice.

OUA considers student's workload, but it does not consider their situation in other modules. The interviews revealed that some students, despite being enrolled in more than one module, handle their studies well. Knowing that the student is active and submitting their TMAs in more than one module suggests that the workload itself is not an issue and might resolve some of the potential FPs. Because of this SoTL project, the 'student workload' has been re-created in the analytics and provided with a clear definition in the dashboard.

The tutorial data is not yet in the predictions, but the data was made available in the dashboard (see **Figure [J6].1**) to provide an integrated view to ALs whether students booked their tutorials, attended them or whether they downloaded the materials related to the tutorials afterwards. Some ALs have informed the project team about the usefulness of the tutorial data in assessing student progress.

Although tutorial data and financial information weren't in the predictions, the identification of these factors, their complexity and the need for reliable data in this SoTL project led to discussions that how factors such as these could lead to FPs and FNs.
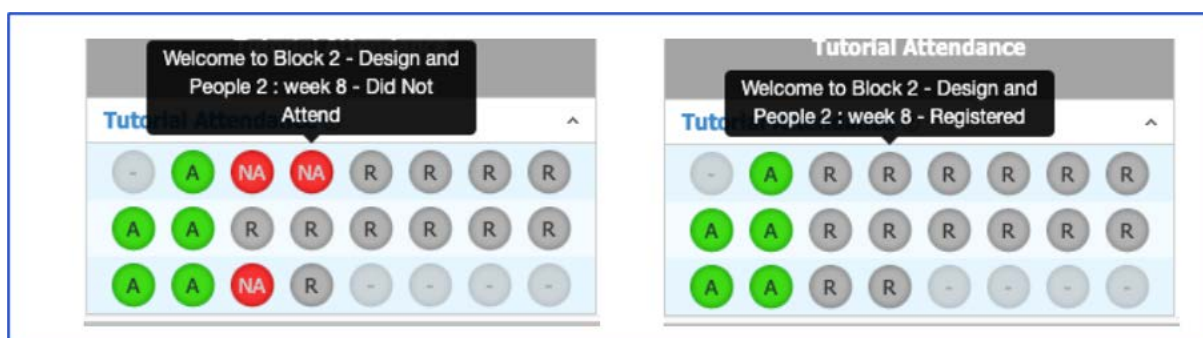

Figure [J6].1 Dashboard showing the registration and attendance in online tutorials in a module

This project's findings have shown that there are unexpected circumstances which occur during study, such as changes in family and/or work responsibilities, unexpected health issues and technical problems which cannot be accounted for through using PLA. To address such issues, communication with ALs, tutorial participation, peer support, and advice from student support services may help the students at-risk to work towards their TMAs.

The project's findings have shown the importance of complementing ML-based systems with human intelligence. ALs are generally aware of the factors/events affecting a student's progress which are invisible to ML algorithms. ALs can, therefore, intervene by providing guidance, encouraging tutorial participation, and suggesting seeking help from student support services, if needed.

The fact that even high accuracy PLA manifests some errors should not discourage its use by ALs. An increasing body of evidence points to PLA's role in increasing student pass and completion rates as well as teaching practice when used systematically by educators.

Based on the facets and attributes of the impact evaluation instrument (**Appendix 1**), the Table below details the impact of this SoTL inquiry.

Impact facet	Attribute	Description
Facet 2: Student retention and progression	Student retention rate Student progression	This SoTL inquiry has shown the inability of PLA to capture the occurrence of unpredictable events in students' lives. ALs should be aware that errors may occur in models and use model data in conjunction with other information they may have from their direct communication with students to support students. Hence, relying on PLA alone isn't sufficient for predicting at-risk students. This SoTL inquiry has shown that the role of the AL/tutor is ever more significant in capturing the uncertainties around students' study behaviours and to intervene accordingly. For example, tutors could direct students to a recording of a tutorial, or advise students about time management strategies, or offer one to one support with understanding concepts. Martin reflects on the implications of the findings: *Combined with the previous evidence of the benefits of OUA for student retention, it seems that the best results might be achieved by combining the strengths of tutors and the analytics informed dashboards.*

Impact facet	Attribute	Description
Facet 3: Evidence of excellence in teaching	Evidence of research-informed teaching Inter-disciplinary collaborations in teaching Informing policy development internally at the level of department, Faculty or University	The research in this project has enabled researchers and data scientists to identify which factors, if properly processed, can potentially mitigate some of the limitations of PLA. The financial situation around student loans at the OU is one such example, but it would require better quality of the data to be reliably considered in the models/predictions. Martin notes: *Despite we know how important this factor is, i.e., if a student loan is not put through, it brings issues not related to learning which can slow down or even stop student from studying at the OU. But the careful capturing of this information is not precise now, so it is not possible to reliably use it.* The project team argues that the fact some predictions might be disproved should not discourage tutors from using PLA systems. Predictions should not be viewed and interpreted as determining a future result. Instead, they should be seen as an estimate of an outcome which would have occurred if no change occurred. The project team, therefore, has recommended that ALs should be offered training to gain insights into the benefits and limitations of PLA so that they develop the skills and knowledge needed to evaluate prediction outcomes and not discard them just for the mere fact that, in some cases, they may produce errors. The end-of-project report of this project is available on OU's intranet as an academic development resource for the ALs/tutors[154]. Martin reflected on the project's significance: *Based on the qualitative and quantitative analysis, we have improved the transparency of study workload definition, and included the caveats and sources of potential errors that can occur even in the case of sophisticated predictive models. These [results of this SoTL project] are now available for tutors in TutorHome [a portal for ALs/tutors on OU's intranet].*

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154 What are Early Alert Indicators and how do they support ALs in their practice? https://openuniv. sharepoint.com/sites/intranet-tutor-help-centre/Pages/introduction-to-early-alert-indicators. aspx or https://tinyurl.com/bdh6zxjf (**requires OU staff login**)

Impact facet	Attribute	Description
Facet 5: Dissemination of project's outcomes	Number of publications from the project/initiative	Martin reported: *"The dissemination in form of presentations helped other OU staff members (tutors, module chairs, scientists) to understand the limitations of predictive analytics. Moreover, these interactions allowed [us] to explain that we [SoTL project team] are aware of these potential sources of errors [with PLA]."* The SoTL project team has published the results in leading learning analytics conferences – LAK[155] and AIED[156]. Findings from this project have also been published in a journal paper (Hlosta *et al.*, 2022).
Facet 6: Adoption of the outcomes of the project	Adoption of the outcomes internally (within the institution) or externally to improve assessment, curriculum design in the same discipline or in other disciplines.	This project's resources are included in the academic development resources for ALs or tutors for their academic development and in the section on 'Early Alert Indicators' (EAI)[157].
Facet 7: Mutual stakeholder understanding	A community that SoTL creates and moving outside traditional silos	The outputs of this project have helped various members of staff at the OU (tutors, module chairs, researchers, data scientists and students themselves) to understand the current limitations of PLA, and yet these limitations should not discourage them to use PLA. Based on the research, the project team was contacted to peer-review and comment on a paper[158] on online learning analytics by Simon Buckingham-Shum[159] of University Technology Sydney. This SoTL project is featured in Simon's paper.

155 International Conference on Learning Analytics and Knowledge (LAK), https://www.solaresearch.org/events/lak/

156 The International Artificial Intelligence in Education Society (IAIED), https://iaied.org/about

157 Early Alert Indicators, https://openuniv.sharepoint.com/sites/intranet-tutor-help-centre/Pages/early-alert-indicators-ou-analyse.aspx or https://tinyurl.com/yc4dea2u (**requires OU staff login**)

158 Should predictive models of student outcome be "colour-blind"?, http://simon.buckinghamshum.net/2020/07/should-predictive-models-of-student-outcome-be-colour-blind

159 Simon Buckingham-Shum is Professor of Learning Analytics, Director of Connected Intelligence Centre and Deputy Vice-Chancellor (Education and Students), University Technology Sydney, https://profiles.uts.edu.au/simon.buckinghamshum

Impact facet	Attribute	Description
Facet 8: Personal and professional development of project team	Continuity in SoTL activity by individual educators Improved practice and personal knowledge	The success of this SoTL project and the significant outcomes led to another eSTEeM-funded project related to investigating BAME[160] awarding gaps on a large scale[161]. A member of OUA team started his PhD in October 2020 on a related topic to this SoTL project. Martin has noted: ❝ *This project has led to a greater understanding of mid-size research projects at the OU, the complexities of all the [ethical] approvals and it helped us to better plan [research] and write the next set of research proposals. The project has helped a PhD student and a tutor with deepening their knowledge in interviewing and qualitative analysis.* ❞
Facet 9: Recognition of project team members and other stakeholders	Invited speaker to events/conferences internally and externally Public recognition through awards	The research on OUA[162], of which this SoTL project represents one workstream, is a major programme of the OU and researchers are increasingly being called upon both internally and externally to support educators in the use of predictive analytics and to advance knowledge in this area. The OUA team has received several awards over the years[163]. EAI Dashboard is the result of bringing two systems together: OU Analyse (OUA, investigated in this SoTL inquiry) and the Student Probability Model (SPM)[164]. The EAI Dashboard aims to provide greater visibility of the engagement levels of students with their online studies, so that AL/tutor support can be offered in a timely fashion when it appears that engagement has waned. The SPM produces predictions of whether an individual student will reach specific milestones (different points in a course presentation or between courses) such as completing and passing a course or returning in the next academic year. Predictions or probabilities in the SPM are based on models generated through logistic regression of a set of 70 explanatory variables. These predictions are generated at the start of the module and updated periodically and offer long-term predictions.

160 BAME: Black Asian Minority Ethnic
161 Understanding the BAME attainment gap at the OU by means of quantitative and qualitative data analytics, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/other/understanding-the-bame-attainment-gap-the-ou-means-quantitative-and or https://tinyurl.com/yxjcec5k
162 OU Analyse, https://analyse.kmi.open.ac.uk/
163 OU Analyse, Media, https://analyse.kmi.open.ac.uk/#media
164 Introduction to Early Alert Indicators (EAI), https://openuniv.sharepoint.com/sites/intranet-tutor-help-centre/Pages/introduction-to-early-alert-indicators.aspx or https://tinyurl.com/bdh6zxjf (requires OU staff login)

Impact facet	Attribute	Description
Facet 10: Fostering SoTL culture	Stimulating interest in SoTL Inspiring others to conduct SoTL	About stimulating interest in SoTL and inspiring others to conduct SoTL, Martin said: *The project helped to understand how the scholarship projects work and directly led us to the subsequent [SoTL] project, which is specifically focusing on errors for minor ethnicity students and on the awarding gaps of these students in general.* *Thanks to this [SoTL] project, four other colleagues in KMi have now started engaging with SoTL.*
Facet 11: Financial implications	Effect on costs of modules or programmes	Although the costs of student drop-out and student retention have not been accounted for in this SoTL project, the ethos of the project is to improve student retention through guiding ALs about the at-risk students.
Facet 12: Funding opportunities	Internal (within the institution) funding for follow-on/new projects/initiatives/events based on SoTL project's success	This SoTL inquiry has led to a new eSTEeM-funded research project related to BAME[165] awarding gap[166]. This project related to BAME awarding gaps has ended and the end-of-project report is available[167]. This follow-on project's aims were to understand the patterns of divergences for students designated as BAME and other students, to understand where the attainment gap happens and what are the other factors contributing to the gap.

165 BAME: Black Asian Minority Ethnic
166 Understanding the BAME attainment gap at the OU by means of quantitative and qualitative data analytics, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/other/understanding-the-bame-attainment-gap-the-ou-means-quantitative-and or https://tinyurl.com/yxjcec5k
167 End-of-project report: Understanding the BAME attainment gap at the OU by means of quantitative and qualitative data analytics. Available at: https://analyse.kmi.open.ac.uk/resources/documents/eSTEeM_final_report_BAME_final_submission.pdf or https://tinyurl.com/msspkhtj

12.5   Reflections on SoTL practice

The project focused on the mixed-method analysis of ML errors of PLA models used in OUA for the first TMA in Level 1 STEM modules. Quantitative analysis of the patterns in the data was followed by interviews. The two research methods complement one another to enable a thorough analysis by the research team.

Martin has reflected on the mixed-method research design:

If you combine robust quantitative and in-dept qualitative analysis of your predictions with students, it can help you to understand the limits of predictive analysis. Moreover, it can reveal features that should be revisited or included in your predictions to improve the model.

Data-driven analysis such as the use of predictive learning analytics might not always be sufficient and can be strengthened and made richer through investigating individual student experiences through interviews, as this project has demonstrated.

Quantitative methods are rather dominant in the LA [Learning Analytics] field, especially due to rich VLE traces. On the other hand, by interviewing students and using a qualitative methodological approach, our findings can fill the gap of unexplained variance from prior quantitative research (Hlosta et al., 2022).

To conclude, Martin's reflections on this SoTL project are:

… there is vast number of papers in the Learning Analytics but none of them analyses where the errors happen. There is a huge gap in terms of transparency. This research also helps to answer the anecdotal comments of various educators, pointing where ML models most likely fail. This research enables to answer these questions in a rigorous way.

12.6   Project resources and references

Project resources

End-of-project report: Disproved predictions of at-risk students: Some students fail despite doing well, others succeed despite predicted as at-risk. Available at: https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/supporting-students/disproved-predictions-risk-students-some-students-fail-despite or https://tinyurl.com/ycxnr9z4

Hlosta, M., Herodotou, C., Papathoma, T., Gillespie, A. and Bergamin, P. (2022). Predictive learning analytics in online education: A deeper understanding through explaining algorithmic errors. *Computers and Education: Artificial Intelligence*, vol. 3, article no. 100108. Available at: https://oro.open.ac.uk/86075/

Hlosta, M., Papathoma, T. and Herodotou, C. (2020). Explaining Errors in Predictions of At-Risk Students in Distance Learning Education. In: *Artificial Intelligence in Education, Lecture Notes in Computer Science* (LNCS), Springer, pp. 119-123.

Notes: This details the second part of the project, covering 12 out of 27 interviews that were available at the time of submission.

Hlosta, M., Zdrahal, Z., Bayer, V. and Herodotou, C. (2020). Why Predictions of At-Risk Students Are Not 100% Accurate? Showing Patterns in False Positive and False Negative Predictions. In: *Proceedings of the 10th International Conference on Learning Analytics and Knowledge (LAK20)*, 23-27 Mar 2020, Frankfurt am Main, Germany.

Notes: This paper is focused around the first part of the project: the quantitative explanation of the errors.

References

Hlosta, M., Herodotou, C., Bayer, V. and Fernandez, M. (2021). Impact of predictive learning analytics on course awarding gap of disadvantaged students in STEM. In *International Conference on Artificial Intelligence in Education*, pp. 190–195.

Herodotou, C., Rienties, B., Hlosta, M., Boroowa, A., Mangafa, C. and Zdrahal, Z. (2020). The scalable implementation of predictive learning analytics at a distance learning university: Insights from a longitudinal case study. *Internet and Higher Education*, 45, article no. 100725. Available at: http://oro.open.ac.uk/68953/

Herodotou, C., Hlosta, M., Boroowa, A., Rienties, B., Zdrahal, Z. and Mangafa, C. (2019a). Empowering online teachers through predictive learning analytics, In: *British Journal of Educational Technology (BJET)*, vol. 50, no. 6, pp. 3064–3079. Available at: http://oro.open.ac.uk/62192/

Herodotou, C., Rienties, B., Boroowa, A., Zdrahal, Z. and Hlosta, M. (2019b). A large-scale implementation of Predictive Learning Analytics in Higher Education: the teachers' role and perspective. *Educational Technology Research and Development*, vol. 67, no. 5, pp. 1273–1306. Available at: http://oro.open.ac.uk/62191/

Herodotou, C., Rienties, B., Boroowa, A., Zdrahal, Z. Hlosta, M. and Naydenova, G. (2017). Implementing predictive learning analytics on a large scale: the teacher's perspective. In: *Proceedings of the Seventh International Learning Analytics & Knowledge Conference*, ACM, NY, pp. 267-271. Available at: http://oro.open.ac.uk/48922/

13   [P1] Interactive virtual visits

Fact box

Title	Are virtual visits an effective way of engaging learners?
Aim of the SoTL inquiry	The aim of this project was to investigate if a live interactive virtual visit to Bletchley Park Museum using technologies such as onscreen polls, multiple choice questions and a chat box was an effective way of enhancing student experience.
Type of inquiry[168]	'Does it work?'
Led by	Careers and Employability Services (CES) and School of Computing and Communications (C&C), Faculty of STEM
Contact	Chris Gardner, chris.gardner@open.ac.uk
Theme	Providing authentic experimental and practical learning
Research methods	survey, onscreen widget analytics
Duration	2019 - 2021
Keywords	employability; student support; virtual visits; widening participation
Webpage	Are virtual visits an effective way of engaging learners?, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/supporting-students/are-virtual-insight-visits-effective-way-engaging-learners-and or https://tinyurl.com/bdzuabcd

13.1   Context and aim of the SoTL inquiry

Participating in field trips and insight visits can be highly beneficial for students (Claiborne *et al.*, 2012). However, factors such as geographical location, disability and time- or family-constraints can prevent students studying at a distance from participating in in-person or physical field trips (Roosmaa *et al.*, 2017; Rasheed *et al.*, 2020).

Students' inability to participate in physical field trips may negatively impact their experience, outcomes and graduate employability (Butcher, 2015; Baxter, 2019). Despite advances in technology, the concept of live virtual visits has not been fully exploited. Most virtual visits delivered by universities, museums and employers are passive experiences (for example, via pre-recorded videos) and involve limited social learning opportunities.

The Open University (OU) has an excellent history of delivering engaging labcasts (Crabb *et al.*, 2022) and fieldcasts (Cooke, 2020)[169] where onscreen widgets are used to enable remote participants to engage with each other and the presenters. This has led to an exploration of how the same technologies could be used in other ways for the benefit of students, such as for off-campus virtual visits.

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168 'Areas of investigation in SoTL', in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109157&section=3.3 or https://tinyurl.com/29t7z2my

169 Video activity: 'Evaluating 'The Open Field Lab' initiative', in 'Scholarship of Learning and Teaching in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109325&section=2.2.4

The Careers and Employability Services (CES) and the School of Computing and Communications (C&C) came together in this SoTL inquiry to investigate whether students could benefit from a live, online co-curricular social learning opportunity. This eSTEeM funded SoTL project investigated whether C&C students found a virtual visit to Bletchley Park Museum engaging. Many C&C students are interested in the World War II codebreaking that took place at Bletchley Park[170] and how the history of codebreaking relates to present day computing and information technology.

13.2   Underpinning research of the SoTL inquiry

Block B at Bletchley Park was selected for the virtual visit, as it has a fascinating exhibition relating to the history of Enigma machines[171] and those involved in the code breaking during World War II. Level 2 C&C students were invited to participate in an Enigma machine demonstration led by Chris (project co-lead) and Bletchley Park's learning manager (**Figure [P1].1**). The OU 'Stadium Live'[172] platform was used so remote participants could interact with the presenters and other participants using widgets such as polls and a chat box.

The virtual visit took place in a single evening and was filmed and produced by three OU media developers. The widgets and chat box were moderated by two OU staff members. At the start of broadcast, a map widget was used to gain a sense of locations of the participants and an opportunity for participants to become accustomed to use of the widgets. Participants were asked questions relating to the Enigma Machine using the widgets and chat box. The level of questions posed by the presenters increased as the virtual visit progressed.

A mixed-method approach was used to evaluate the virtual visit involving use of the OU student data, onscreen widget analytics and a participant survey. The OU student data used included gender, disability status, age, geographical location, and Index of Multiple Deprivation (IMD). Evaluation of usage of onscreen widgets and chat box was conducted to assess participant engagement during the virtual visit. An eight-question student participant survey using 1–5 Likert scale[173] was used to assess student experience.

13.3   Findings of the SoTL inquiry

The research findings are as follows:

- 101 students (of which 75% were studying qualifications linked to the School of C&C) and 63 OU staff members participated in the Interactive virtual visit which indicated interest in the event beyond the original target audience (students).

- 20% of students who participated had a disability.

- 42% of students resided in locations which are identified as being in the lowest 50% of the Index of Multiple Deprivation.

- 139 participants used the onscreen widgets, and 144 messages were posted in the chat box by 133 participants.

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170   Bletchley Park, https://bletchleypark.org.uk/
171   Engima, Bletchley Park, https://bletchleypark.org.uk/our-story/enigma/
172   Webcasts@OU, https://stadium.open.ac.uk/stadia/index.php?s=31
173   Likert scale, https://en.wikipedia.org/wiki/Likert_scale

- Using a 1-5 Likert scale (1 = not at all, 5 = a lot) and by calculating the median value of responses, the student survey found that the virtual visits increased study motivation and student experience 'quite a bit (4/5)'.

- 54% of respondents said they would find it difficult to visit Bletchley Park; yet 100% expressed the wish to visit the museum in person in future.

- 100% of respondents said they would like to participate in future interactive virtual visits.

Reflections from the project team indicated how collaborative working between the OU and Bletchley Park Museum was vital to the project's success. The findings indicate that interactive virtual visits are an effective way of engaging students and can remove participation barriers. The findings may also show that virtual visits promote real-world interest in locations, and don't replace physical (in-person) visits.

Post-event student satisfaction was high. Two representative quotes from participating students are:

"

Fired my enthusiasm for the subject; Helped put a physical view on the theory studied.

"

Tom Briggs, Learning Manager, Bletchley Park Museum spoke about his experiences of organising a virtual visit:

"

I think the virtual visit went really well. I have worked on similar things before, but nothing with this level of interactivity. From my point of view being involved was an amazing experience.

"

Figure [P1].1 Presenters (Left: Christine Gardner, The Open University, right: Thomas Briggs, Bletchley Park Trust) discussing the Enigma Machine

13.4 Key lessons and details of the impact

The project team has identified the following benefits of live interactive virtual visits:

- enhancement of student motivation and experience;

- ability to offer visits at larger scale than in-person visits;

- increasing the breadth/diversity of students who can participate;

- promotion of webcast location (encourage site visits); and

- participant engagement during the virtual visit indicates that live interactive visits promote social cognitive learning which is harder to achieve during pre-recorded and augmented reality[174] based virtual tours.

The project team has concluded that virtual visits could be an excellent 'welcome' or 'bridging' activity for students. The team recommends:

- The expected number of participants must be closely considered when designing live virtual visits as the number will affect broadcast structure, activities, and moderation.

- Virtual visits must closely link to teaching, learning and assessment for students to feel that the visits directly support their studies.

The findings of this project have shown how the concept of virtual visits can enhance OU student employability. Virtual visits to employer locations such as factories may allow students to virtually visit and learn about workplace environments that they would typically not be able to access. Virtual visits may help some students make more informed career decisions. Furthermore, employers may find that use of virtual visits could increase the diversification of applications it receives. Students with barriers to education participation may not always be able to attend insight visits organised by employers. This could limit the breath of applications employers receive and prevent them from achieving Equality, Diversity, and Inclusion (EDI) objectives and diversity in workforce.

Interesting future research directions include investigating if interactive virtual visits to employers improves the diversity of candidates who apply for work with them, and whether interactive webcasts could be used as a method of reducing student mathematics anxiety.

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174 Augmented reality, https://en.wikipedia.org/wiki/Augmented_reality

Based on the facets and attributes of the impact evaluation instrument (**Appendix 1**), the Table below details the impact of this SoTL inquiry.

Impact facet	Attribute	Description
Facet 1: Student experience	Learning design Student engagement with course content Student engagement with the technological intervention	Chris and David[175] discuss their reflections on student engagement and experience. Chris notes: *Student engagement at the event was good, with the interactive widgets being well received.* David comments: *Interactive webcasts to locations such as industry or museums can expose students to environments, they would not typically be able to access for reasons such as geographical location or disability. The key benefit of delivering live webcasts using learning technology such as onscreen polls is they are an active experience which promotes social learning. This improves audience engagement and experience. Use of learning technology also allows presenters to adapt content to meet audience needs and interests.*
Facet 2: Student retention and progression	Student registrations Module completion rate Module pass rate Student retention rate Student progression	The timing of the virtual visit was aimed towards maintaining student motivation between modules and levels, thus supporting retention of students across the qualification. Chris reports: *Student progression was one of the wider objectives for running the event. There is a gap between modules during the summer, and this event was timed to run in the study gap. Hopefully this kept the students interested in topics relating to their degree.* David notes: *The extent to which the virtual visit had a positive impact on retention and progression is unclear as these aspects were not the primary focus of this project; further, there is difficultly proving whether the virtual visit was cause of any change towards retention and progression rates.*

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175 David Conway, formerly of OU's Careers and Employability Services (CES), left the OU in February 2023 to take up a role at another UK institution.

Impact facet	Attribute	Description
Facet 3: Evidence of excellence in teaching	Student skills-set Inter-disciplinary collaborations in teaching Informing policy development internally at the level of department, Faculty or University	The project was a collaboration between CES in Academic Services and the School of C&C It is rare for a team in Academic Services to collaborate with a School (and academics) on scholarship projects. David comments: *Collaboration between Academic Services teams such as the careers service or student support can add a different dimension and/or perspective to [SoTL] project design and its findings. This can increase a project's impact.* The findings of this project (as discussed above) have shown how the concept of interactive virtual visits could be used to enhance OU student employability. Chris reports: *There was an element of problem-solving, as students were asked multiple choice questions during the event. Although this was not direct group-working, all results were displayed on screen, so there was an element of collaboration in the activities, sharing results. There was also a focus on digital literacy, as students were engaging in a technology that was probably new to them.* Chris further notes: *As the event was organised jointly between C&C and the careers department, one of the objectives was to enhance student employability by helping develop their digital literacy skills, and collaboration [in online environments].* *There is the potential for inter-disciplinary collaborations via virtual visits, as the venue can be any kind of physical place that would be interesting to visit, such as museums, galleries, educational institutions, workplaces, etc.*
Facet 4: Influence on discipline-based teaching, research, and practice	Change in the ways in which subject concepts are taught	This project has influenced a change in the approach in how physiology is taught in Health Sciences and in Sport, Fitness and Coaching at the OU – as discussed below in **Facet 6**.

Impact facet	Attribute	Description
Facet 5: Dissemination of project's outcomes	Number of publications from the project/ initiative	The project has been widely disseminated resulting in publications and project resources listed at the end of this case study.

David relates:

"

Following the dissemination of the project at the AMPS conference[176], an academic based in India contacted me to discuss further. They were interested in using interactive webcasts to expose nomadic Indian sheep herders to environments they would typically not have access to. This may help them transition to different ways of life more effectively and make more informed decisions on whether to leave herding communities. The academic has not been able to test the webcast concept to date due to fluctuating Covid transmission rates in India.

" |

176 Conway, D., Gardner, C. and Hughes, J. (2021). Are virtual insight visits an effective way of engaging learners? In: Architecture, Media, Politics, Society (AMPS) Conference Online Education: Teaching in a Time of Change, 21-23 Apr 2021, (Video) Available at: https://www.youtube.com/watch?v=e8pAajojGVY&list=PL6zYdPl0DZ2ruGlBxeTTHvfGA5gUnuiW8&index=34 or https://tinyurl.com/cu64fmtj (17 minutes)

Impact facet	Attribute	Description
Facet 6: Adoption of the outcomes of the project	Adoption of the outcomes internally (within the institution) or externally to improve assessment, curriculum design in the same discipline or in other disciplines.	After this project, Chris was involved in another virtual event In July 2022, 'Codes, Codebreaking and Cryptography' that was aimed at Level 1 Maths, Computing and Data Science students and was jointly organised by colleagues in Schools of C&C and Mathematics and Statistics. David has reported that CES has delivered two virtual visits to employers. Although the visits were passive tours and not interactive like used in this SoTL project, the use of virtual visits was directly influenced by this project. The School of Arts and Humanities at the OU is considering if a virtual art gallery visit can be incorporated into a module, although the COVID-19 pandemic seem to have caused work in this area to be paused. Chemical Engineering academics from London South Bank University who became aware of the project through dissemination and eSTEeM's website, are exploring if webcasts can be used to deliver some lab test protocols. It is felt that webcasts could increase lab school accessibility and student attendance. Dissemination activities of the project have directly led to the inclusion of an interactive webcast in a Level 1 OU Health Sciences module[177] as a method of introducing students to real data collected during an exercise test protocol. This initiative in the Health Sciences module has influenced a Sport, Fitness and Coaching academic to start a PRAXIS project[178] which is investigating the use of webcasts in relation to exercise physiology and statistical analysis.

177 SK190 Human biology: a body in balance; planned for launch in Oct 2023, https://www.open.ac.uk/courses/health-sciences/degrees/bsc-health-sciences-q71
178 Live Physiology Webcasts, Ben Langdown (project lead), https://openuniv.sharepoint.com/sites/intranet-wels/Pages/praxis-projects.aspx (**requires OU staff login**) PRAXIS Is the Scholarship and Innovation Centre In OU's Faculty of Wellbeing, Education and Language Studies (WELS).

Impact facet	Attribute	Description
Facet 7: Mutual stakeholder understanding	A community that SoTL creates and moving outside traditional silos	Chris noted: *The event helped to consolidate understanding of some of the themes from Computing. There was a good number of academics also present at the event, thus possibly fostering a community enabled via SoTL.* Project collaboration between CES and C&C has led to their working closely to map out employability competencies across each module and qualification pathway in C&C which ensures that the Employability Framework[179] has been applied to modules and qualifications in C&C.
Facet 8: Personal and professional development of project team	Improved practice and personal knowledge Becoming a mentor to others Becoming a champion for SoTL Continuity in SoTL activity by individual educators	Chris notes: *[the project] has the potential to improve practice by helping to make teaching and learning more interactive and collaborative.* David has reported that the project has improved his media development and research skills. David now feels confident in delivering media artefacts in future without as much support as was needed for this project. David is now a critical friend to OU colleagues who are interested in using webcasts as part of a project or in curriculum design.
Facet 9: Recognition of project team members and other stakeholders	Invited speaker to events/conferences internally and externally Public recognition through awards	Members of the project team have been invited to present at events, such as the eSTEeM scholarship showcase[180] and OU's Access, Participation and Success (APS) conference, 2021[181]. This project was the 'Winner of the 5th Best Poster Competition'[182] at the 9th eSTEeM Annual Conference.

179 The Open University's Employability Framework, https://www.open.ac.uk/blogs/learning-design/wp-content/uploads/2021/04/Employability-and-Employer-Engagement-Guide-to-Learning-Design-A3-screen-CC-logo-compressed.pdf or https://tinyurl.com/59zzy8xc

180 Are virtual visits an effective way of engaging learners?, eSTEeM Seminar Series: Scholarship Showcase held on 20th April 2022, https://www.open.ac.uk/scholarship-and-innovation/esteem/events/esteem-seminar-series-scholarship-showcase-april-2022 or https://tinyurl.com/mrem7kjh

181 Are virtual insight visits an effective way of engaging learners?, https://www.youtube.com/watch?v=f1kSEmfXwLY&list=PL_IhkJB-WjZUt9uJSbLLCmNP7XDwoJn5u&index=78 or https://tinyurl.com/2h354cpa, The Open University's 6th Biennial International Conference on Access, Participation and Success, https://www.open.ac.uk/about/wideningparticipation/external-events-and-publications/biennial-aps-conference/aps-conference-2021, March 15-March 18, 2021.

182 A fully online experience for the eSTEeM Annual Conference, https://www.open.ac.uk/scholarship-and-innovation/esteem/news/fully-online-experience-esteem-annual-conference or https://tinyurl.com/43yujtfm

Impact facet	Attribute	Description
Facet 10: Fostering SoTL culture	Stimulating interest in SoTL Inspiring others to conduct SoTL	There has been an increased appetite and level of confidence in becoming involved in scholarship amongst the CES staff. For example, Careers Consultant Arabella Nock[183] is presently completing a project with C&C Staff Tutor Alexis Lansbury. David reports: *Several of my colleagues [in CES] have been inspired to undertake scholarship activity because of this project. To my knowledge, two of my peers are presently completing approved scholarship activity. For example, Arabella Nock is completing an eSTEeM project and Marie Da Sliva is completing a pan university digital badging project[184].*
Facet 11: Financial implications	Effect on costs of modules or programmes	Chris reported: *This [event] has been costed and was relatively expensive per student. However, it [the event] has the potential to be scaled up without incurring further costs.* There is potential to add live interactive virtual visits to the OU's OpenSTEM Lab[185] or to KMi's[186] portfolio. Interactive virtual visits could be offered to external audiences such as primary schools or overseas universities.
Facet 12: Funding opportunities	Internal (within the institution) funding for follow-on/new projects/initiatives/ events based on SoTL project's success	The School of C&C has provided CES with some funds to create employer talking head videos. David says: *Success of the virtual visit project led to the School having the confidence in the career service to deliver such projects.*

183 Arabella's profile on eSTEeM's website, https://www.open.ac.uk/scholarship-and-innovation/esteem/people/arabella-nock

184 Badging Employability and User Perceptions: Evidence from Examples of Practice (BEAUPEEP), a pan university scholarship project that is investigating open digital badges to recognise the additional benefits of study linked to gaining employability skills. Details available at: https://openuniv.sharepoint.com/sites/units/lds/scholarship-exchange/SitePages/Perceptions-of-Digital-Badging.aspx or https://tinyurl.com/ejn625e8 (requires OU staff login)

185 The OpenSTEM Labs, https://stem.open.ac.uk/study/openstem-labs

186 KMi, Knowledge Media Institute, The Open University, UK, https://kmi.open.ac.uk

13.5   Reflections on SoTL practice

This SoTL project has shown how a collaboration across two units of the university can enrich the project in terms of content, but also provide access to different communities and venues to disseminate. David and Chris have disseminated in both STEM-related and employability-focussed events. As a result, they perceived their project and its benefits from both pedagogical (e.g. Computing education, collaborative learning) and employability perspectives.

The dissemination and dialogues in different communities have enabled the project team to have an impact in terms of adoption and uptake of their initiative of virtual visits, experiences, and project in other disciplines. Further, this project has set an exemplar that diverse groups of skills and insights from different parts of an Institution can strengthen SoTL activity and lead to collaborations that last beyond the SoTL project.

The CES and Jill Shaw, the employability lead in C&C, are now working together on videos that will showcase typical roles in C&C such as data communications specialist, cloud engineer, telecommunications specialist, and so on.

Jill said:

These videos will be really valuable for our C&C students to get a better picture of which area of work they are interested in pursuing, and the employability skills that they can work on throughout their studies with us.

To conclude, David's reflections on this SoTL project are:

...interactive webcasts to off-campus locations are an excellent way of upscaling and increasing the accessibility of field trips and insight visits. It is not always feasible for institutions to take a large number of students to certain locations. Personal circumstances such as socio-economic background and childcare responsibilities can also restrict student participation. Interactive webcasts which use low specification computer software or are accessible on mobile devices can remove participation barriers.

Chris has noted:

...this project has shown that it is possible to organise a short interactive session available to all the students, and that virtual visits open opportunities for those who can't travel to the venue.

Curriculum design should include such events [interactive virtual visits], although, this event [in this project] was not module-specific.

13.6   Project resources and references

Project resources

End-of-project report: Are virtual visits an effective way of engaging learners? Available at: https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/supporting-students/are-virtual-insight-visits-effective-way-engaging-learners-and or https://tinyurl.com/bdzuabcd

Poster: Conway, D, Gardner, C. and Hughes, J. (2020). Are virtual insight visits an effective way of engaging learners? Available at: https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/supporting-students/are-virtual-insight-visits-effective-way-engaging-learners-and or https://tinyurl.com/bdzuabcd

Virtual visit video: Recording of a live interactive Enigma demonstration at Bletchley Park Museum. Hosted by Computing and Communications lecturer Christine Gardner (Open University) with guest Tom Briggs (Bletchley Park Trust). Available at: https://www.youtube.com/watch?v=-T94hYz1U1A (32 minutes)

Video: Conway, D., Gardner, C. and Hughes, J. (2021). Are virtual insight visits an effective way of engaging learners? *In: Architecture, Media, Politics, Society (AMPS) Conference Online Education: Teaching in a Time of Change*, 21–23 Apr 2021. Available at: https://www.youtube.com/watch?v=e8pAajojGVY&list=PL6zYdPl0DZ2ruGlBxeTTHvfGA5gUnuiW8&index=34 or https://tinyurl.com/4pwe5ex3 (17 minutes)

Conway, D., Gardner, C. and Hughes, J. (2021). Are virtual insight visits an effective way of engaging learners and supporting student retention in distance learning environments? *Computer and Learning Research Group (CALRG) Conference*, The Open University, 16 June, https://www.open.ac.uk/blogs/CALRG/teaching-and-learning-in-ou/

Conway, D. (2021). Virtual visits: An effective way of engaging learners, *The Association of Graduate Careers Advisory Services (AGCAS) Phoenix*, August 2021 – The Technology-Enhanced Careers Service, page 8, https://issuu.com/agcas_00/docs/phoenix_issue_163_august_2021

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A paper based on this project is due to published in the journal '*New directions in teaching physical sciences*' in early 2023 based on the presentation at the 2022 UK Horizons in STEM Higher Education Conference, https://ukstemconference.com/about/

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Claiborne, L., Morrell, J., Bandy, J. and Bruff, D. (2012). Teaching outside the classroom, https://cft.vanderbilt.edu/guides-sub-pages/teaching-outside-the-classroom/

Rasheed, R. A., Kamsin, A., and Abdullah, N. A. (2020). Challenges in the online component of blended learning: A systematic review, *Computers & Education*, volume 144. https://www.sciencedirect.com/science/article/abs/pii/S0360131519302544

Roosmaa, E. and Saar, E. (2017). Adults who do not want to participate in learning: a cross-national European analysis of their perceived barriers. *International Journal of Lifelong Education*, vol. 36, no. 3, pp.254-277.

Crabb, E., Janes, R. and Bradshaw, K. (2022). ***End-of-project report:*** eSTEeM-funded project, Blending labcasts and remote/virtual experimentation: students' perception in practical skills development, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/onlineonscreen-stem-practice/blending-labcasts-and-remotevirtual-experimentation-0 or https://tinyurl.com/m6ren88e

Cooke, J. (2020). ***End-of-project report:*** eSTEeM-funded project, Assessing The 'Open Field Lab': Evaluating Interactive Fieldcasts for Enhancing Access to Fieldwork, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/technologies-stem-learning/assessing-the-'open-field-lab'-evaluating-interactive or https://tinyurl.com/552vewd4

14 [P2] A 3D virtual field trip

Fact box

Title	A 3D virtual field trip
Aim of the SoTL inquiry	The aim of this SoTL inquiry was to investigate the pedagogical advantages of 3D (three-dimensional) virtual field trips and the challenges for their adoption.
Type of inquiry[187]	'Does it work?'
Led by	School of Environment, Earth and Ecosystem Sciences (EEES)
Contact	Tom Argles, tom.argles@open.ac.uk
Theme	Providing authentic experimental and practical learning
Research methods	demonstrations, service design workshops, interviews, meetings, survey, thematic analysis
Duration	2014 – 2019
Keywords	3D simulation; physical fieldwork; physical fieldtrips; virtual fieldtrips; virtual fieldwork
Webpage	Evaluation of The OpenScience Lab's 3D Virtual Skiddaw application, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/teaching-laboratory-practice-online/evaluation-the-openscience-lab's-3d-virtual or https://tinyurl.com/3nddjwfy

14.1 Context and aim of the SoTL inquiry

The 3D virtual geology field trip – the *Virtual Skiddaw* App[188] in The OpenScience Laboratory[189] of The Open University (OU) formed the basis for investigations in this SoTL project. Virtual Skiddaw is a 3D simulation (using the Unity 3D gaming engine[190]) of a virtual field trip to six locations in the Skiddaw range[191] of England's Lake District.

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187 'Areas of investigation in SoTL', in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109157&section=3.3
188 Virtual Skiddaw, https://learn5.open.ac.uk/course/format/sciencelab/section.php?name=vsp
189 The OpenScience Laboratory, https://learn5.open.ac.uk/course/view.php?id=2
190 Unity 3D, https://unity3d.com
191 Skiddaw, https://en.wikipedia.org/wiki/Skiddaw

The application is based around a 10km x 10km low to medium detail model of the terrain around Skiddaw created with airborne LiDAR[192] (radar) data and photography survey data. The model is overlaid with photogrammetry-derived mesh and textual imagery and augmented with in-built Unity terrain and flora. *Virtual Skiddaw* includes licensed map data from Ordnance Survey, and digital topographic data from Infoterra via Getmapping PLC. Within Virtual Skiddaw, the user can employ a web-based virtual microscope application that brings the resolution down to micron levels in individual rocks. The virtual embodiment in the form of student avatars in a multi-user environment give a sense of co-presence and facilitates real-time interaction and collaboration between students and educators[193]. In the multi-user mode students can see other users (avatars) but can fade them out if they get in the way of making geological observations, such as sketching or looking at the minerals of the rocks. The sense of immersion is heightened by ambient audio tracks that were recorded on location. The virtual field trip (VFT) is accompanied by pre-recorded teaching instructions.

The 3D VFT has both realistic and non-realistic dimensions. The interactions and the learning activities within the 3D environment are designed to mirror the experience of a physical field trip. The VFT provides a venue for the development of fieldwork skills: investigating rock characteristics, observations, note-taking, sketching, synthesis, and comparison of localities. The non-realistic aspects offer the users activities beyond what a physical field trip can provide: aerial flyovers for panoramic views, teleporting (flying over) from one site to another, scale changes from regional geology to microscopic views of rocks, cutaways into a mountainside to see the geology beneath, or draping the mountains with maps such as the Ordnance Survey map and the geological map (see **Figure [P2].1** for a few photographs of the Virtual Skiddaw app).

By showcasing the Virtual Skiddaw app, a 3D geology field trip, the aim of this SoTL inquiry was to investigate the pedagogical advantages of 3D VFTs and the challenges for their adoption.

192 LiDAR – A technology driving transition, https://www.getmapping.co.uk/post/lidar-a-technology-driving-transition
193 Since the SoTL inquiry was conducted, the support for the Unity web-player has been withdrawn by all the main internet browsers. Virtual Skiddaw is provided to OU students of the Earth Science module (S209), https://www.open.ac.uk/courses/modules/s209) as a self-contained executable file downloadable from the S209 and The OpenScience Laboratory websites.

A student (as an avatar) at a site of Skiddaw. The checklist at left shows the tasks to be completed. The markers here show potential sketching points.

A group of users/students (as avatars) collaborate on a task as they would in a physical field trip. Students can chat with each other in text and in speech, and even fade other avatars out of view.

Kit selection for a virtual field trip as a part of the learning exercise on how to prepare for a physical fieldtrip.

The individual sites of Skiddaw can be situated within a larger virtual space – in this case a 10km x 10km area of the Lake District. As well as aerial photo overlays, there are map and subject-specific overlays (for example, geological maps), and animations, such as the cross-section shown.

Figure [P2].1 Images of the Virtual Skiddaw app

14.2   Underpinning research of the SoTL inquiry

The primary objective of developing a 3D simulation has been to provide students and educators with a visual and spatial experience that is not constrained by a 'flat' 2D user interface of a DVD or a 2D representation via images, videos, etc. on the Web. The VFT provides an authentic and realistic 3D interactive simulation with a high degree of fidelity to the actual environment. The application is fully accessible and is supported by keyboard navigation.

The SoTL inquiry involved investigating the pedagogical advantages of 3D virtual field trips and the challenges for their adoption. The user-centred research (Stone *et al.*, 2005) involved a variety of stakeholders and particularly, the end-users such as educators, students, and fieldwork specialists, and the project team interacted with them via interviews, service design[194] workshops, demonstrations, and an online survey to elicit their perceptions and requirements (see **Table [P2].1**). The project team applied thematic analysis for the analyses of the qualitative data from various sources.

Table [P2].1: Data sources, dates of the events and the number of participants

Description	Participants
Online VFT survey	25 (students, educators and field trip professionals)
Higher Education Network 'eGaming in GEES[195] disciplines' workshop as a part of the Geological Society of London Conference, Plymouth University	17 educators from further education (FE) and higher education (HE)
OpenScience Lab Stand at the JISC Digifest, Birmingham	Several people visited our stand, and two significant requirements were recorded
eSTEeM's 4th annual conference, OU	12 (5 in the poster session with whom we also had email correspondence after the event; 7 participated in the structured discussion)
Science Circle meeting in the 3D virtual world, Second Life[196]	18 [international participation by colleagues involved in STEM education within 3D Virtual Environments (VEs) and in the real-world]
Virtual Worlds Education Roundtable Forum in Second Life	23 (international participation from educators and students who are involved in learning and teaching, and conducting research in 3D VEs)
OU Educators meeting on 3D VFTs	5
Innovate UK monitoring meeting at Daden Ltd. in Birmingham	1 + project team
Milton Keynes (MK) Geography Teachers Network Meeting (local school in MK)	12 Geography teachers from schools across MK
Meeting with Ordnance Survey	4 + 3 project team members
Conversation with an assessment body	2 + 2 project team members
A school in Birmingham	2 workshops with GCSE level and A-level students: 20 students and 7 teachers

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194 Service Design, https://www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed/service-design and Service Design Toolkit, https://www.servicedesigntoolkit.org
195 Geography, Earth and Environmental Studies (GEES)
196 Second Life (a 3D virtual world), https://secondlife.com

14.3   Findings of the SoTL inquiry

This 3D VFT is complementary to physical field trips such as for enhancing briefings and de-briefings of physical field trips, or to facilitate the completion of observations and discussions after a physical field trip. It also allows multiple virtual visits for getting acquainted with the landscape and its geology. Further, the virtual field trip may help to overcome the disadvantages faced by mobility impaired students, or students who are in other home-bound situations. The App may be the best solution in cases where there are too many students in a class and a physical field trip may not be feasible, or to enable international participation of students and experts.

Although a 3D virtual trip may not be able to recreate all the challenges of doing science in the field, such as encountering unfavourable weather conditions or learning about the limitations of conducting observations and measurements in a physical environment, it gives students the opportunity to carry out fieldwork as an interactive and immersive experience. The persistent 3D environment gives the flexibility to visit and practise as many times as required.

The challenges for the adoption of VFTs included: resistance to the ideas of VFTs particularly if they are perceived as replacing physical fieldwork; individual educator's motivation and digital literacy skills; and affordability of adopting VFTs, such as the development costs but also the costs involved in induction and training of educators (and students) to include VFTs in the curriculum.

14.4   Key lessons and details of the impact

3D VFTs facilitate experiences and visits related to the curricula where it may not be possible to conduct physical fieldwork – such as a problem-based learning scenario of visiting a coral reef ecosystem, discussing the threats to the biodiversity in that coral reef and explaining what is being done and could be done to reduce the effects of the threats. Another example could be visiting a rainforest in Ghana and identifying the risks to it, evaluating the impact of human activity, how the logging could be carried out in a sustainable manner, and the ways in which the rainforest could be a source of income for local people.

The project team have listed the following aspects that other educators can learn from this project:

- Virtual field experiences support physical fieldwork learning and teaching.

- Virtual fieldwork should not be viewed as a straight replacement for physical fieldwork, nor can it ever fully achieve that.

- Educators should embrace the virtuality of the environment, rather than just trying to replicate the physical fieldwork experience.

- Even modest in-app audio can dramatically increase immersion and improve the experience.

- Virtual approaches are invaluable for introducing novice fieldworkers to the concept of fieldwork; for widening participation in field activities; for enabling access to field skills teaching and field experiences for those unable to attend physical events (for multiple reasons); for providing access to dangerous, hostile or inaccessible environments (for example, deep sea explorations).

- Virtual fieldwork came to the rescue during the COVID-19 pandemic!

- The teaching resources should be separate from the virtual environment, allowing for flexibility and re-use of the resources.

- Be aware of trade-off between resolution and performance (more detail in the virtual environment leads to slower response).

- Don't neglect the ability of the human visual system to translate 2D images or video into 3D objects. Tom elaborates on this aspect:

> *...effort might be saved in some cases by leaving the 3D perception up to the human brain, rather than painstakingly creating a 3D mesh model of a rock where a photo or even video might be more than adequate. Such images or even videos are often easier to deliver online than the 3D mesh models, which can quickly become too cumbersome.*

Virtual Skiddaw is provided to OU students of the module *Earth Science* (S209)[197]. Since the SoTL inquiry was conducted, the support for the Unity web-player has been withdrawn by all the main internet browsers. Virtual Skiddaw is, therefore, provided as a self-contained executable file downloadable from the S209 and the OpenScience Laboratory[198] websites.

Because the virtual landscape in Virtual Skiddaw is based on the field area visited by S209 students who attend the physical fieldtrip, all S209 students have the opportunity to explore the teaching sites in the app and conduct very similar exercises to those on the physical trip. Students who experience the physical field trip may use the app before they go, for orientation and out of curiosity. They may also use the app after their visit to refresh their memory of the physical activities and to support their project write-up for the end-of-module assessment, which may be based on the field trip.

Students who don't or can't attend the physical fieldwork may use the app as one of the metamorphic petrology exercises in the module, or simply from curiosity. There is also a project option to design a virtual field trip of their own; students who attempt this will use the app to familiarise themselves with the concept of virtual field trips and prompt ideas for their own version.

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197   S209 Earth Science, https://www.open.ac.uk/courses/modules/s209
198   The OpenScience Laboratory within The OpenSTEM Labs, https://stem.open.ac.uk/study/openstem-labs

Based on the facets and attributes of the impact evaluation instrument (**Appendix 1**), the Table below details the impact of the SoTL inquiry and the evaluations from having integrated the app within the OU module, S209.

Impact facet	Attribute	Description
Facet 1: Student experience	Learning design Student engagement with course content Student engagement with the technological intervention	Student feedback through end-of-module survey (S209) and in discussion forums indicates that the students are very impressed with the app. There are, however, problems related to accessing or downloading or using the app. The app was more popular in 2020 as students sought alternatives to fieldwork projects during the COVID-19 pandemic. This is to be expected since the physical field trip was cancelled for two presentations of the S209 module in 2020-2021.
Facet 3: Evidence of excellence in teaching	Student skills-set (e.g. group-working Evidence of research-informed teaching	A key innovation of the app was enabling teamwork and in-world tutoring. However, the demise of the web-player and consequent loss of multiuser functionality (standalone version is single user only) ruled out that option not long after launch. The app has served as an online alternative to field teaching and experience during the COVID-19 pandemic, though its reduced usability (at 7-8 years old) has been an issue for many students. Tom was on the advisory panel involved with revision of the QAA[199] subject benchmark statements for Earth and Environmental Sciences and Environmental Studies (known as ES3). Tom emphasised the utility of virtual field teaching and its role in supporting physical fieldwork or providing alternatives for some students. Physical fieldwork may not always be inclusive and accessible. Tom reports: *These [ES3] statements were revised so that compulsory field teaching was not required, and guidance on potential alternatives, including virtual field trips, was added.*

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199 The Quality Assurance Agency for Higher Education (QAA), https://www.qaa.ac.uk

Impact facet	Attribute	Description
Facet 4: Influence on discipline-based teaching, research, and practice	Change in the ways in which subject concepts are taught	This SoTL project inspired the development of other VR apps at the OU: For example, Virtual Ocean Dives[200] - an app which is used in the module *Earth processes*, (S309)[201]. Integrated in exercises around scientific observations or critical real-world problems such as ocean acidification, this app provides students with an opportunity to gather observations from a submersible and experience practical ocean science. Tom shared his Virtual Skiddaw expertise with the team involved with the development of the Virtual Ocean Dives. Shailey Minocha, the project co-lead of this SoTL inquiry, was involved with the development of the VR app for training social work students and particularly to support newly qualified social workers: 'Virtual Home Visits for Social Workers'[202]. Tom reports: **"** *Colleagues in EEES [School of Environment, Earth and Ecosystem Sciences] are currently exploring options for further virtual experiences.* *Interest in virtual field experiences surged in the geoscience community during the COVID-19 pandemic and I received a few requests for help/advice from colleagues in the UK and abroad related to virtual teaching.* **"**

200 Virtual Ocean Dives, The OpenScience Laboratory, The Open University, https://learn5.open.ac.uk/course/format/sciencelab/section.php?name=voft
201 S309 Earth processes, https://www.open.ac.uk/courses/modules/s309
202 Virtual Home Visits for Social Workers, Case study is available at: https://www.daden.co.uk/_files/ugd/0c2908_953076c3861c41029925bd072dd3d6ec.pdf or https://tinyurl.com/3x7eey6h

Impact facet	Attribute	Description
Facet 5: Dissemination of project's outcomes	Number of publications from the project/ initiative	The project has been widely disseminated resulting in publications and project resources listed at the end of this case study. Tom states: *When the University of Leeds was developing its own Unity-based virtual field mapping app, I held several discussions with them at various UK meetings on geoscience teaching, as well as presenting on Virtual Skiddaw of virtual field trips generally at some events, such as:* *Goldschmidt Conference (Geoscience Education session), Paris, Aug 2017* *International Geological Congress (Education theme), Cape Town, Aug 2016* *CALRG Annual conference, June 2015* *Higher Education Network (Geological Society) Jan 2015, Plymouth University* *Higher Education Network (Geological Society) Jan 2014* *Earth Science Teachers' Association conference, Sept 2013, Plymouth University* *HEA STEM Annual Conference, April 2013, Birmingham*
Facet 6: Adoption of the outcomes of the project	Adoption of the outcomes internally (within the institution) or externally to improve assessment, curriculum design in the same discipline or in other disciplines.	The VR app - Virtual Ocean Dives (discussed in **Facet 4**) - that is used in OU's curriculum has been inspired by the Virtual Skiddaw App. This app provides an opportunity to experience a series of dives in a submersible at key locations around the world. The dives are designed to provide students with 3D interactive visualisations of the complex ocean and how ocean processes vary across the planet. The VR app for training social workers for home visits (for social work students and mentioned in **Facet 4**) in the OU's Faculty of Wellbeing, Education and Language Studies was inspired by the Virtual Skiddaw app. Tom reports: *I gave a presentation in Feb 2019 on virtual field trips (and Virtual Skiddaw, in particular) to the OU's School of Geography. I also passed on some advice on virtual field trips in May 2019 to the Head of School of Social Sciences and Global Studies in FASS[203] in the context of widening access for students with disabilities.*

203 FASS, The OU's Faculty of Arts and Social Sciences, https://fass.open.ac.uk

Impact facet	Attribute	Description
Facet 7: Mutual stakeholder understanding	A community that SoTL creates and moving outside traditional silos	The external partnership with the developers, Daden Limited[204], was successful leading to further projects and funding opportunities.
		The project has enabled introduction to a wider community of educators and practitioners in UK and abroad who were interested in virtual experiences, accessibility and widening participation.
		The pedagogical effectiveness of 3D VFTs in fieldwork education and experiences, as demonstrated by the Virtual Skiddaw app, has led to the formation of a Virtual Fieldwork Hub within the OU which is being led by Sarah Davies[205] in EEES. This Hub brings together a diverse group of people from across the university who are interested in virtual worlds and virtual fieldwork, such as, academics, media developers, learning designers, researchers, colleagues involved with The OpenSTEM Labs, and IT services.
Facet 8: Personal and professional development of project team	Improved practice and personal knowledge	Tom notes: *Certainly, my career has benefitted, and acquired skills, knowledge and perspective boosted my career trajectory after the project ended.* *My team-working skills improved, and I developed further on the Fieldscapes[206] project [follow-on project funded by Innovate UK[207]].*
Facet 9: Recognition of project team members and other stakeholders	Career trajectory that can be attributed to SoTL such as promotions Fellowships or memberships of professional associations nationally and internationally Invited speaker to events/conferences internally and externally	Tom reflects on his experiences: *I have gained SFHEA[208] status (March 2018) which certainly benefitted from the project.* *I suspect my application for Director of Teaching (EEES) was boosted by my involvement in the Virtual Skiddaw project.* *Externally, my profile was raised by the project dissemination, resulting in an invitation to a panel debating fieldwork at the 2016 Geographical Association conference.* *[The project] has raised my profile in UK HE (and internationally) as a geoscience educator – this led to various positions on committees and within organisations such as the Geological Society and the Earth Science Teachers' Association.*

204 Daden Limited, https://www.daden.co.uk
205 Sarah Davies, https://www.open.ac.uk/people/smd432
206 Burden, D.J.H., Argles, T., Minocha, S., Rock, J., Tilling, S. and Wheeler, P. (2017). Fieldscapes – Creating and Evaluating a 3D Virtual Field Trip System. In: iLRN 2017, Proceedings from the Third Immersive Learning Research Network Conference (Beck, Dennis; Allison, Colin; Morgado, Leonel; Pirker, Johanna; Khosmood, Foaad; Richter, Jonathon and Gütl, Christian eds.), Immersive Learning Research Network, pp. 18-29. Available at: http://oro.open.ac.uk/50378/
207 Innovate UK, https://www.ukri.org/councils/innovate-uk/
208 Senior Fellowship, Advance HE, https://www.advance-he.ac.uk/fellowship/senior-fellowship

Impact facet	Attribute	Description
Facet 10: Fostering SoTL culture	Stimulating interest in SoTL Inspiring others to conduct SoTL	Tom reports: ❝ *Hard to gauge – perhaps it has paved the way for more cross-faculty collaborations for EEES and STEM colleagues generally. It raised the level of ambition in our School I think – we pride ourselves on being innovative and pushing the boundaries in teaching, and Virtual Skiddaw could take some credit for that ambition.* ❞
Facet 11: Financial implications	Effect on costs of modules or programmes	The development of the Virtual Skiddaw app itself was expensive - however, the costs were absorbed by the Wolfson funding for the Open Science Laboratory. The app continues to be integral to the S209 module and the module costs to host this app are minimal.
Facet 12: Funding opportunities	Internal (within the institution) funding for follow-on/new projects/initiatives/events based on SoTL project's success	The project led to three external funding successes: Google's Virtual Reality Research Award: *Pedagogical and usability evaluation of Google Expeditions* (mobile virtual reality field trips) in collaboration with UK's Association for Science Education, Geographical Association and Field Studies Council. *Design and deployment of a 3D virtual oceanic field trip*, funding from Wolfson Trust. *VFTaaS – Virtual Field Trips as a Service*, a feasibility study for virtual field trip exercises in 3D multi-user virtual environments in schools and higher education, funding from Innovate UK.

14.5 Reflections on SoTL practice

The design and development of the Virtual Skiddaw app involved collaboration between a geologist (Tom) and a Computer Science educator (Shailey). The subject expertise that Tom brought to the project combined with Shailey's prior experience with a 3D environment, Second Life[209], and expertise in Human-Computer Interaction and user-centred design resulted in the development of an VR app that was both pedagogically effective and usable. The integration of the app in the S209 module, evaluation in this SoTL inquiry, dissemination activities and positive response from the community[210] have motivated other disciplines and communities to consider and adopt virtual reality (VR) and virtual worlds in pedagogy.

The evaluations of the Virtual Skiddaw App as a part of this SoTL project led to external collaborations (for example, with UK's Field Studies Council, Geographical Association) and funding from Google, Wolfson Trust and Innovate UK. Tom and Shailey are regularly contacted by colleagues within the OU and externally to share their VR expertise.

However, the project co-leads and the OpenScience Laboratory didn't make the app easily accessible from the start. For uptake of the outcomes of a technological innovation, it is important to make the project's outcomes easily and openly accessible.

To conclude, Tom's reflections on this SoTL project are:

...I regret that we did not make the app more freely available from the start – an opportunity missed. Leeds University created a very similar open-access app shortly after Virtual Skiddaw, which has been very successful; by contrast the OU's pioneering role is largely unknown worldwide. Compare the globally renowned OU's Virtual Microscope[211] - open to all via an external website.

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209 Second Life, https://secondlife.com
210 In 2014, The Open Science Laboratory won the Outstanding ICT Initiative of the Year in the Times Higher Education Awards, https://www.cambridgenetwork.co.uk/node/482365
211 Virtual microscope, https://www.virtualmicroscope.org

14.6 Project resources and references

Project resources

End-of-project report: Evaluation of The OpenScience Lab's 3D Virtual Skiddaw application. Available at: https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/teaching-laboratory-practice-online/evaluation-the-openscience-lab's-3d-virtual or https://tinyurl.com/3nddjwfy

Application in the OpenScience Laboratory: Virtual Skiddaw, https://learn5.open.ac.uk/course/format/sciencelab/section.php?name=vsp

Case study: Virtual Skiddaw, Training Geologists at The Open University, https://www.daden.co.uk/_files/ugd/0c2908_e9c87a3bee0342dd8a26a2aabd129df1.pdf?index=true or https://tinyurl.com/36akxsr4

Project video: Evaluation of The OpenScience Lab's 3D Virtual Skiddaw application, Available at: https://www.youtube.com/watch?v=oIosxNYrLis

Project video: 3D Virtual Geology Field Trip, https://www.youtube.com/watch?v=zfbA1s9uRoU

Project Video: Virtual Skiddaw – Virtual Geology Field Trip, https://vimeo.com/78057630 (**requires login/registration**)

Project videos: Skiddaw Trailer Part 1, https://www.youtube.com/watch?v=5_h4Nl3AvCY and Trailer Part 2, https://www.youtube.com/watch?v=MOdu5jQukUk

Blog-post: Reflections on virtual reality projects – part 1, https://www.shaileyminocha.info/blog/2019/2/12/reflections-on-our-virtual-reality-projects-part-1

Argles, T. W., Burden, D., Tilling, S. and Minocha, S. (2017). FieldscapesVR: Virtual world field trips to extend and enrich field teaching. In: *International Geological Congress*, Abstracts, 35, article no. 2109. Available at: https://oro.open.ac.uk/48850/

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Minocha, S., Tilling, S., Argles, T., Braithwaite, N., Burden, D. and Rock, J. (2015). Pedagogical advantages of 3D virtual field trips and the challenges for their adoption. In: *Computers and Learning Research Group (CALRG) Conference 2015*, The Open University, Milton Keynes, UK. Available at: https://oro.open.ac.uk/46406/

Argles, T., Minocha, S. and Burden, D. (2015). Virtual field teaching has evolved! What benefits does a 3D gaming environment bring? *Geology Today* vol. 31, no. 6, pp. 222–226.

Minocha, S., Burden, D., Tilling, S., Argles, T. and Rock, J. (2015). 3D Virtual Field Trips as a Service (VFTaaS): Learning Design. The Open University, Milton Keynes, UK.

Argles, T. (2014). Virtually fieldwork? Lessons from a digital Lakeland landscape. *Teaching Earth Sciences*, vol. 39, no. 1, pp. 23–27.

Minocha, S., Davies, S., Richardson, B. and Argles, T. (2014). 3D virtual geology field trips: opportunities and limitations. In: *Computers and Learning Research Group Annual Conference* 2014, 10–11 Jun 2014, The Open University, Walton Hall, Milton Keynes, UK. Available at: https://oro.open.ac.uk/40406/

Argles, T., Richardson, B., Davies, S., Minocha, S. and Braithwaite, N. (2013). 3D virtual geology field trips: opportunities and limitations. In: *HEA STEM*: *Annual Learning and Teaching Conference 2013*: *Where practice and pedagogy meet*, 17–18 Apr 2013, Birmingham. Available at: https://oro.open.ac.uk/37420/

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15 [P3] Geology photo blog

Fact box

Title	Geology photo blog
Aim of the SoTL inquiry	The aim of this SoTL inquiry was to re-develop the pilot Geology Photo Blog, initially for use in a predecessor module, 'Geology', and re-launch it as an integral part of the 'Earth Science' module.
Type of inquiry[212]	'What works?'
Led by	School of Environment, Earth and Ecosystem Sciences (EEES)
Contact	Tom Argles, tom.argles@open.ac.uk
Theme	Providing authentic experimental and practical learning
Research methods	interviews, survey
Duration	2011 – 2014
Keywords	geosciences education; peer-to-peer support; photo blog; spatial learning; spatial literacy
Webpage	Geospatial technologies in distance learning and teaching in Science, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/teaching-laboratory-practice-online/geospatial-technologies-distance-learning-and or https://tinyurl.com/3rhw6sc8

15.1 Context and aim of the SoTL inquiry

Geospatial technologies that underpin services such as Google Earth™, ArcGIS™, remote sensing and the Global Positioning System (GPS) are being used to help students grasp difficult or threshold concepts, such as three-dimensional (3D) visualisation, and improve their spatial thinking skills, or 'spatial literacy'. 'Spatial thinking' is the ability to visualise and interpret location, distance, direction, relationships, change, and movement over space and 'spatial literacy' is the competent and confident use of maps, mapping, and spatial thinking to address ideas, situations, and problems within daily life, society, and the world around us (Sinton, 2012).

Competence in spatial literacy and Geographic Information System (GIS) techniques is recognised as a necessary skill by employers in a wide range of industries. These skills, therefore, need to be enhanced in a modern environmental and geoscience curriculum.

In this SoTL project, the project team developed a 'Geology Photo Blog'[213] tool (**Figure [P3].1**), based around a Google Maps™ interface, to enable geology students and tutors at The Open University (OU) to upload geological photos and videos, linked to the geological maps of the UK. Each posted photo is linked to its location on the map and accompanied by a brief description.

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212 'Areas of investigation in SoTL', in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109157&section=3.3
213 Geology photo blog, https://students.open.ac.uk/science/s209/photoblog/v1/map.php (requires OU login)

The map page (**Figure [P3].2**) displays the locations of all media posted using markers. Students can click on a marker to view the photo (**Figure [P3].3**) and jump to the corresponding blog entry. Moreover, students can overlay the standard map with semi-transparent maps depicting bedrock geology, superficial deposits and fault lines for different UK regions (**Figure [P3].4**). Students can post comments on one another's photos on the blog and participate in a discussion. This tool was developed for the module *Geology* (S276)[214], and embedded in the replacement, 60 credit module *Earth Science* (S209)[215].

The aim of this SoTL inquiry was to re-develop the pilot Geology Photo Blog, initially used in S276, and re-launch it as an integral part of S209.
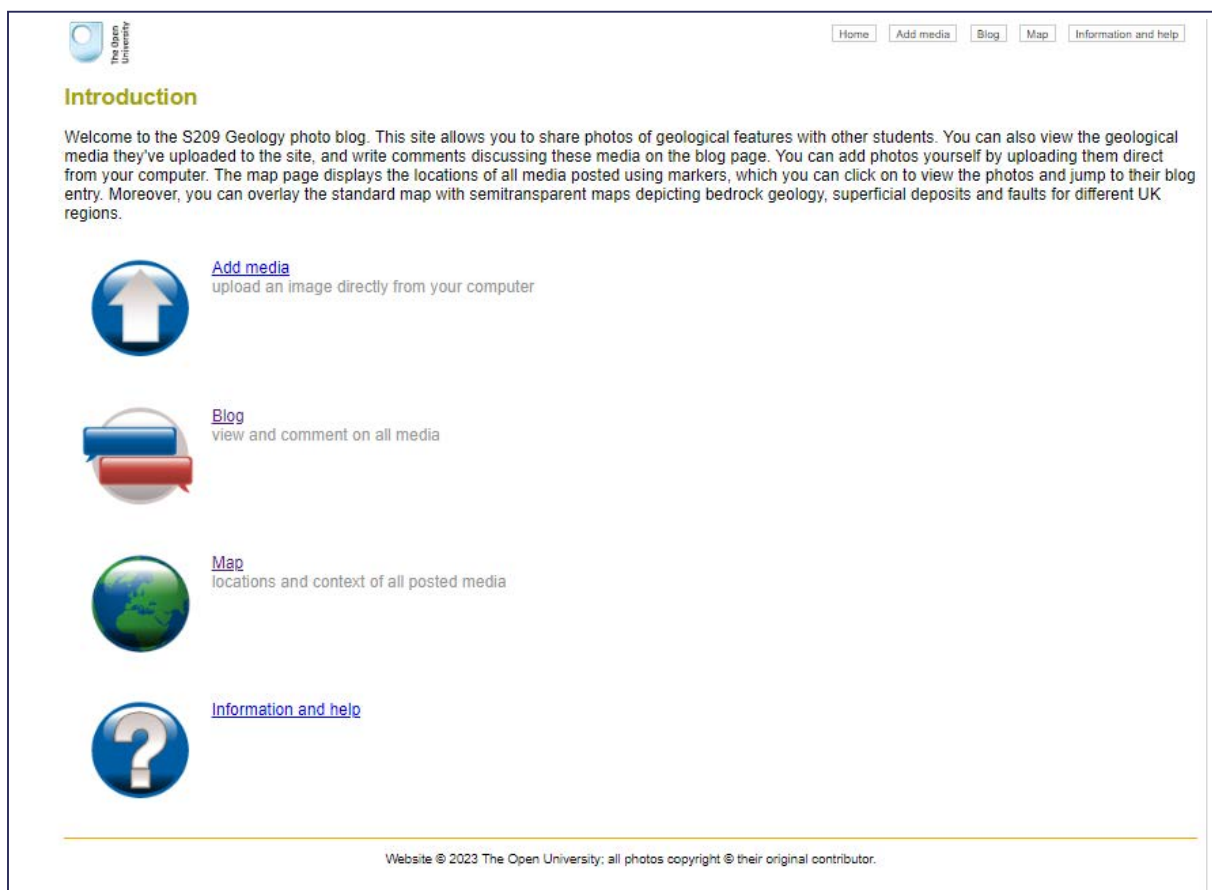
Figure [P3].1 Home page of the Geology photo blog which is a portal to the main components of the site

214 S276 Geology, https://www.open.ac.uk/library/digital-archive/module/xcri:S276/study
215 S209 Earth Science, https://www.open.ac.uk/courses/modules/s209

Figure [P3].2 Red pins or markers scattered across the map page of the S209 Geology photo blog mark the locations of geological samples or features students and tutors are sharing with each other

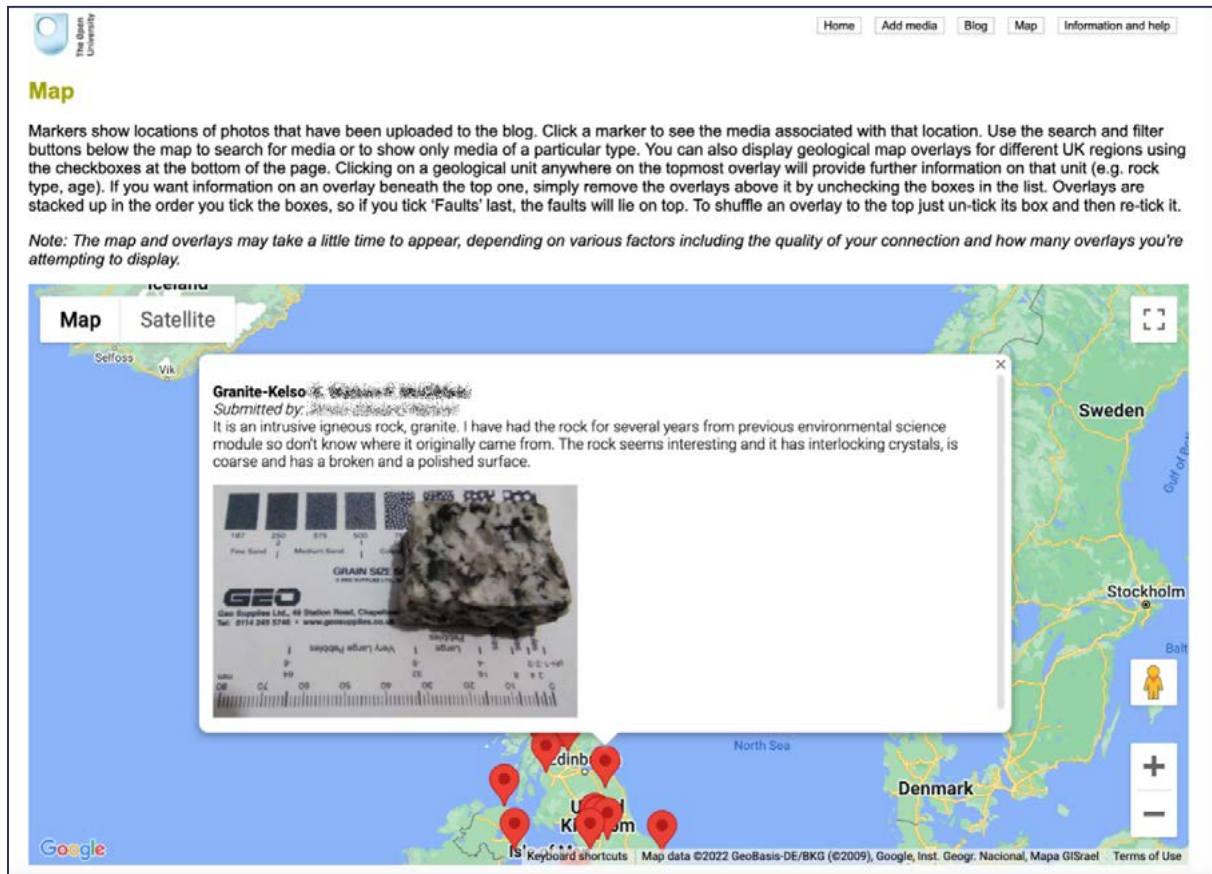The rock sample at a particular red pin on the map is shown in **Figure [P3].3**.

Figure [P3].3 Details of a rock submitted by a student on the Geology photo blog and represented as a red pin on the map

Map

Markers show locations of photos that have been uploaded to the blog. Click a marker to see the media associated with that location. Use the search and filter buttons below the map to search for media or to show only media of a particular type. You can also display geological map overlays for different UK regions using the checkboxes at the bottom of the page. Clicking on a geological unit anywhere on the topmost overlay will provide further information on that unit (e.g. rock type, age). If you want information on an overlay beneath the top one, simply remove the overlays above it by unchecking the boxes in the list. Overlays are stacked up in the order you tick the boxes, so if you tick 'Faults' last, the faults will lie on top. To shuffle an overlay to the top just un-tick its box and then re-tick it.

Note: The map and overlays may take a little time to appear, depending on various factors including the quality of your connection and how many overlays you're attempting to display.
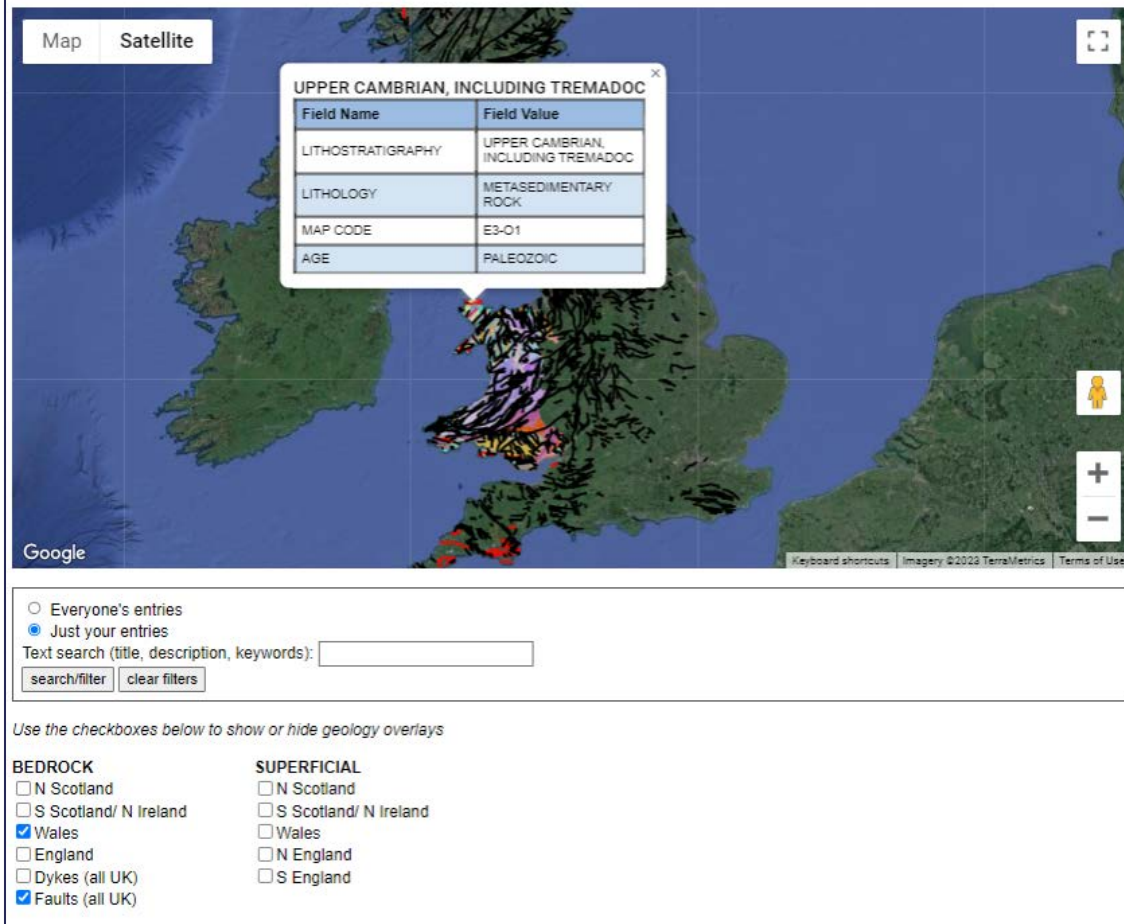
Figure [P3].4 The map with a set of layers – showing the bedrock units of Wales with fault lines overlain on them. Clicking on a colour provides some information on that geological unit from the British Geological Survey.

15.2   Underpinning research of the SoTL inquiry

This project built on several earlier initiatives at the Open University such as:

- COLMSCT (Centre for Open Learning in Mathematics, Science, Computing and Technology, OU) teaching fellowship held by Tom (project lead of this SoTL inquiry) that investigated how GIS-based materials could be delivered to geoscience distance students in a conventional OU module.

- The launch of a GIS-based 'mashup' enabling students to post images and video clips to an online site built round an interactive map was another initiative. This pilot project ran in the 2010 presentation of the module S276 (Nov 2010 – Jul 2011).

- The Google Maps based data collection and photo mashup tool for the module *Ecosystems* (S396)[216] enabling students to geolocate data (temperature measurements) and photographs (tree canopies) for representation on an online map for collaborative data collection across a student cohort.

Development of the Geology Photo Blog (GPB) occurred in various bursts and through a process of iterative design, development and evaluation with Associate Lecturers (ALs) alongside authoring of specific teaching materials related to GPB in S209. The final integration of GPB into S209 website took place in September 2014 and some minor fixes were made to it in October-November 2014 in response to feedback from students and ALs. GPB's pilot was run in 2011-2012 through interviews with ALs and a student survey.

15.3   Findings of the SoTL inquiry

The findings pertain to the evaluations of GPB's pilot conducted in 2011-2012. The ALs felt the GPB would be much more effective if introduced at the module start, especially for icebreaker-type activities. One AL suggested that the blog's role would change as the module progressed, from a teaching aid early on to a more reflective discussion forum as the students developed more confidence and gained experience of the module content.

As GPB was made available to the whole S276 cohort towards the end of the module, it limited the student survey's effectiveness. Only 9 students engaged in some way with the GPB between September 2011 and July 2012; 3 students completed the online survey. Nevertheless, the project team was able to collect student feedback from the discussion forums.

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216   S396 Ecosystems, https://www.open.ac.uk/library/digital-archive/module/xcri:S396/study

A student commented:

The blog is a great idea. I have never used one before. It's very interesting seeing people's finds!

Tom has reflected on student experience with GPB:

The Geology Photo Blog works so well partly because it encourages peer-to-peer interactions and discussion, building a peer support community right from the start of a module, based around an activity that most students find very engaging.

Further, due to not having the support of the module team to run GPB with the entire cohort of students on S276 and, thereby, limiting student participation and evaluations, Tom reflects on his experience of a SoTL inquiry involving a technological innovation:

The success of technology in teaching and learning does not merely follow from the quality of the technology, or the value of the idea behind it. Innovations must be championed and supported not just by the people who design and develop them, but also by those implementing them: module team members and chairs, curriculum managers, tutors/ALs, and ultimately students.

The contrast between the success of the Geology Photo Blog in S209 (embedded from the start) and its comparative failure in S276 (a limited pilot only) illustrates this finding clearly.

Since 2014, GPB has been an integral resource for students in S209. A video recording introduces GPB to the students and provides a brief tutorial.

15.4 Key lessons and details of the impact

GPB features in question 2 (25 of 100 marks) of the first tutor-marked assignment (TMA) of S209. The question assesses competence in identifying and classifying rocks. The question covers the learning outcomes of application (concepts and principles of Earth Sciences) and communication.

Students are asked to describe a rock of their choice which should be a coarse-grained rock (not a mineral or crystal) with a fresh, broken or polished surface. Students are encouraged to use a magnifier and grain size scale to examine their chosen rock specimen. Then the students are asked to take a digital photograph of the chosen rock which should be clearly in focus, suitably cropped and include a scale (detailed guidance on effective photography of rock samples, written by an AL, was made available on the module website for later presentations).

Students are asked to identify and record whether the rock is igneous, sedimentary, or metamorphic and list three observations that helped them to come to that conclusion. The photo of the rock and the description are pasted in the TMA document. Finally, students post this photo in the S209 Geology photo blog (**Figure [P3].5**) and add a caption (aimed at other S209 students) that states what the rock is and where the student found it. For example, the title contains (i) rock type, (ii) location, (iii) student name and (iv) tutor name, e.g. Sandstone – Kimmeridge – J. Bloggs – J. Smith.

GPB is particularly useful for distributed students who can share geolocated data, images and representations online.

Tom, the project lead, reflects on the success of GPB:

Perhaps the primary finding of this project was the value of peer support in distance learning communities, and the various strategies for promoting and encouraging this.

Figure [P3].5 Excerpt of the Geology photo blog

Figure [P3].6 shows the close-up of the second rock sample in the excerpt of the GPB in **Figure [P3].5**.

Figure [P3].6 Close-up of the second rock sample in the excerpt of the GPB in Figure [P3].5

Based on the facets and attributes of the impact evaluation instrument (**Appendix 1**), the Table below details the impact of this SoTL inquiry.

Impact facet	Attribute	Description
Facet 1: Student experience	Learning design Student engagement with course content Student engagement with the technological intervention	The GPB is an icebreaker activity – it has helped formalising what was already happening sporadically (in terms of socialisation) on module discussion forums. GPB has encouraged student engagement with module website and with each other from start of module.
Facet 2: Student retention and progression	Student registrations Average marks as compared with previous year(s) Module completion rate Module pass rate Student retention rate Student progression	TMA01 submission rate was higher on first year of S209 (92.2%) than on final year of S276 (84.3%); S276 was the predecessor module of S209. Pass rate and return rate were also several % points higher on S209 than on S276. Completion rates were identical, even though dissatisfaction with the loss of printed books was expressed in a lower satisfaction rate for S209.
Facet 3: Evidence of excellence in teaching	Student skills-set Inter-disciplinary collaborations in teaching Informing policy development internally at the level of department, faculty or University	GPB has enabled a gentle introduction to digital and spatial literacy to students through an engaging activity – a model that has been used repeatedly for tricky topics like Geographic Information Systems (GIS) in other modules subsequently (e.g. S288[217], S831[218], S309[219]) This initiative has been shared within the School of EEES[220] as good practice, encouraging similar map mashups and sharing activities in other modules (e.g. S309).
Facet 4: Influence on discipline-based teaching, research and practice	Change in the ways in which subject concepts are taught	This initiative of GPB has successfully demonstrated how teaching of maps could be integrated with students' experiential learning. GPB has helped model how GIS concepts could be introduced to students with no prior experience. Ultimately, it paved the way for the development of virtual field schools in ArcGIS Online[221] during the COVID-19 pandemic.

217　S288 Introducing Practical Science; There were five modules in the S288 suite: Chemistry and Analysis (SXC288); Environmental Science (SXE288); Earth and Environment (SXG288); Biology and Health (SXL288) and Physics and Astronomy (SXP288)
218　S831 Environmental Science Challenges, https://www.open.ac.uk/postgraduate/modules/s831
219　S309 Earth processes, https://www.open.ac.uk/courses/modules/s309
220　School of Environment, Earth and Ecosystem Sciences (EEES), Faculty of STEM, The Open University, UK
221　ArcGIS Online, https://www.arcgis.com/index.html

Impact facet	Attribute	Description
Facet 5: Dissemination of project's outcomes	Number of publications from the project/initiative	The project team shared their experiences at internal OU events such as in the Learn About Fair in 2012 and 2013. In 2013, one of the two posters was focussed on developing the GPB for the module S276.
Facet 6: Adoption of the outcomes of the project by other educators	Adoption of the outcomes internally or externally (within the institution) to improve assessment, curriculum design in the same discipline in same or different contexts	GPB reinforced the value of icebreaker activities for student socialisation, peer-to-peer support and collaboration. GPB demonstrated the value of peer support, which was a keystone of the Student Buddies project[222] developed in EEES.
Facet 7: Mutual stakeholder understanding	A community that SoTL creates and moving outside traditional silos	The GPB has enabled making connections between students, tutors and central academics to a greater effect in S209 than in previous modules.
Facet 8: Personal and professional development of project team	Improved practice and personal knowledge	Tom gained expertise in GIS and map mashups that he developed thereafter. He now manages the online map for annual GeoWeek[223] UK events. Tom has authored GIS material on the modules S288, S831, S319; he will likely contribute to introductory GIS activities on the replacement module for S209.
Facet 9: Recognition of project team members and other stakeholders	Career trajectory that can be attributed to SoTL such as promotions Fellowships or memberships of professional associations nationally and internationally (e.g. Advance HE fellowships)	Both project co-leads (Tom Argles[224] and Sarah Davies[225]) have served as Scholarship Leads in their School (EEES) Tom Argles' promotion to senior lecturer and award of Senior Fellow of the HEA were both significantly boosted by this work and related innovations.
Facet 10: Fostering SoTL culture	Stimulating interest in SoTL Inspiring others to conduct SoTL	Both project co-leads served as Scholarship Leads in their School (EEES), promoting scholarship and drawing on their experience with this project and others.

222 An eSTEeM-funded project: Online peer mentoring at scale: Benefits and impacts from a student buddy perspective, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/supporting-students/online-peer-mentoring-scale-benefits-and-impacts-student-buddy or https://tinyurl.com/36av648w

223 GeoWeek 2023, https://earth-science.org.uk/geoweek/

224 Tom Argles, Project leader page on eSTEeM's website, https://www.open.ac.uk/scholarship-and-innovation/esteem/people/tom-argles; Professional biography, https://www.open.ac.uk/people/ta28

225 Sarah Davies, Project leader page on eSTEeM's website, https://www.open.ac.uk/scholarship-and-innovation/esteem/node/1592; Professional biography, https://www.open.ac.uk/people/smd432

Impact facet	Attribute	Description
Facet 11: Financial implications	Effect on costs of modules or programmes	The GPB was developed as an online enhancement of, and alternative to, previous paper-based activities that required paper maps to be sent to students (or for students to buy themselves). This initiative has been a significant part of a wave of innovation in the switch of EEES curriculum to wholly online delivery.
Facet 12: Funding opportunities	Internal (within the institution) funding for follow-on/new projects/initiatives/ events based on SoTL project's success	There has been no specific follow-on funding. However, the GIS innovation has continued and matured within the OU in EEES[226], STEM and FASS[227] over subsequent years in various forms.

15.5   Reflections on SoTL practice

As Sarah (project co-lead)[228] explains in her quote below, the photo-blog project was inspired by an innovation that she had set up in another module. Sharing SoTL practice with peers is one of the key principles of SoTL. Making SoTL public[229] is a pathway to generating impact of a SoTL inquiry. Engaging with the community enables peer review, facilitates sharing challenges experienced and the solutions, facilitates uptake of the outcomes of your SoTL inquiry and helps demonstrate how a SoTL inquiry can be conducted to colleagues who are new to SoTL. In this case, Sarah presented her innovation from another module within her School and OU's e-learning community which inspired Tom to set up the Geology Photo Blog.

To conclude, Sarah (project co-lead) reflects on the project:

On a previous project before eSTEeM [the OU's Centre for STEM pedagogy] existed, I developed an online system for collecting observations and data on ecosystems from students: a Google Maps/data collection/ photo mashup tool for S396 Ecosystems[230] ... a successor to this is still in use on an ecosystems module S397[231]. I gave presentations on this in my School [EEES] and to the eLearning Community in the OU. This led to the work with Tom to produce the Geology Photo Blog, which is now in use in a geology [S209 Earth Science] module.

226 School of Environment, Earth and Ecosystem Sciences (EEES), https://www.open.ac.uk/stem/environment-earth-ecosystem-sciences/
227 Faculty of Arts and Social Sciences (FASS), https://fass.open.ac.uk/
228 Sarah Davies, Scholarship activity in eSTEeM, https://www.open.ac.uk/scholarship-and-innovation/esteem/people/sarah-davies
229 'Making SoTL public', in 'Scholarship of Learning and Teaching in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109326&section=1
230 S396 Ecosystems, https://www.open.ac.uk/library/digital-archive/module/xcri:S396/study
231 S397 Terrestrial Ecosystems, https://www.open.ac.uk/courses/modules/s397

15.6 Project resources and references

Project resources

End-of-project report: Geospatial technologies in distance learning and teaching in Science. Available at: https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/teaching-laboratory-practice-online/geospatial-technologies-distance-learning-and or https://tinyurl.com/3rhw6sc8

Project poster: Geospatial technologies in distance teaching and learning in Science. Available at: https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/teaching-laboratory-practice-online/geospatial-technologies-distance-learning-and or https://tinyurl.com/3rhw6sc8

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Sinton, D. S. (2012). How would you define spatial literacy? Available at: http://dianamaps.com/2012/07/25/how-would-you-define-spatial-literacy/

16   [D1] Interactions in OpenStudio across a qualification

Fact box

Title	Are we making progress? Progression through learners' interaction in OpenStudio across a qualification
Aim of the SoTL inquiry	The aim of the project was to investigate how students progress in OpenStudio as they move through the Design and Innovation qualification.
Type of inquiry[232]	'What will happen?'
Led by	School of Engineering and Innovation, Faculty of STEM
Contact	Derek Jones derek.jones@open.ac.uk and Nicole Lotz, nicole.lotz@open.ac.uk
Theme	Influencing concepts, practices and ways of thinking in a discipline
Research methods	questionnaire; consensual assessment technique; interviews; workshop; conversation analysis; thematic analysis; statistical analysis
Duration	2015 – 2017
Keywords	design education; social learning; virtual design studio
Webpage	Are we making progress? Progression through learners' interaction in OpenStudio across a qualification, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/technologies-stem-learning/are-we-making-progress-progression-through-learners' or https://tinyurl.com/ykc4ammv

16.1   Context and aim of the SoTL inquiry

OpenStudio is a web-based environment integrated within Moodle, the Virtual Learning Environment (VLE) at The Open University (OU), that enables students to share their work (e.g. photos, videos), view others' contributions and engage in discussion around the shared artefacts (**Figure [D1].1**). OpenStudio was developed by the OU to meet the needs of students on Level 1 Design module, *Design thinking: creativity for the 21st century* (U101)[233], but it is now used across the university.

OpenStudio[234] is an online design studio that emulates aspects of the learning experience of a studio in a conventional design course, such as sharing design artefacts with peers and building a student-community. However, OpenStudio is much more powerful than a physical design studio in terms of the possibilities for interactions and social learning, because of the sheer number of students that can enter its (virtual) doors. OpenStudio can support the development of a community of design students with a wide range of experiences and backgrounds.

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232 'Areas of investigation in SoTL', in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109157&section=3.3

233 U101 Design thinking: creativity for the 21st century, https://www.open.ac.uk/courses/modules/u101

234 OpenStudio is referred to as OpenDesignStudio (implying the use of OpenStudio in Design education) in some of this project's resources listed at the end of this case study.

The aim of this project was to investigate how students on the Design and Innovation Qualification (Q61)[235] at the OU progress in OpenStudio as they move through their qualification. The project builds on the premise that social learning is key to student success and progression in online learning environments. However, surprisingly, little has been understood about exactly which social behaviours and interactions support student engagement, community-building and student success in a virtual design studio.
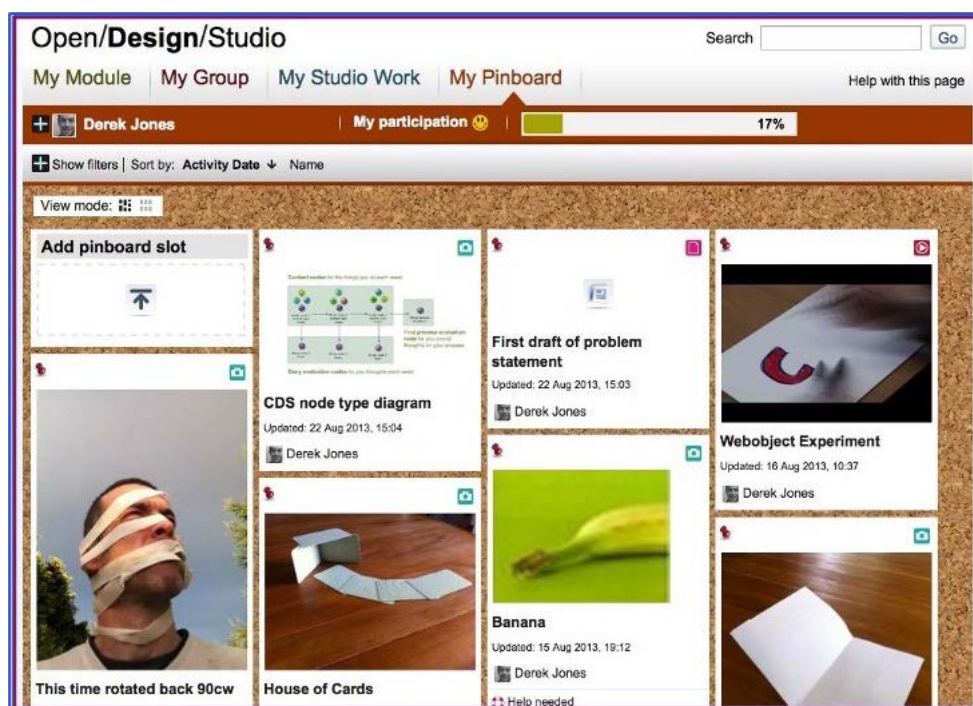
Figure [D1].1 A view of OpenStudio showing some of the icebreaker activities that are run to engage students, to introduce the tool, and to induct the students into design studio practices

16.2 Underpinning research of the SoTL inquiry

The team's previous work on social engagement in OpenStudio (Lotz *et al.*, 2015) revealed that at Level 1, there is a positive relation between engagement with the work of others and student success. To test the applicability of this finding at further levels of study, to better understand the criteria for engagement throughout a qualification, and to construct a progression pathway for Q61, the project team collected two sets of quantitative and qualitative data about engagement with the OpenStudio and devised an OpenStudio STEM workshop to construct OpenStudio progression pathways.

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235 BA/BSc (Honours) Design and Innovation, Q61 qualification, https://www.open.ac.uk/courses/design/degrees/ba-bsc-design-and-innovation-q61

In work package 1, statistical data pertaining to OpenStudio usage was collected. This involved data of nearly 3000 students distributed over five presentations of U101, two presentations of Level 2 Design module (T217)[236], and one presentation of Level 3 Design module (T317)[237] between 2012 and 2014. In work package 2, quantitative data or ratings from six experts (that is, four tutors and two members of the project team) was collected. The experts were asked to rate 30 artefacts of students' work and their descriptions uploaded on OpenStudio. Qualtrics survey software was used to collect data on the ratings using the Consensual assessment technique (CAT) (Amabile, 1982). In work package 3, qualitative data on the perceptions of OpenStudio was collected by interviewing 11 qualification students. Work package 4 involved analysing the conversations by some of the interviewed students around the uploads on OpenStudio. Work package 5 involved running a workshop with module team chairs and qualification leads to determine how they could use OpenStudio in their modules and to construct STEM OpenStudio progression pathways. This workshop helped towards devising Design Education progression pathway.

16.3   Findings of the SoTL inquiry

The project team confirmed, using a larger sample size, that there was a significant, positive correlation between engagement in studio activity and student achievement at Level 1. The team found that social engagement in OpenStudio at this level is linked to students gaining confidence in giving constructive feedback, their skills development, and student success. Students reported a sense of community in OpenStudio.

A student said:

It [OpenStudio] gave an element of community, a place where all us newbies could rock up and share our wares and not be embarrassed (well maybe the first time). Distance learning is hard so the more opportunity you have to interact with people, the easier your journey will be.

Students also identified challenges of a lack of engagement and interaction.

One student remarked:

Really liked sharing, we can all learn from the block [module] materials but design is about being inspired by other people's work. That sharing aspect of the community, that vision, is a golden goal. However, it can disintegrate if people do not participate fully.

Unexpectedly and contrary to the team's 2015 paper (Lotz *et al.*, 2015), the team identified correlations between 'passive' engagement approach of viewing other students' work ('lurking') and student success. Therefore, 'lurking' should be considered as a 'learning action' like 'listening in' in traditional studio space, and as valid and important as commenting. There was some indication that 'listening in' encourages, a deeper level of learning engagement that is often unrecognised. Students also recognise the value in this viewing behaviour by how it supports the development of confidence and design ability (Jones *et al.*, 2021).

236 T217 Design Essentials, https://www.open.ac.uk/courses/modules/t217
237 T317 Innovation: Designing for change, https://www.open.ac.uk/courses/modules/t317

The project team found extended social engagement with OpenStudio in U101 at Level 1, but that this did not extend to Levels 2 and 3 of the Q61 qualification. Engagement decreases at higher levels, which may be explained by a shift in studio culture (influenced by learning design, activity design, and student cohort and their backgrounds) in these levels. On average, Level 1 students completed about 73% of the planned slots compared to only 16% at Level 3 and 42% at Level 2. U101 students were 2–3 times more likely to comment on others as compared to the Level 3 module, T317.

16.4 Key lessons and details of the impact

The team found that OpenStudio helps to think about communication, and in the development of visual skills and the use of images and other artefacts particularly for sharing with other students (**Figure [D1].2**). Students reported that viewing other people's posts is inspiring but, importantly, enables comparison of their work with others - showing different interpretations of tasks and varied viewpoints.

A student said (reported in Jones *et al.*, 2021):

...sometimes you think 'Am I doing the right thing? Have I taken this idea the right way?' So, it is quite nice to see what everyone else is doing; nice to know you're thinking along the same lines but at the same time people are thinking slightly differently.

Identifying peers with similar interests helped to create a sense of community to some extent although few reported relationships that extended beyond OpenStudio.

The research showed that overall engagement with OpenStudio declines as students advance through the Q61 qualification. Students use OpenStudio much less as they progress to Levels 2 and 3 though the reasons are different. At Level 1, OpenStudio helps students to overcome isolation and inhibition. Quick and fun activities create a critical mass of posts that show the value of playfulness in creativity and ideation. At higher levels, a change in studio culture changes the engagement paradigm. At Level 2 (T217), individual activities are less playful, more technical, and take longer to complete. There is also a lack of critical mass as it is a much smaller module on Level 2. At Level 3 (T317), projects run for a long time and individual progress is varied. Further, many students come into the Level 3 module from other disciplines with no knowledge of studio work.

Figure [D1].2 Examples of student output possible with well-designed activities that allow a high degree of variation for students to engage in social comparison

The findings influenced the efforts to improve the student experience across the qualification: for example, designing module-specific inductions to OpenStudio, and in the redesign of modules and OpenStudio module activities (that is, learning design for progression) in the qualification.

The team noted that if a clearer Qualification OpenStudio progression pathway were implemented, with induction to the unique studio culture in OpenStudio at each level this may help students to maintain their progress across levels. This may be achieved by the creation of a longitudinal OpenStudio space, connecting all stages of study although this would have its own challenges.

The team has concluded (Jones *et al.*, 2021) that studio is a necessary, but insufficient, condition for the emergence of learning and a community of practice. It is clear from this SoTL inquiry that without careful design and consideration of how the virtual design studio should operate, it can inhibit student engagement just as any other poorly run conventional design studio would. A virtual design studio may be a significant catalyst for individual student interactions to take place, but it is the community of practice that emerges and develops that creates the studio 'place' itself.

A wider audience of STEM academics and LDS[238] staff benefitted from this project - enabling them to think beyond the implementation of OpenStudio in individual modules and instead to focus on progression strategies across a qualification.

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238 Learner and Discovery Services (central unit at the OU that leads on the learning design and innovation services), https://openuniv.sharepoint.com/sites/intranet-learner-discovery-services/pages/home.aspx (requires OU staff login)

The importance of social comparison and connection was recognised and some of the specific details of interaction and activity are being incorporated into current and future learning designs, as well as other scholarship. For example, students' use of social comparison (Jones *et al.*, 2021) to orient themselves in their study came across in feedback and comments, such as: confirmation they are going in the 'right' direction (validation) or that what they are doing is at a suitable quality level (verification), or even simply to just check that they are not alone in what they are experiencing.

The project will directly inform the next iteration and development of virtual design studio at the OU, planned with the development of the new Bachelor of Design (BDes) qualification.

Based on the facets and attributes of the impact evaluation instrument (**Appendix 1**), the Table below details the impact of this SoTL inquiry.

Impact facet	Attribute	Description
Facet 1: Student experience	Student engagement with course content Student satisfaction Learning design Curriculum design	The study was undertaken because the researchers believed it was crucial to understand the student experience in using this tool for the tool's better application and integration in teaching and learning. The study confirmed what had been informally observed in OpenStudio use at the OU: • student engagement is exceptionally high (especially at Level 1) • student reaction to OpenStudio use is exceptionally positive • student success is correlated to engagement in OpenStudio, and • there is evidence of student/socially constructed activity and content in OpenStudio. These findings have had an impact on the activity of re-writing learning materials for design modules (notably U101[239] and T317[240]). The use of the findings of this project in subsequent teaching demonstrates the desire of the project team to connect scholarship and research with teaching to improve student learning and experience.

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239 U101 Design thinking: creativity for the 21st century, https://www.open.ac.uk/courses/modules/u101
240 T317 Innovation: designing for change, https://www.open.ac.uk/courses/modules/t317

Impact facet	Attribute	Description
Facet 2: Student retention and progression	Student retention Student progression	This project's findings have shown that student success is correlated to OpenStudio use especially in Level 1 but less so in higher levels of study. Results show a student desire for a continuous studio experience between modules. The project team hypothesises that continuous studio experience between modules will have a positive impact on student retention and progression in design. This consideration will be the subject of future work when developing the new Bachelor of Design (BDes) qualification.
Facet 3: Evidence-based excellence in teaching	Student skills-set	The development of OpenStudio and its subsequent use has led to the development of many skills of students, including visual literacy and communication; however, these developments cannot be directly claimed by this SoTL project. However, as discussed above, the social learning mechanisms are an important finding in the project and can be particularly difficult to develop in an online and distance setting. To see the level of student engagement and achievement in the results demonstrates excellence in this type of learning and teaching environment (an online space for sharing and critiquing visual artefacts).

Impact facet	Attribute	Description
Facet 4: Influence on discipline-based teaching, research and practice	Change in the ways in which subject concepts are taught	During the COVID-19 Pandemic, the project team's expertise and experiences on this SoTL project helped support educators in other institutions transitioning to online and distance modes. Educators losing traditional studio spaces found it particularly difficult to make up for the tacit and social properties that are available in physical settings.

The OU Design Group[241] (of which the project team are members of) set up the Distance Design Education blog[242] and created the Creating Distance Design Courses guide[243] – all of which was influenced by the project team's work on OpenStudio and many of the results from this SoTL inquiry.

Through the Design Research Society (DRS)[244] Education special interest group (EdSIG), an international community of design educators was brought together through video conferencing to discuss pedagogical approaches to the pandemic crisis.

Being able to convince design educators that social learning is possible and to also give them both theoretical and practical information about how an online/virtual design studio works helped many educators make the transition to online and distance learning. |
| **Facet 5: Dissemination of project's outcomes** | Publications from the project | Several conference papers were produced and presented during this SoTL project to disseminate and demonstrate ongoing work. These were presented at the Design Research Society's Pedagogy Special Interest Group conferences (Learn X Design series) in 2015, 2017 and 2019.

Each paper presented the latest results from this inquiry and the analyses and thinking around these. This included both positive and negative results, and a hypothesis proposed in the 2015 paper was disproven in later work, helping to consolidate and strengthen the final analyses. The project has led to several conference papers and a journal article. |

241 Design@Open, https://www.open.ac.uk/blogs/design/
242 Distance Design Education, https://distancedesigneducation.wordpress.com
243 Creating Distance Design Courses, https://distancedesigneducation.wordpress.com/creating-distance-design-courses/
244 Design Research Society, DRS, https://www.designresearchsociety.org/cpages/home

Impact facet	Attribute	Description
Facet 6: Adoption of the outcomes of the project by other educators	Adoption of the outcomes internally or externally (within the institution) to improve assessment, curriculum design in the same discipline in same or different contexts	Since the COVID-19 pandemic, colleagues in several countries have adopted guidance, advice and approaches outlined in this project's resources listed at the end of the case study. Additionally, the project team shared the results and experiences through the Distance Design Education blog[245], the Creating Distance Design Courses online resource[246], and the team's work in the Design Research Society Education SIG[247]. The resources supported educators to make an emergency transition to online and distance modes of teaching during the COVID-19 pandemic. But latterly this 'support initiative' has developed into more in-depth discussion and work with design educators across the world on student experience and learning in online design education spaces.
Facet 7: Mutual stakeholder understanding	A community that SoTL creates and moving outside traditional silos	The material has been disseminated to many of the stakeholders outlined in the other facets (of impact) above and particularly the stakeholders involved in the development of OpenStudio. The project has opened new avenues for collaboration with external academics and bidding for external funding to investigate the design of social online learning environments in design and innovation.
Facet 8: Personal and professional development of project team	Improved practice and personal knowledge collaborative or team-working skills	Reflecting on the longitudinal study (3 years, 3000 students) of student behaviour in OpenStudio reported in Jones *et al.* (2021), Derek reflects: *The size and scale of the project has required us to develop our understanding and approach to learning research. The nature of the data collected required a mixed methods approach from the start (for example, two principal researchers had to develop additional statistical methods skills and knowledge). But it was the iterative approach to the research and analysis that necessitated a far more integrated approach to the methods, making it an abductive[248] research process.*

245 Distance Design Education (Blog), https://distancedesigneducation.wordpress.com/blog-2/
246 Creating Distance Design courses (Guide), https://distancedesigneducation.wordpress.com/creating-distance-design-courses/
247 Special Interest Group in Design Education (EdSIG), Design Research Society, https://www.designresearchsociety.org/cpages/design-pedagogy-sig
248 Timmermans, S. and Tavory, I. (2012). Theory Construction in Qualitative Research: From Grounded Theory to Abductive Analysis, Sociological theory, vol. 30, no. 3, pp. 167-186. Also, Kennedy, B. (2018). Deduction, Induction, and Abduction. The SAGE Handbook of Qualitative Data Collection. London: SAGE Publications Ltd.

Impact facet	Attribute	Description
Facet 9: Recognition of project team members and other stakeholders	Fellowships or memberships of professional associations nationally and internationally (e.g. Advance HE fellowships)	The project helped two team members (Derek Jones and Nicole Lotz) to gain Senior Fellowships of Advance HE[249]. Project team members are regularly invited to give talks and presentations (for example, the Irish National Forum for the Enhancement of Teaching and Learning in 2021).
Facet 10: Fostering SoTL culture	Stimulating interest in SoTL	Whilst not directly, several other projects have studied OpenStudio in relation to this project's findings (and in parallel to them as well), for example: 'Using OpenStudio in STEM learning (Thomas *et al.*, 2018); and 'Students' feelings in social and collaborative learning: some case studies' (Hilliard *et al.*, 2019).
Facet 11: Financial implications	Opportunities for income diversification Effect on costs of modules or programmes.	The project supports the ongoing development of OpenStudio, which was initially developed for photography and design courses but is now used across all faculties and subject areas (for example, OpenEngineeringStudio). The project team have concluded that there is a clear benefit of taking an evidence-informed pedagogical and user-centred design approach to developing learning products, such as in the case of OpenStudio.
Facet 12: Funding opportunities	Internal (within the institution) funding for follow-on/new projects based on SoTL project's success External funding (from outside the institution) for follow-on/ new projects based on SoTL project's success.	A few smaller network and impact projects, funded internally (£10K in 2018) and (£10k in 2020), were also in part shaped by the findings of this project. Insight from this project led to a highly rated grant application in 2022 on hybrid design studios (result on award pending).

249 Advance HE, https://www.advance-he.ac.uk/

16.5 Reflections on SoTL practice

The SoTL project on the use of virtual design studio in distance design education is longitudinal (Jones *et al.*, 2021) and started in 2014. This case study reports one of the stages of this ongoing SoTL project. The ongoing SoTL inquiry has continuously fed into the learning and curriculum designs for distance Design Education and in the usability and pedagogical designs of OpenStudio.

'Going public' or sharing the outcomes of SoTL so that others can critique and build on the work is one of the key guiding principles[250] of SoTL. Sharing of SoTL outcomes can enable/encourage other educators to make use of the outcomes through adoption and adaptation. Therefore, there is a greater possibility of impact of a SoTL project if the team makes the results public as soon as it is possible to share. A continuous cycle of dissemination both internally and externally through presentations, workshops and publications in this SoTL project is generating impact at several levels[251]: discipline, institutional, national, and international.

The OpenStudio platform is now in use in several disciplines across the university. The thorough and comprehensive knowledgebase on the pedagogical effectiveness of virtual design studios built over several years through SoTL led to this team's advising Design educators around the world during the COVID-19 pandemic on the role of virtual design studios in remote Design education.

Further, a longitudinal project interspersed with dissemination and engagement with peers provides opportunities to the SoTL project team to reflect on the SoTL inquiry, strengthen the interpretations of the data, and to iteratively make enhancements/changes to the SoTL project's research design.

To conclude, the project team's thoughts on the project are:

The project is a good example of how teaching, SoTL and research can be combined at the OU. Institutionally, we have a strong tradition of supporting and engaging in scholarship as part of learning and teaching design and, where there is a subject intersection, this is often readily extended to more widely applicable [discipline-based educational] research.

Very often, learning and teaching at a distance 'makes visible' pedagogical matters in other [traditional, face-to-face] settings – whether in contrast or in synergy – and this can be exceptionally valuable as a research vehicle in both settings.

In design particularly, the boundaries between online or traditional modes are now [in post-COVID-19 era] far less stark than they once were and our (OU) knowledge and experience in scholarship and research is of value and relevance across a number of disciplines.

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250 'Principles of SoTL', in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109160&section=2

251 'The impact of SoTL', in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109326&section=2

16.6 Project resources and references

Project resources

End-of-project report: Are we making progress? Progression through learners' interaction in OpenStudio across a qualification. Available at: https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/technologies-stem-learning/are-we-making-progress-progression-through-learners' or https://tinyurl.com/ykc4ammv

Project video: Are we making progress?, https://www.youtube.com/embed/sUjmUq7_gZg?rel=0&showinfo=0 or https://tinyurl.com/bddfuf2f

Project posters and presentations: Are we making progress? Progression through learners' interaction in OpenStudio across a qualification. Available at: https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/technologies-stem-learning/are-we-making-progress-progression-through-learners' or https://tinyurl.com/ykc4ammv

Jones, D. (2022). Studio use in Distance Design Education. PhD thesis The Open University. Available at: http://oro.open.ac.uk/82824/

Jones, D., Lotz, N. and Holden, G. (2021). A longitudinal study of Virtual Design Studio (VDS) use in STEM distance design education. *International Journal of Technology and Design Education*, vol. 31 pp. 839–865. Available at: http://oro.open.ac.uk/69782/

Lotz, N., Jones, D. and Holden, G. (2019). OpenDesignStudio: virtual studio development over a decade. *In Proceedings of the DRS Learn X Design Conference 2019*, 9–12 Jul 2019, Ankara. Available at: http://oro.open.ac.uk/60115/

Lotz, N., Jones, D. and Holden, G. (2018). Engaging Qualities: factors affecting learner attention in online design studios. *In Proceedings of DRS2018*, Design Research Society, London, pp. 2746-2764. Available at: http://oro.open.ac.uk/56874/

Jones, D., Lotz, N. and Holden, G. (2017). Lurking and learning: Making learning visible in a Virtual Design Studio. *In Proceedings of the Learn X Design London 2017 Conference* (Pritchard, Gary and Lambert, Nick eds.), London, pp. 176–183. Available at: http://oro.open.ac.uk/52977/

Lotz, N., Holden G. and Jones, D. (2015). Social engagement in online design pedagogies. *In Proceedings of the 3rd International Conference for Design Education Researchers* (Vande Zande, Robin; Bohemia, Erik and Digranes, Ingvild eds.), Aalto University, pp. 1645-1668. Available at: https://oro.open.ac.uk/43592/

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Amabile, T. M. (1982). Social psychology of creativity: A consensual assessment technique. *Journal of Personality and Social Psychology*, vol. 43, no. 5, pp. 997–1013.

Hilliard, J., Rosewell, J., Kear, K., Donelan, H. and Heaney, C. (2019). Students' feelings in social and collaborative learning: some case studies. *In: The Online, Open and Flexible Higher Education Conference: Blended and online education within European university networks*, 16-18 Oct 2019, UNED, Madrid. Available at: http://oro.open.ac.uk/67526/

Thomas, E., Barroca, L., Donelan, H., Kear, K., Jefferis, H. and Rosewell, J. (2018). Using OpenStudio in STEM learning. ***End-of-project report*** to eSTEeM, the OU Centre for STEM pedagogy. Available at: http://oro.open.ac.uk/62690/

17   [D2] Remote pair programming

Fact box

Title	Investigating the perceived benefits to computing students of remote pair programming
Aim of the SoTL inquiry	The aim of the project was to investigate the benefits for distance learning Computing students by engaging in 'remote pair programming' in their learning.
Type of inquiry[252]	'What will happen?'
Led by	School of Computing and Communications, Faculty of STEM
Contact	Brendan Murphy, brendan.murphy@open.ac.uk
Theme	Influencing concepts, practices and ways of thinking in a discipline
Research methods	live and video demonstrations, survey, focus groups, descriptive statistics
Duration	2019 – 2021
Keywords	employability; pair programming; remote collaboration; remote pair programming
Webpage	Investigating the perceived benefits to computing students of remote pair programming, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/supporting-students/investigating-the-perceived-benefits-computing-students-remote or https://tinyurl.com/yv2m8fmk

17.1   Context and aim of the SoTL inquiry

Pair programming is routinely used in the software industry[253] and involves two people programming together at the same machine. The benefits of pair programming include sharing of expertise and fewer coding errors.

Pair programming is taught in lab classes in face-to-face teaching to develop students' coding expertise. At The Open University (OU), distance-education Computing students learn to program on their own. Providing an online/remote pair programming experience for students is, however, no longer exclusive to the OU: other higher education institutions moved to online learning and teaching during COVID-19 pandemic, and some continue to practise hybrid mode[254] in the post-COVID-19 era.

Whilst the technical logistics of implementing remote pair programming are not particularly problematic, the design of the educational logistics needs sensitivity. Educators may wonder if the effort required to arrange remote pair programming is worthwhile, particularly given that partnerships need to be arranged between students who may have never met, as is the situation for the OU.

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252 'Areas of investigation in SoTL', in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109157&section=3.3

253 The friendship that made Google huge: Coding together at the same computer, Jeff Dean and Sanjay Ghemawat changed the course of the company - and the Internet, https://www.newyorker.com/magazine/2018/12/10/the-friendship-that-made-google-huge

254 Blended learning in higher education, https://www.jisc.ac.uk/guides/blended-learning-in-higher-education

This project aimed to investigate the benefits of engaging in remote and online pair programming for OU's Computing students. In particular, the investigations aimed to go beyond academic learning to explore 'non-technical' benefits (that is, soft skills) such as community and employability benefits, both of which are relevant to the NSS[255] amongst other measures of student satisfaction.

17.2   Underpinning research of the SoTL inquiry

Ethical permissions were obtained for student participation and for the project, in general. Permissions were also sought from the module team of *Introduction to computing and information technology 2* (TM112)[256] in which this SoTL project was based. 43 students participated in the project (approximately 17% of the students registered). In keeping with the gender balance of the module, 25% of the participants were female.

- *Passive:* watching a video recording of two expert tutors pair programming in Python[257] "side-by-side".

- *Indirect participation:* watching two tutors pair programming live in Microsoft Teams™[258], with the opportunity to interact with them during the session.

- *Direct participation:* working on a remote pair programming task with a student partner online.

In each of the methods, the task to be solved had been devised by the tutors to correspond to the level of difficulty and topics the participants were studying at that stage in TM112.

After experiencing each method, students were asked to complete an online survey to describe their perceptions of pair programming. From the survey data, the project team identified five areas for investigation in a focus group, which was conducted online with three participants by an OU student facilitator.

During data analysis, there was triangulation[259] of the data by the investigators. Three team members were involved, thereby mitigating bias, and increasing the range of perspectives in interpreting the collected data.

17.3   Findings of the SoTL inquiry

Whilst all three methods of experiencing pair programming were reported positively by the participants in terms of soft-skills benefits, the direct participation method of working with a remote partner led to the strongest agreement that these benefits accrued (even when working with a student who was not previously known to them).

Direct participation remote pair programming can help students to develop the social confidence to discuss their programming. The perceived benefits included improvements in verbal communication, problem solving, initiative

255 National Student Survey, NSS, https://www.thestudentsurvey.com/
256 TM112 Introduction to computing and information technology 2, https://www.open.ac.uk/courses/modules/tm112
257 Python programming language, https://www.python.org/
258 Microsoft Teams, https://www.microsoft.com/en-gb/microsoft-teams/group-chat-software
259 'Triangulation', in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109325&section=2.2.3

and decision-making. Interactions were found to be useful for confirming technical understanding, gaining inspiration, learning how to ask for help, and for developing mentoring skills.

The project team found that the indirect participation method can help students to regard their more experienced educators as approachable, learning how to break the social barrier and/or discomfort of engaging with more experienced or senior others to articulate their questions. In these ways at least, the project team believes that non-technical remote pair programming skills can benefit organisations as well as individuals. This was an important finding.

The team found that technological obstacles in online pair programming tools may be disappointing for distance learning students (Adeliyi *et al.*, 2021). Further, the pairs may not be well-matched, such as a mismatch of experience or expertise. Pairs need time to get used to working with each other. In this initiative, sessions too few and too far apart were seen as a downside.

Remote pair programming was conducted on Microsoft Teams™ which was a familiar collaborative environment for the project team and student participants. The project team recognised that using a pair programming tool, such as Microsoft LiveShare[260], would have provided a more realistic environment for students if it wasn't for the likely requirement for student training and the learning of a new environment for the purposes of this project.

17.4 Key lessons and details of the impact

Remote pair programming can supplement the social and community aspects of the student experience that are otherwise limited for distance learners, even when students are partnering with someone whom they have never met. Working with a fellow student may help impart soft skills to students required in the post-pandemic world of home or remote working.

The project team developed the following recommendations for Computer Science educators who are teaching pair programming at a distance and increasingly in hybrid modes since the COVID-19 pandemic:

- Focus on preparing (and supporting) the students in communication, turn-taking, interacting, and questioning, rather than the process of using the collaboration technologies.

- Aim to match student pairs according to expertise and self-efficacy, but also establish and take account of any expressed preferences for partnership (for example regarding the gender of the partner), or concerns such as anxiety about skill or level of English language.

- Encourage students to appreciate the benefits that can be gained when partnering up with people of different levels of expertise, particularly for the development of soft skills, such as articulating their own reasoning, learning to ask for help, and mentoring.

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260 Microsoft LiveShare, https://code.visualstudio.com/learn/collaboration/live-share

Reflecting on the project, Brendan states:

> *Pair programming can "force" two students to come together. As we know from tutorials and the general unwillingness of students to participate [online] verbally (though chat is fine) this can be problematic – even across the full period of a typical presentation. I'd say pair programming would need to run the full - typical, 21 weeks of a module, with real effort put in at the start to ensure pairs were correctly matched and supported, giving the best chance of success.*

The project team also developed guidance on using Microsoft Teams™ to pair program. However, because of this project, there has been a growing awareness amongst the OU's School of Computing and Communications of other remote/online pair programming using tools such as Microsoft LiveShare, replit[261] and Coding Rooms[262]. The module *Algorithms, data structures and computability* (M269)[263], is adopting pair programming on a trial basis based on the results of this project. M269 uses programming as a tool for algorithmic problem solving. In addition, the module *Introduction to computing and information technology 2* module (TM112)[264], is adapting the tutorial model for programming to adopt pair programming.

The project team has inferred that the benefits of remote pair working could be considered in other (non-programming) Computing/Computer Science modules such as database management and analysis, or information security, which may benefit from greater communication and collaboration. New graduates will have considerable need of remote working communication and collaboration skills, as experienced here in remote pair programming, if they are to avail themselves of colleague support networks in the post-pandemic era.

The findings of this project are relevant for higher education, in general, given the significance of optimising remote and hybrid learning and teaching in the post-COVID-19 era. Educators are aware that social and support aspects can be crucial for student retention. Therefore, designing encounters in the curriculum for distance-learning students to interact with educators and with each other can contribute to the sense of community, provide opportunities for collaboration, and develop the soft skills valued by employers.

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261 Replit, Collaborative browser-based IDE (Integrated Development Environment), https://replit.com/
262 Coding Rooms, Developer Training & Enablement Platform, https://www.codingrooms.com/
263 M269 Algorithms, data structures and computability, https://www.open.ac.uk/courses/modules/m269
264 TM112 Introduction to computing and information technology 2, https://www.open.ac.uk/courses/modules/tm112

Based on the facets and attributes of the impact evaluation instrument (**Appendix 1**), the Table below details the impact of this SoTL inquiry.

Impact facet	Attribute	Description
Facet 1: Student experience	Learning design Student engagement with course content Student engagement with the technological intervention	This project has increased awareness of the benefits that students can gain from working together with their fellow students such as socialisation and collaborative learning. The project has uncovered new possibilities for supporting students who are studying at a distance and in helping them to gain employability skills such as working in a team and learning how to ask for help.
Facet 4: Influence on discipline-based teaching, research and practice	Change in the ways in which subject concepts are taught	The project has raised possibilities of including formative opportunities for pair programming in two modules on programming in the OU's School of Computing and Communications, whether led by module teams or by tutors directly. The project has developed guidance on the use of Microsoft Teams™ for pair programming.
Facet 5: Dissemination of project's outcomes	Number of publications from the project/initiative	Several publications including end-of-project report have resulted from this project.
Facet 6: Adoption of the outcomes of the project by other educators	Adoption of the outcomes internally or externally (within the institution) to improve assessment, curriculum design in the same discipline in same or different contexts	Within the OU, the project has led to a small number of ALs adjusting their teaching practices to include pair programming. The COVID-19 situation has made this OU-based project relevant to institutions who had to move to online learning during COVID-19 and are now involved in hybrid modes of learning and teaching. The paper (Hughes *et al.*, 2020) has been cited by a set of researchers in Linkoping University, Sweden. The poster (Adeliyi *et al.*, 2021) has been downloaded 157 times from the ACM[265] database and has been cited in a 2022 paper by a team of Computer Science educators in the US.
Facet 7: Mutual stakeholder understanding	Understanding among students and staff	There has been an enhanced and richer understanding of the benefits of pair programming amongst students, tutors and module teams in the School. Dialogues between this project team and another research team in the School led to a joint poster (Adeliyi *et al.*, 2021) at an international Computer Science Education forum.

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265 ACM, Association for Computing Machinery, https://www.acm.org/

Impact facet	Attribute	Description
Facet 8: Personal and professional development of project team	Improved practice and personal knowledge	The project team believes that the project has contributed to professional development of all the team members with respect to this topic of Computer Science Education and the ethical considerations involved in SoTL projects.
Facet 9: Recognition of project team members and other stakeholders	Public recognition through awards	This project/SoTL initiative was awarded the 'eSTEeM Scholarship Project of the Year Award' at eSTEeM's 11th Annual Conference[266].
Facet 10: Fostering SoTL culture	Increased involvement of students in SoTL	This SoTL project involved collaboration amongst tutors, academics, staff tutors (line managers of tutors) and students in a distance-education setting. In keeping with eSTEeM's ethos of Students as partners in SoTL[267], students were involved as research participants in this project (also see case study **[SP]**[268]). One student participated as a pilot evaluator of the research materials and as a co-researcher/co-inquirer.
Facet 12: Funding opportunities	Internal (within the institution) funding for follow-on/new projects/initiatives/events based on SoTL project's success	The initial pilot of this project received funding from Scottish Funding Council, distributed by the OU in Scotland (OUiS) enhancement themes (Hughes *et al.*, 2020). After a successful pilot, the project was supported by eSTEeM[269], and which has been reported in this case study.

17.5   Reflections on SoTL practice

'Going public' or sharing the outcomes of a SoTL inquiry through internal workshops, poster presentations and similar is a preparation for scholarly publications in peer-reviewed journals and conferences[270]. Early dissemination of the project's aim and expected outcomes through poster and informal networking events of this SoTL initiative led to discussions with academic colleagues including a postgraduate student who is investigating tools for pair programming, and the student's supervisors, leading to collaboration on a conference poster (Adeliyi *et al.*, 2021).

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266 eSTEeM's 11th Annual Conference: Scholarship Success Stories – Innovation Through Community, 11-12 May 2022. News item: https://www.open.ac.uk/scholarship-and-innovation/esteem/events/11th-esteem-annual-conference-scholarship-success-stories---innovation-through-community or https://tinyurl.com/y75jp27w

267 'Students as partners in SoTL', in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109324&section=1

268 Reference to the case study [SP] in this compendium.

269 eSTEeM, The OU Centre for STEM pedagogy, https://www.open.ac.uk/scholarship-and-innovation/esteem/

270 'Principles of SoTL', in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109160&section=2

As a result of this eSTEeM-funded project, the team has gained an enhanced understanding of the role eSTEeM plays in supporting SoTL in STEM and how the scholarship projects in STEM contribute to the OU's growing scholarship knowledgebase. The role of eSTEeM, dedicated and specialised Centre for supporting SoTL in OU's Faculty of STEM, is discussed in OpenLearn's badged open course – 'SoTL in STEM'[271].

To conclude, Ann's and Janet's[272] reflections are:

The project has demonstrated that students can benefit from working together with their fellow students, not only in learning to program, but in gaining confidence to ask for help, employability skills such as working in a team, and enjoying interaction with peers. But not all students will prefer this method of working, as they may prefer to work in isolation or only with people they are familiar with.

While we have been undertaking the project, we have had heightened awareness of findings from other scholarship projects. We have learned that having a sense of belonging increases student success. Any initiative that encourages students to interact and network safely with fellow students in a formative way can contribute to a range of related positive outcomes, including those of a social nature.

17.6   Project resources and references

Project resources

End-of-project report: Investigating the perceived benefits to computing students of remote pair programming. Available at: https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/supporting-students/investigating-the-perceived-benefits-computing-students-remote or https://tinyurl.com/yv2m8fmk

Adeliyi, A., Hughes, J., Kear, K., Law, B., Murphy, B., Rosewell, J., Walshe, A. and Wermelinger, M. (2021). Remote Pair Programming. *In SIGCSE'21 - Proceedings of the 52nd ACM Technical Symposium on Computer Science Education*, 13-20 Mar 2021, Virtual, ACM. Available at: http://oro.open.ac.uk/74995/

Hughes, J., Walshe, A., Law, B. and Murphy, B. (2020). Remote pair programming. in H.C. Lane, S. Zvacek and J. Uhomoibhi (eds), *Proceedings of the 12th International Conference on Computer Supported Education*, vol. 2, pp. 476-483. Available at: http://oro.open.ac.uk/71776/ and https://researchonline.gcu.ac.uk/en/publications/remote-pair-programming

Hughes, J., Law, B., Murphy, B. and Walshe, A. (2019). Online pair programming: Benefits to distance learning students, *Ninth Pan-Commonwealth Forum on Open Learning (PCF9)*, 9-12 September, Edinburgh.

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271 'Supporting SoTL through communities', in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109159&section=4

272 Ann Walsh and Janet Hughes were project co-leads along with Brendan Murphy (named contact of this case study) and Bobby Law.

18 [SP] Students as partners in Scholarship of Teaching and Learning

Fact box

Title	eSTEeM: Students as partners
Aim of the SoTL inquiry	The aim of this ongoing project is to develop structures, guidance, and support for student engagement in eSTEeM projects and to monitor and evaluate the role of students as partners in SoTL.
Type of inquiry[273]	'What will happen?'
Led by	eSTEeM, The Open University's Centre for STEM pedagogy, Faculty of STEM
Contact	Trevor Collins, trevor.collins@open.ac.uk
Theme	Involving students as partners
Research methods	monitoring the community forum; assessing projects that involve students as partners; student participation at the annual eSTEeM online student conference; and eSTEeM's events during annual Student Voice Week
Duration	2019 - ongoing
Keywords	co-designers; co-researchers; participatory design; students as partners
Webpage	Students as partners in Scholarship, https://www.open.ac.uk/scholarship-and-innovation/esteem/working-with-us/students-partners-scholarship

18.1 Context and aim of the SoTL inquiry

Students have always been integral to SoTL at The Open University (OU): for example, providing feedback on module content and the curriculum via questionnaires and workshops, and in usability and accessibility evaluations of websites and other study resources. Similarly, in eSTEeM[274], students have participated as research participants in SoTL projects. The 'Students as Partners in Scholarship' initiative was launched in April 2019 with Diane Butler and Cath Brown (Director of eSTEeM and President, OU Students Association, respectively, at the time) co-designing and co-leading the initiative. Since then, the extent of student engagement in eSTEeM has been extended to include students as co-researchers[275], co-designers, and co-investigators[276] in SoTL projects, and in an advisory capacity[277] to eSTEeM.

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273 'Areas of investigation in SoTL', in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109157&section=3.3

274 eSTEeM, The OU Centre for STEM pedagogy, https://www.open.ac.uk/scholarship-and-innovation/esteem/

275 Video case study: 'Student co-design of confidence-building formative assessment for Level 1 Computing & IT students', in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/mod/oucontent/view.php?id=109324&section=1.3.3

276 Case study: 'How are students using extensions and what is the impact on success?' in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/ocw/mod/oucontent/view.php?id=109324&section=1.2

277 eSTEeM Student Reference Panel, https://learn1.open.ac.uk/course/view.php?id=100174 (requires OU login).

The initiative was started by establishing a 'Student Reference Panel' in April 2019 and the 'eSTEeM & Co' website[278]. The reference panel consists of six student representatives drawn from across the six STEM schools. The eSTEeM and Co site is hosted on the OU's Virtual Learning Environment (VLE) and gives eSTEeM a place to share resources and information with OU students (see **Figures [SP].1a** - **[SP].1c**).

eSTEeM has also been developing the support infrastructure including approaches to communicate scholarship opportunities to students (e.g. an online Student Newsletter and social media posts), systems for recording students' interests and contact details (e.g. an Expressions of Interest form and Student Register), mechanisms for recognising and rewarding students' contributions to scholarship (e.g. a digital badge, certificates, vouchers and payments), and training and support resources for student participation in SoTL.
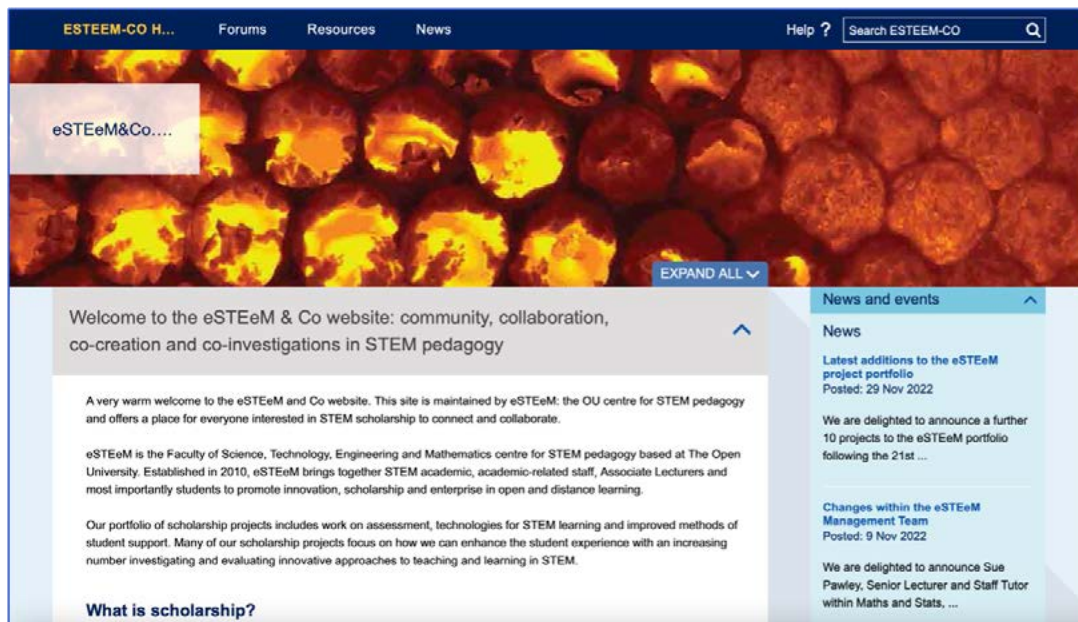
18.2 Underpinning research of the SoTL inquiry

Through the Students as Partners in Scholarship initiative, eSTEeM has been undertaking the following initiatives to promote student engagement in SoTL:

- eSTEeM launched a Student Reference Panel in April 2019 for consultation and discussion on matters of STEM scholarship. The panel comprises of six students from the Schools in Faculty of STEM.

- An online community space ('eSTEeM & Co') has been set up. The community space links to SoTL resources including recordings of eSTEeM's events and newsletter. A form for expressing interest to participate in SoTL is available for students on this site. A community forum provides a space for students to share their interests in SoTL and experiences of participating in SoTL.

- eSTEeM has organised an evening of presentations on SoTL projects during OU's annual Student Voice Week[279]. The showcased projects have demonstrated involvement of students in SoTL practice, and how some of the projects have made a considerable impact on student experience, employability, student journey, and so on. During this event, students have been informed about the online community space and opportunities to participate in SoTL.

- Four members of the eSTEeM Student Reference Panel volunteered to help develop an action plan for Students as Partners in Scholarship in eSTEeM. This resulted in a working document that shaped how eSTEeM is communicating with and engaging students in scholarship. The group also works closely with representatives of the OU Students Association to ensure eSTEeM's work is responsive to the student voice.

- The approach (working document) that eSTEeM developed was shared and further developed with the other three scholarship centres at the OU[280] resulting in a 'Students as Partners in Scholarship Framework' (Collins, 2022), iteratively developed and authored by Trevor, former Director of eSTEeM. This framework has been adopted as a guiding framework to facilitate the involvement of students in SoTL in scholarship centres across the OU.

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278 eSTEeM & Co website: community, collaboration, co-creation and co-investigations in STEM pedagogy, https://learn1.open.ac.uk/course/view.php?id=100174 (requires OU login)
279 OU Student Voice Week, https://www.oustudents.com/whats-on/student-voice-week/
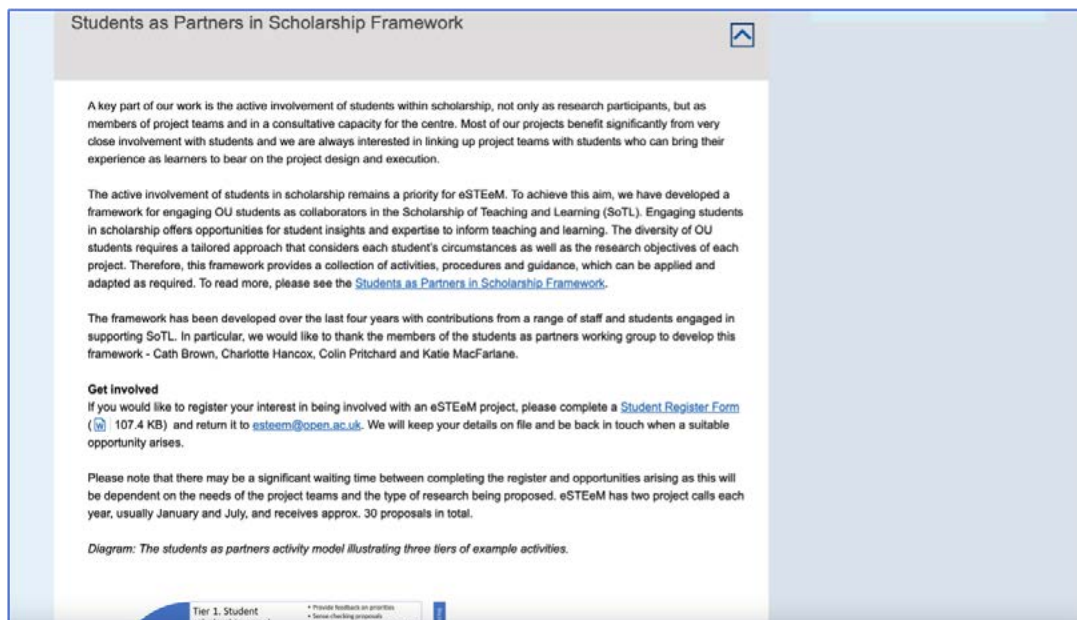280 Scholarship at The Open University, https://www.open.ac.uk/scholarship-and-innovation/esteem/working-with-us/scholarship-open-university

Figures [SP].1a eSTEeM & Co community website
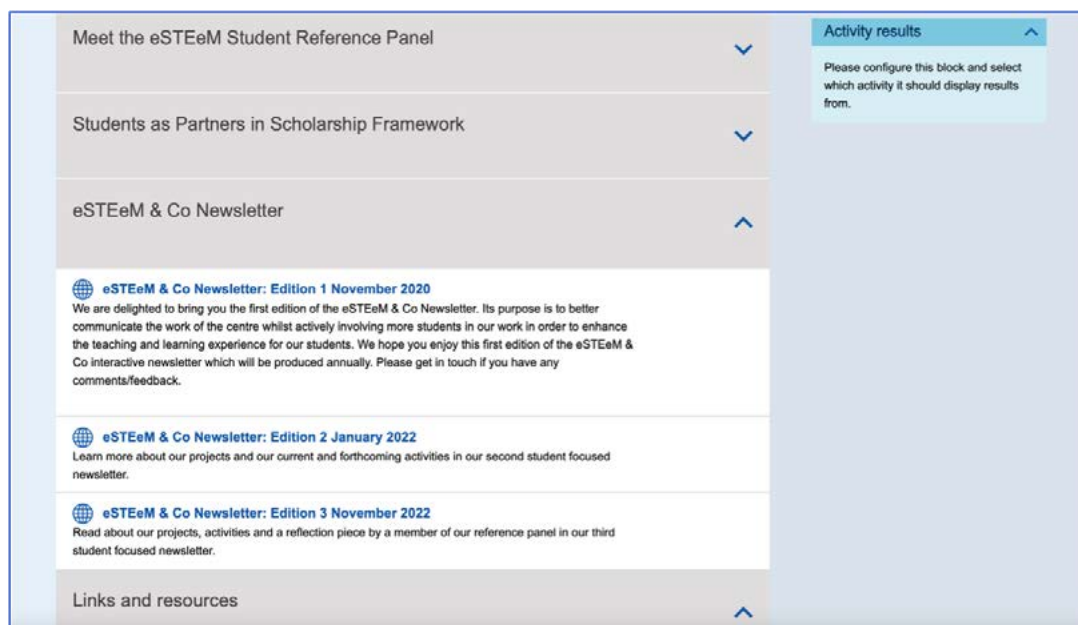
Figures [SP].1b eSTEeM & Co community website – newsletters and resources

Figures [SP].1c eSTEeM & Co community website – students as partners in scholarship

18.3 Findings of the SoTL inquiry

Diane Butler (former Director of eSTEeM, Faculty of STEM) and Cath Brown (Former President, OU Students Association) developed a three-tiered model for Students as Partners in Scholarship (**Figure [SP].2**) that was presented at the 2019 Horizons in STEM Higher Education Conference and has been the basis for developing examples of student scholarship activities.

The model groups examples of student engagement activities into three categories involving increasing levels of engagement. The first tier refers to a Student Scholarship Panel that involves a pool of students that have registered an interest in being contacted to undertake well defined pieces of scholarship, such as, providing feedback on scholarship priorities, sense checking of proposals, and commenting on survey questions and interview scripts.
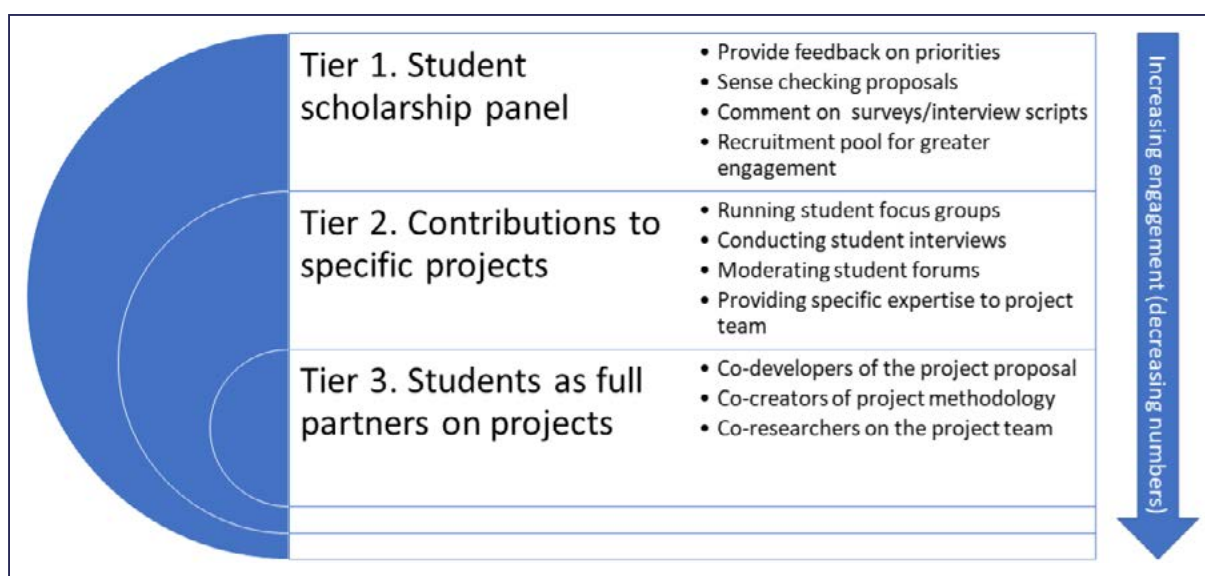

Figure [SP].2 The students as partners in scholarship activity model illustrating three tiers of example activities requiring increasing levels of student engagement from tier 1 (lower engagement) to 3 (higher engagement)
(based on Butler and Brown, 2019)

The second tier requires more involvement and is for contributions to specific projects. The activities could include running student focus groups, conducting interviews, moderating student forums, and providing specific expertise to a project team. The third tier extends the level of engagement for students to be full partners on projects, either as members of the project team or project leaders. The distinction here is student involvement in developing the project proposal, designing the methodology, and being recognised as a researcher on the project team.

The project lead, Trevor, reflects on the initiative:

The strongest encouragement we have had are the insights and enthusiasm of the participating students and the appreciation of the project teams they work with; the students bring a different perspective which enriches the research. We have been collating examples and case studies as our best way of communicating these benefits.

18.4 Key lessons and details of the impact

eSTEeM is working towards integrating student voice in SoTL practice through the following:

Communications: Multiple routes for communication with students about eSTEeM's news and events via a mailing list, online newsletters, online community space, and social media (Twitter, YouTube, Facebook); apprising students about opportunities to participate in SoTL in the welcome email of a module.

Recognition: Recognising and rewarding student participation in scholarship in tiers 1 and 2 (in **Figure [SP].2**) by providing a digital badge[281]; involving students in project dissemination including collaborative authoring of reports and papers (tier 3); and providing a student reference letter acknowledging their participation and contributions to SoTL (tiers 2 and 3).

Professional Development: Online training resources to support students interested in participating in SoTL projects are being developed to complement synchronous training.

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281 Student Partner in Educational Research, https://www.open.edu/openlearn/science-maths-technology/student-partner-educational-research/content-section-0?active-tab=description-tab or https://tinyurl.com/3mvb79xn

Based on the facets and attributes of the impact evaluation instrument (**Appendix 1**), the Table below details the impact of this SoTL inquiry.

Impact facet	Attributes	Description
Facet 1: Student experience	Student engagement with the (SoTL) interventions Student satisfaction	Students are participating in SoTL projects as research participants and increasingly across all the three tiers. Student experience has been positive in terms of their learning: for example, development of research skills; awareness of how teaching content is created; and learning how to disseminate to different audiences. The educators have similarly benefited from having a student perspective to the SoTL inquiry, research design and research materials (see Halliwell and Brown, 2021 and Piwek and Savage, 2022).
Facet 3: Evidence-based excellence in teaching	Student skills-set Inform policy development internally at the level of the sub-unit, faculty or University	Students have reported development of research skills and dissemination strategies through their involvement in SoTL projects. The processes for student engagement with SoTL practice in STEM faculty are guiding the 'Students as Partners' initiatives in other OU Faculties and scholarship centres[282].
Facet 5: Dissemination of project's outcomes	Number of publications from the project/ initiative	The working group involved with this SoTL inquiry has disseminated the initiative in internal events (for example, the video listed in the resources below), and in external events (e.g. Butler and Brown, 2019). There have been quite a few examples in eSTEeM where students have been involved in projects undertaking specific research roles and this is growing as the benefits of student participation and available support (e.g. recruitment for participation) are being understood. eSTEeM has shared experiences with colleagues in OU's other scholarship centres (PRAXIS[283], SCiLAB[284] and FASSTEST[285]), with colleagues in PVC-Students and Open University Students Association (OUSA), and eSTEeM contributes to OU's Scholarship Steering Group's workstream on Student Engagement.

282 Scholarship at The Open University, https://www.open.ac.uk/about/teaching-and-learning/esteem/working-us/scholarship-the-open-university
283 PRAXIS, Scholarship and Innovation Centre, https://www.open.ac.uk/scholarship-and-innovation/praxis/
284 SCiLAB, Centre for Innovation in Legal and Business Education https://www.open.ac.uk/scholarship-and-innovation/scilab/
285 FASSTEST, FASS Centre for Scholarship and Innovation, https://www.open.ac.uk/scholarship-and-innovation/fasstest/

Impact facet	Attributes	Description
Facet 6: Adoption of the outcomes of the project by other educators	Adoption of the outcomes internally or externally (within the institution) to improve assessment, curriculum design in the same discipline in same or different contexts	eSTEeM developed a framework for engaging OU students as partners in SoTL[286]. The framework provides a collection of activities, procedures, and guidance, which can be applied and adapted as required. The framework has been developed over the last four years with contributions from a range of staff and students engaged in supporting SoTL. In November 2022, the framework was approved by the OU's Scholarship Steering Group and recommended as a guiding framework for involving students as partners in SoTL at the OU and across all the scholarship centres at the OU[287].
Facet 7: Mutual stakeholder understanding	Understanding among students and staff	Students have reported a better awareness and understanding of how educators' engagement with SoTL helps towards evidence-based and research-informed teaching. Trevor reports: *I feel we are starting to build a community for student scholarship, … The traditional discipline boundaries sometimes help (e.g. discipline-based educational research) but SoTL also benefits from cross-disciplinary working (e.g. higher education research). Related to that is the power structures and hierarchy of higher education that sometimes work against engaging students as partners in SoTL.*
Facet 8: Personal and professional development of project team	Improved practice and personal knowledge	Educators have reported a better awareness of students' perspective through their student involvement in SoTL. Student involvement as a co-researcher in a SoTL inquiry can help unravel student-perceptions which students may be hesitant to share with the educator. For example, a student participated as project co-lead in an eSTEeM funded SoTL project (Halliwell and Brown, 2021). A case study based on their project is included in the 'SoTL in STEM' Badged Open Course[288]. Catherine, the project (staff) co-lead of the Halliwell and Brown (2021) project states: *Working in partnership with a student investigator [as a co-lead] allows me to be much more adventurous in my research aims. We can ask questions that students might be reluctant to answer in front of academic staff, as we can use student facilitated focus groups to provide a safe and honest discussion space. Student investigators can help develop relevant questions in the context of their own learning experiences.*

286 Students as Partners in Scholarship framework, https://www.open.ac.uk/scholarship-and-innovation/esteem/resources/students-partners-scholarship-framework

287 Scholarship at The Open University, https://www.open.ac.uk/scholarship-and-innovation/esteem/working-with-us/scholarship-open-university

288 Case study: 'How are students using extensions and what is the impact on success?' in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/ocw/mod/oucontent/view.php?id=109324&section=1.2

Impact facet	Attributes	Description
Facet 10: Fostering SoTL culture	Stimulating interest in SoTL Inspiring others to conduct SoTL Increased involvement of students in SoTL A move towards staff-student collaboration in curriculum design, development and evaluation	Educators are increasingly involving students in SoTL projects. Halliwell and Brown (2021) reflect in their end-of-project report (p. 25): *Examples of students as partners in a scholarly investigation often focus on curriculum improvement in specific disciplines Whilst this might be most appropriate focus at many HE institutions, OU students are potentially well placed and skilled to be partners in being active research partners in more wider scoping scholarly research. OU students can bring expertise, prior academic achievement, life experiences and can have skills sets complementary to an educator's; so, we decided to pursue this investigation as an equal partnership.* Cath Brown (student as project co-lead) led on the quantitative research aspects of their project (Halliwell and Brown, 2021) which illustrates how students can bring vital research skills to SoTL projects. In another project (Piwek and Savage, 2022), students were co-researchers. A video case study based on their project is included in the 'SoTL in STEM' Badged Open Course[289]. The project team has documented the process for involving student partners (in their end-of-project report) to inform future projects and initiatives. However, Paul reflects further on their project, Piwek and Savage (2022): *I think the most distinctive part of the project, which is orthogonal to the research-oriented tiers of Butler and Brown (2019), was that the students were co-creators of new assessment – so they were not just partners in the research project but partners in the pedagogy of the module, that is, in the actual creation of educational material (that is, quiz questions). We worked with small teams of one student + one academic to create the assessment items.* In an ongoing project[290], the project team worked with members of eSTEeM's 'Student register' to develop questions for the student survey. Trevor says: *…the [students as partners] initiative has helped to widen the scholarship community through student participation in scholarship research. The adoption of the values of respect and reciprocity underpinning Students as Partners (in my view) enhances the culture for SoTL at the OU.*

289 Student co-design of confidence-building formative assessment for Level 1 Computing & IT students, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/innovative-assessment/student-co-design-confidence-building-formative-assessment or https://tinyurl.com/4xs7xyua

290 Evaluation and improvement of print packs use for Environmental Science students, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/other/evaluation-and-improvement-print-packs-use-environmental-science-students or https://tinyurl.com/yybf3sf9

Impact facet	Attributes	Description
Facet 11: Financial implications	Effect on costs	eSTEeM is currently developing both synchronous and asynchronous training events for students who are interested in SoTL. This involves investment of time and funds by eSTEeM in setting up the training infrastructure. These costs will be offset in time by increased student involvement as partners in SoTL and students' contributions to SoTL in the STEM Faculty.

18.5   Reflections on SoTL practice

eSTEeM's infrastructure is instrumental in supporting project teams' engagement with students as partners in scholarship. eSTEeM supports projects that involve students through funding, providing guidance for ethical approval from OU's Student Research Project Panel and Human Research Ethics Committee, and organising training for students who are interested in participating in SoTL.

Fiona Aiken, project co-lead on an ongoing eSTEeM funded SoTL project[291], said:

We took help from students from the student register (recommended by eSTEeM) in developing our questions for a student survey…. We found their feedback very helpful as it helped us to improve the questions we asked and the language we used. I would certainly use members of the student register again when designing questionnaires or interview questions for students.

The interim results of Fiona's project have been reported in (Aiken and Hutton, 2022a) and (Aiken and Hutton, 2022b).

Working with stakeholders across the University, eSTEeM's approach to involving students as partners in scholarship and enabling project teams to work in partnership with students, is developing a scalable model of good practice for embedding student voice in academic practice.

To conclude, Trevor's thoughts on the 'Students as Partners' initiative are:

There is increasing interest in involving students in projects and it is important to understand each student's interests and motivations and work with them. … The impact of the Students as Partners in Scholarship initiative will be reflected through the culture and community for SoTL at the OU.

I think the three-tiered model and the forms of recognition and support for students as partners that we created in eSTEeM will be widely applicable across Higher and Further Education. As this work continues, I hope that the training and support resources we develop for (and hopefully with) students will be useful to many students interested in scholarship (not just OU students).

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291 Evaluation and improvement of print packs use for Environmental Science students, https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/other/evaluation-and-improvement-print-packs-use-environmental-science-students or https://tinyurl.com/yybf3sf9

18.6   Project resources and references

Project resources

eSTEeM & Co website: community, collaboration, co-creation and co-investigations in STEM pedagogy, https://learn1.open.ac.uk/course/view.php?id=100174 (requires OU login)

Video: Students as partners in Scholarship, The Student Hub Live, https://studenthublive.open.ac.uk/abstract/students-partners-scholarship

The 1st eSTEeM Online Student Conference: Engaging Students as Partners in Scholarship, https://www.open.ac.uk/scholarship-and-innovation/esteem/events/1st-esteem-online-student-conference-engaging-students-partners-scholarship or https://tinyurl.com/3pwfrads

The 2nd eSTEeM Student Conference: Engaging Students as Partners in Scholarship, https://www.open.ac.uk/scholarship-and-innovation/esteem/events/2nd-esteem-student-conference-engaging-students-partners-scholarship or https://tinyurl.com/378nh7yt

Student Scholarship Conference 2021: Showcasing our research into teaching and learning at the OU, https://www.open.ac.uk/scholarship-and-innovation/esteem/events/student-scholarship-conference-2021-showcasing-our-research-teaching-and-learning-ou or https://tinyurl.com/yw4bw3by

Butler, D. and Brown, C. (2019). Students as partners in scholarship in STEM open and distance learning, *In Proceedings of the Horizons in STEM Higher Education Conference*, Kingston University, 3-4 July 2019. Abstracts available at: https://ukstemconference.files.wordpress.com/2019/06/horizons-conf-19-abstract-booklet-.pdf

References

Aiken F.J. and Hutton C. (2022a). Evaluating the effectiveness of printed materials as an alternative to online resources, *Advance HE Teaching and Learning Conference 2022*: *Teaching in the spotlight*: *Where next for enhancing student success?* Newcastle-upon-Tyne, 5-7 July. Session abstracts for Day Two are available at: https://www.advance-he.ac.uk/sites/default/files/2022-06/Advance-HE-Teaching-and-Learning-Conference-2022-Abstracts-Day-Two-6-July-2022-2706.pdf or https://tinyurl.com/mr4789pf

Aiken F.J. and Hutton C. (2022b). Print Packs, *STEM EDIA (Equity, Diversity, Inclusion and Accessibility) Conference 2022*, The Open University, Milton Keynes (online), 20th October.

Collins, T. D. (2022). Student Engagement Framework: Students as Partners in Scholarship. *Scholarship Steering Group Report*. The Open University, UK. October 2022. Available at: https://www.open.ac.uk/scholarship-and-innovation/esteem/resources/students-partners-scholarship-framework or https://tinyurl.com/bdekszk6

Halliwell, C. and Brown, C. (2021). How are students using extensions and what is the impact on success? ***End-of-project report available at:*** https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/supporting-students/how-are-students-using-extensions-and-what-the-impact-success or https://tinyurl.com/3ffyfssc

Piwek, P. and Savage, S. (2022). An eSTEeM project on the 'students as partners' theme: Student co-design of confidence-building formative assessment for Level 1 Computing & IT students. ***End-of-project report available at:*** https://www.open.ac.uk/scholarship-and-innovation/esteem/projects/themes/innovative-assessment/student-co-design-confidence-building-formative-assessment or https://tinyurl.com/4xs7xyua

Related resources

Developing pedagogical partnership, https://www.alisoncooksather.com/

Dollinger, M., Tai, J., Jorre St Jorre, T., Ajjawi, R., Krattli, S., Prezioso, D. and McCarthy, D. (2022): Student partners as co-contributors in research: a collective autoethnographic account, *Higher Education Research & Development*.

New literature review on engaging students through partnership, https://www.advance-he.ac.uk/news-and-views/new-literature-review-engaging-students-through-partnership (full report is available to Advance HE members)

Pedagogical Partnerships, A How-To Guide for Faculty, Students, and Academic Developers in Higher Education, https://www.centerforengagedlearning.org/books/pedagogical-partnerships/

Students as partners, https://www.centerforengagedlearning.org/resources/students-as-partners/

'Students as partners in SoTL' in 'Scholarship of Teaching and Learning in STEM', Badged Open Course (BOC), The Open University, https://www.open.edu/openlearn/ocw/mod/oucontent/view.php?id=109324&section=1

Students as Partners (SaP) Toolkit, Council of Australian Universities Librarians (CAUL) SaP Project Team, https://caul.libguides.com/students-as-partners-toolkit/home

Student engagement through partnership in higher education, Advance HE, https://www.advance-he.ac.uk/guidance/teaching-and-learning/student-engagement-through-partnership

Appendix 1: Impact Evaluation Framework for SoTL

The 12 facets of the Impact Evaluation Framework (IEF) for SoTL are divided into four categories:

1. Learning and Teaching
2. Transfer to others
3. Stakeholder benefits
4. Cultural and economic benefits

The facets and attributes are listed against each of these four categories in the Table below.

Table A1 Facets and attributes of IEF for SoTL in four categories

Learning and Teaching		
1 Student experience pre-registration; induction; curriculum design; design of assessment; learning design; student engagement with course content; student engagement with the technological intervention; and student satisfaction rate.	**2 Student retention and progression** student registrations; average marks as compared with previous year(s); module completion rate; module pass rate; student retention rate; and student progression.	**3 Excellence in teaching** student skills-set (e.g. academic writing; critical thinking; reflection; problem-solving; group-working; digital literacy); student employability; evidence of research-informed teaching; data for assessments (e.g. UK's TEF[292]), programme reviews and accreditation processes; inter-disciplinary collaborations in teaching; accreditation against professional standards; informing policy development internally at the level of department, faculty or University; and informing policy development externally (in another institution or in the sector).

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292 Teaching Excellence Framework, https://www.officeforstudents.org.uk/advice-and-guidance/teaching/about-the-tef/

Transfer to others		
4 Discipline-based teaching, research and practice change in the ways in which subject concepts are taught; leading to discipline-based research; uptake of outputs in industry practice.	**5 Dissemination of project's outcomes** number of publications from the project; impact factor of individual journals or conferences; publications with students as co-authors; Google Scholar analytics or institutional analytics (e.g. OU's ORO[293]) on downloads of reports/publications; and sharing of novel research methods/strategies for conducting SoTL.	**6 Adoption of the outcomes** adoption of the outcomes internally (within the institution) or externally to improve assessment, curriculum design in the same discipline or in other disciplines.
Stakeholder benefits		
7 Mutual stakeholder understanding understanding among students, tutors, learning designers, IT support; for example, their skills, challenges, requirements; a community that SoTL creates and moving outside traditional silos.	**8 Personal and professional development of project team and associated stakeholders** improved practice or personal knowledge; developing an analytical mind-set; collaborative or team-working skills; reflective skills; becoming a mentor to others; becoming a champion for SoTL; continuity in SoTL activity by individual educators.	**9 Recognition of project team members and other stakeholders** career trajectory that can be attributed to SoTL such as promotions; fellowships or memberships of professional associations nationally and internationally; invited speaker to events/conferences internally and externally; public recognition through awards, publications, conference presentations; leadership roles related to teaching and membership of strategic committees; external examiner and membership of external bodies.

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293 The Open University's (OU's) Research repository, Open Research Online (ORO), http://oro.open.ac.uk

Cultural and economic benefits		
10 Fostering of SoTL culture stimulating interest in SoTL; inspiring others to conduct SoTL; increased involvement of students in SoTL projects; a stronger overall faculty that values teaching and student learning; renewing/raising faculty excitement about teaching and making them more aware of how they teach; a move towards staff–student collaboration in curriculum design, development and evaluation; recognition of SoTL at par with disciplinary research.	**11 Financial implications** opportunities for income diversification; effect on costs of modules or programmes.	**12 Funding opportunities** internal (within the institution) funding for follow-on/new projects based on SoTL project's success; external funding (from outside the institution) for follow-on/new projects based on SoTL project's success.

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Appendix 2: Terminology at The Open University

The compendium of case studies refers to several learning and teaching terms that are specific to The Open University (OU). Some of the key OU-specific terms related to learning, teaching[294] and assessment[295] are defined below.

Associate Lecturer (AL) or tutor[296]

OU's model of student support is that students are supported by their AL/tutor in connection with the course and student learning and progress in the course. An AL/tutor provides correspondence tuition, assesses students' work according to given marking schemes, and gives written and other defined feedback to students to help them in their learning. An AL provides academic support which may be offered through face-to-face, telephone or electronic teaching methods.

Computer Marked Assignments (CMAs)

Some modules use online computer marked assignments for teaching and assessment purposes.

End-of-module Tutor-Marked Assignments (emTMAs)

Modules that don't have an examination, the end-of-module Tutor-Marked Assignment (emTMA) is the final piece of assessed work. The tutor marks the assignment, but the student doesn't receive their score and feedback until their module result is released.

End-of-module Assessment (EMA)

For many modules, most recently the traditional end-of-module exam has been either replaced or supplemented by another assessment activity, such as a project, portfolio, or dissertation. This work is generally referred to collectively as end-of-module assessment (EMA).

Module

A module is the basic building block of the OU study[297]. Modules usually take 9 months to complete. On successful completion of a module, a student earns credits. Students can study a module on its own, or they can study multiple modules to work toward a nationally recognised qualification such as a certificate, diploma or degree.

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294 Glossary of terms and abbreviations, https://tinyurl.com/32tbf437 and The OU Glossary of Terms, https://tinyurl.com/4hpudaw3 (**requires OU staff login**)

295 Assessment, assignments, exams and results, https://openuniv.sharepoint.com/sites/intranet-tutor-help-centre/Pages/student-assessment.aspx or https://tinyurl.com/y4ckfh8w (**requires OU staff login**)

296 Tutors and tutorials, https://www.open.ac.uk/courses/what-is-distance-learning/tutors

297 For more details, please see: Frequently asked questions, How OU study works, https://www.open.ac.uk/courses/what-is-distance-learning/faqs

Staff tutor

A staff tutor is an academic who is responsible for the delivery of modules in a region/nation setting. (OU is uniquely a university of four nations[298], based and funded in England, Wales, Scotland, and Northern Ireland.)

Tutor-Marked Assignment (TMA)

As part of the teaching methodology most modules require students to submit essays, answers to questions set up in the module's assessment to their tutor; these are called tutor-marked assignments (TMAs). The tutor marks the assignment, usually giving a score and written comments, via the online TMA system.

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298 Four nations, One University,
https://www.open.ac.uk/about/main/strategy/four-nations-one-university

Appendix 3: Abbreviations

The following abbreviations have been mentioned in the compendium of case studies.

The Open University's (OU) Library's website hosts a glossary[299] that contains definitions related to the OU and Higher Education acronyms.

Abbreviation	Full form
3D	Three-dimensional
AI	Artificial Intelligence
AL	Associate Lecturer[300] or Tutor at The Open University (OU); the terms AL and tutor have been used interchangeably in this compendium.
BAME	Black, Asian and Minority Ethnic
CES	Careers and Employability Services (at the OU)
CPD	Continuing Professional Development
C&C	School of Computing and Communications, Faculty of STEM, OU
EEES	School of Environment, Earth and Ecosystem Sciences, Faculty of STEM, OU
FE	Further Education
GIS	Geographic Information System
GPB	Geology Photo Blog
GPS	Global Positioning System
HE	Higher Education
IE	Impact Evaluation
IEF	Impact Evaluation Framework
IT	Information Technology
KMi	Knowledge Media Institute, Faculty of STEM, OU
LA	Learning Analytics
M&S	Mathematics and Statistics

299 The Open University (OU) Glossary, https://www.open.ac.uk/library/help-and-support/ou-glossary
300 Associate Lecturer, Teaching and Tutoring Roles, The Open University, https://www.open.ac.uk/jobs/tutors/teaching-roles; the terms Associate Lecturer (AL) and tutor have been used interchangeably in the case studies.

Abbreviation	Full form
ML	Machine Learning
OES	Overall Exam Score (a term used at the OU)
OJCs	Online Journal Clubs
OU	The Open University, UK
OUA	OU Analyse
PLA	Predictive Learning Analytics
REF	Research Excellence Framework[301]
RS	Remote Sighted
SaP	Students as Partners
SiSE	Students in Secure Environments
SoTL	Scholarship of Teaching and Learning
SPS	School of Physical Sciences, Faculty of STEM, OU
SRF	Student Recruitment and Fees (at the OU)
SRSC	Student Recruitment and Support Centres (at the OU)
SST	Student Support Team (at the OU)
STEM	Science, Technology, Engineering and Mathematics
TEF	Teaching Excellence Framework[302] (in the UK)
TMA	Tutor-Marked Assignment (at the OU)
VE	Virtual Environment
VI	Visually Impaired
VLE	Virtual Learning Environment
VFT	Virtual Field Trip

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301 REF: Research Excellence Framework, https://www.ref.ac.uk
302 About the TEF, Teaching Excellence Framework,
    https://www.officeforstudents.org.uk/advice-and-guidance/teaching/about-the-tef/